Modelling Land Reform Beneficiaries' Choice of Disaster Risk Reduction and Adaptation Strategies in Response to Climate Change

by

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DECLARATION

I, **Karneels Thabang Thinda**, with student number **1997544661,** herewith declare that this thesis titled ***'Modelling Land Reform Beneficiaries' choice of disaster risk reduction and adaptation strategies in response to climate change*** is my own original work except for acknowledgement and references which are attributed to their sources. This thesis has not been previously submitted to any other university and will not be presented at any other university for a similar or another degree award.

KT THINDA	**DATE**

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ABSTRACT

The main objective of the study was to develop a model of smallholder farmers' disaster risk reduction and adaptation strategies in response to climate change. The study also explored the choice and intensity of adoption in addition to the perception of smallholder farmers' choice of adaptation strategies in the context of climate change. The specific objectives of the study were to profile the perception of and adaptation strategies to climate change among the smallholder farmers in the study area; analyse the factors influencing the smallholder farmers' decision to adopt and the intensity of adoption of climate change adaptation strategies; estimate factors that constrain smallholder farmers' adaptation to climate change; and profile an adaptation strategies model for the smallholder farmers in response to climate change.

Data collection comprised of a multistage sampling technique. Data were collected from 183 participants from the nine (9) selected district municipalities in South Africa, namely Lejweleputswa and Thabo-Mofutsanyane (Free State), eThekwini, uGu, iLembe and Amajuba (Kwa-Zulu Natal), Mopani and Vhembe (Limpopo) and Dr Kenneth Kaunda (North West). A total of 183 contributors to land reform beneficiaries during the 2017-2018 farming season completed a cross-sectional household survey. A structured questionnaire was used for data collection. Descriptive statistics such as mean, percentages, frequencies and standard deviations were used to analyse and categorise the information gathered. Descriptive statistics and appropriate econometric models such as Double-Hurdle with count data and Multivariate Probit models were utilised for the analyses.

The results justified the use of the MVP model. The empirical results of the MVP indicated a lack of knowledge of climate change constraints. These were influenced by age, gender, off-farm activity, susceptibility and membership in farm-based organisations of the smallholder farmers. However, a lack of information about climate change was influenced by access to extension agents, non-farm activity, access to radio and agricultural training. Similarly, a lack of capital constraints was influenced by access to extension services, access to radio and on-farm demonstration in the form of training.

The results of the Zero-Inflated Double Hurdle Model indicated that different socioeconomic factors such as gender, age and experience in crop farming, institutional factors such as access to extension services and access to climate change information significantly

influenced the adoption of climate change adaptation strategies among beneficiaries of land reform in South Africa. Concerning the intensity of adoption, age, educational level, farming experience, on-farm training, off-farm income, access to information through ICT and locational variables are the significant determinants of intensity of adaptation strategies. Thus, education attainment, non-farm employment and farming experience are significant incentives to enhance smallholder farmers' adaptive capacity through the adoption of many adaptation approaches.

The results further suggest that farmers who perceive climate change based on effective impression and direct personal experience are more likely to suffer cognitive bias in their perceptions compared to farmers who perceive climate risk based on knowledge and analytic processing of climate information. The Multivariate Probit Model was used in assessing the role of information, household demographics and farm characteristics as a response to climate risks among smallholder farmers in the study. Plot characteristics, credit constraints and availability of climate-related information explain the adoption of several climate change adaptation strategies.

This study found that a high percentage of smallholder farmers are constrained in adopting climate change adaptation strategies as a result of a lack of knowledge, lack of information on climate change and lack of capital. Approximately 90% of the farmers indicated a lack of climate information as major constraints to the adoption of climate change adaptation strategies. Furthermore, 74% of the farmers indicated a lack of capital and 77% a lack of knowledge in agricultural production as the important constraints to the adoption of adaptation strategies. The likelihood ratio test of the independence of the error terms in the different constraint equations was also rejected. Thus, the study accepted an alternative hypothesis of interdependence among the different constraints to the adoption of climate change adaptation strategies.

This study concluded that farm-level policy efforts aiming to improve rural development should focus on farmers' education, on-farm demonstration and non-farm employment opportunities that seek to engage the farmers, particularly during the off-cropping season. The income from non-farm employment can be ploughed back into farm operations such as the adoption of soil and water conservation, the use of improved planting varieties and insurance, among others, to fight climate variability and subsequently increase productivity.

The study found that access to extension advice, social capital and collective action also positively affect the adoption decisions, thus suggesting the importance of information and networks. The impact estimate shows that the adoption of farm management practices has a positive and statistically significant impact on maize productivity, which highlights the positive synergies between adaptation strategies and food security. Policies and investment strategies of the Government should be aimed towards supporting education, providing on-farm demonstration training and disseminating information about climate change adaptation strategies, particularly for smallholder farmers in the country.

Thus, to improve the adaptive capacity of farmers, Government and development partners should collaborate to improve the conditions of access of farmers to climate change information, suitable agricultural credit, including the policy incentives aimed at lowering the stringent conditions of borrowing in the agricultural sector. It is also recommended that policies enhancing and strengthening institutional support may be valuable in improving the productivity of smallholder farmers in South Africa. Therefore, the Government, stakeholders and donor agencies must provide capacity-building innovations around the agricultural extension system and education on climate change using information and communication technologies. Comprehensive programmes through extension service and farmers' education should be planned in order to teach farmers on improved farm management practices, as well as how to build their adaptive capacities against the harmful effects of climate change.

The study recommended that the deepening of extension access with information on the appropriate adaptation strategies is crucial to assist farmers in their adaptation decisions. Lastly, the dynamics persuading the choice of smallholder farmers' climate change adaptation strategies have a significant impact on the farming system. The study, therefore, advocates that the Department should mainstream these livelihood barriers and choice of adaptation strategies in the farmer production support unit of the Department for successful support and monitoring of smallholder farmers' production. This will assist smallholder farmers in having wider access to markets, with the more experienced commercial farmers mentoring them.

Keywords: *Adaptation, Climate Change, Disaster Risk Reduction, Land Reform Beneficiaries, Double-Hurdle, Multivariate Probit Model, Smallholder Farmer, Zero-Inflated Double Hurdle Model, Zero-Inflated Regression Model*

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ABBREVIATIONS AND ACRONYMS

ADPC : Asian Disaster Preparedness Centre

AIACC : Assessment of Impact and Adaptation to Climate Change

ASGISA : Accelerated and Shared Growth Initiative for South Africa

ARC : Agrarian Reform Communities

BATAT : Broadening Access to Agricultural Thrust

CARP : Comprehensive Agrarian Reform Program

CCAFS : Climate Change Agriculture and Food Security

CC : Climate Change

CLRB : Communal Land Rights Bill

CRDP : Comprehensive Rural Development Programme

CASP : Comprehensive Agricultural Support Programme

CSIR : Council for Scientific and Industrial Research

DEA : Department of Environmental Affairs

DEAT : Department of Environmental Affairs and Tourism

DFID : Department for International Development

DRDLR : Department of Rural Development and Land Reform

DRR : Disaster Risk Reduction

ESTA : Extension of Security of Tenure Act

FAO : Food and Agriculture Organisation

HFA : Hyogo Framework for Action

GDP : Gross Domestic Product

GEAR : Growth, Employment and Redistribution

GCM : General Circulation Models

IDS : Institute of Development Studies

IFAD : International Fund for Agricultural Development

IIED : International Institute for Environment and Development

IPCC : International Panel for Climate Change

IPILRA : Interim Protection of Informal Land Rights Act

IRG : International Resources Group

ISDR : International Strategy for Disaster Reduction

LAST : Livelihood Assets Tracking

LDC : Least Developed Countries

LRAD : Land Redistribution for Agricultural Development

LRCF : Land Reform Credit Facility
LRP : Land Reform Programme
LRPP : Land Reform Pilot Programme
LTA : Labour Tenants Act
MAFISA : Micro Agricultural Finance Institute of South Africa
MDG : Millennium Development Goals
MVP : Multivariate Probit Model
NAFTA : North American Free Trade Agreement
NCCRS : National Climate Change Response Strategy
NDP : National Development Plan
NEMA : National Environmental Management Act
NGP : New Growth Path
NRAC : National Resource Advisors' Conference
OECD : Organisation for Economic Co-operation and Development
PLA : Participatory Livelihoods Assessment
PLAS : Proactive Land Acquisition Strategy
RECAP : Recapitalization and Development Programme
RCM : Regional Climate Models
RDP : Reconstruction and Development Programme
RSAC : Republic of South Africa Constitution
SARD : Sustainable Agriculture and Rural Development
SCCF : Special Climate Change Fund
SDG : Sustainable Development Goals
SLF : Sustainable Livelihood Framework
SIS : Settlement and Implementation Support
SLA : Sustainable Livelihoods Approach
SLAG : Settlement Land Acquisition Grant
UNEP : United Nations Environment Programme
UNCED : United Nations Conference on Environment and Development
UNISDR : United Nations International Strategy for Disaster Reduction
UNFCCC : United Nations Framework Convention on Climate Change

CHAPTER ONE: INTRODUCTION AND BACKGROUND

1.1. Introduction and Background

Climate change has brought substantial welfare loss, especially to smallholder farmers in many developing countries (Komba & Muchapondwa, 2012). Given the known negative impacts of climate change, it is desirable to minimise its adverse effects. Thus, climate change discourse focuses on mitigation and adaptation (Chambwera & Stage, 2012). As empirically posited in literature, the adoption of adaptation strategies, therefore, remains an important option in mitigating the effect of climate change and addressing its prevailing challenges on agricultural production (Deressa *et al.,* 2009; Seo, 2011). Climate change adaptation has emerged as one of the most important responses for environmental development challenges of the twenty-first century (Boko *et al.,* 2007; Pielke *et al.*, 2007).

According to Mugi-Ngenga *et al.* (2016), the adverse effects of climate change on agricultural productivity are on the increase. Thus, there is a need for smallholder farmers to devise adaptation measures (Omoyo *et al.,* 2015). Adaptation strategies are being widely implemented in Africa that includes soil and water conservation, for example, structures, early maturing and drought-resistant improved crops, diversification, planting trees and the development of early warning systems. The Intergovernmental Panel on Climate Change (IPCC, 2001) stated that adaptation strategies could help farmers mitigate their vulnerability to climate by making rural communities better able to adjust to the climate, moderate potential damages and cope with adverse consequences. Adaptation will require the involvement of multiple stakeholders, including primarily farmers and policymakers, extension agents, NGOs, researchers, local communities and the private sectors.

In South Africa, the growth of smallholder farmers is hindered by the numerous challenges that they face. These also impede their contribution to food security compared to commercial farmers. Linking to some of the challenges faced by the smallholder farmers is a lack of access to land, physical and institutional infrastructure (Ortmann & King, 2007; Ncube, 2018; Kamara *et al.,* 2019). These constraints hinder their propensity to adopt climate change adaptation strategies because of the huge capital outlay required. Another factor hindering their growth is the high transaction costs that they incur mainly due to poor infrastructure.

These challenges also lead to low productivity, for example. Unreliable markets and poor road networks are a disincentive to production, thus these farmers end up resorting to a farming gate or local selling, which attracts low prices. Smallholder farmers also face a constraint of high illiteracy and poor technological skills. Most of these targeted land reform beneficiaries lack business skills and often fail to meet quality standards for their produce. As a result, their products are not only of low quality, but they are also producing low quantities and evidently fail to compete in the market. This inconsistency in production is worsened by the lack of bargaining power, which results in the need for support services to ensure smallholder farmers' growth.

Empirical studies related to climate change (CC) adaptation strategies have considered the impact of CC on agricultural productivity (Kurukulasuriya *et al.,* 2006; Ajetomobi *et al.,* 2010, Hassan and Nhemachena, 2008) and the perception of CC (Phuong *et al.,* 2018; Williams *et al.,* 2019). Other studies also analysed the determinants of CC adaptation strategies (Bryan *et al.,* 2009; Mulwa *et al.,* 2017; Ojo and Baiyegunhi, 2019) and the impact of the adoption of CC adaptation strategies on food security (Nunfam *et al.,* 2019; Kerr *et al.,* 2019). However, there is limited information available on the determinants of constraints to CC adaptation strategies except for Vignola *et al.* (2015) who profiled the constraints but failed to estimate the factors constraining smallholder farmers' adoption of CC adaptation strategies. It is against this backdrop that this study sought to empirically estimate the determinants of constraints of adoption of CC adaptation strategies among the land reform beneficiaries in South Africa.

Knowledge of key socioeconomic factors influencing farmers' adaptability to climate can play a significant role in policy formulation in an attempt to mitigate the effects of climate change on smallholder agriculture (Deressa *et al.,* 2009). Also, knowledge of these socioeconomic factors can play a role in assisting policymakers to strengthen adaptation by investing in them. For example, education of the household head is hypothesised to increase the probability of adapting to climate variability (Deressa *et al.,* 2009). According to Mugi-Ngenga *et al.* (2016), the reason could be ascribed to the fact that education increases farmers' ability to access, process and use information relevant to adaptation to the effects of climate change.

Therefore, knowing how rural smallholder farmers perceive climate change and the factors that influence their choice would facilitate a better understanding of how these farmers adapt to the

negative impacts thereof. Several studies have been conducted on the impacts of climate on smallholder farmers in South Africa, for example, Maponya and Mpandeli (2013), Turpie and Visser (2013) and Ziervogel *et al.* (2014). However, very little research exists on smallholder farmers' choice of climate change adaptation strategies interventions in the selected study area. Understanding the climate change adaptation strategies employed by smallholder farmers vis-à-vis factors influencing the adoption and intensity of adoption will be a solution for policymakers to develop policies and strategies that could enhance smallholder farmers' adoption of the correct adaptation strategies for agricultural production.

Furthermore, the major flooding that occurred in dissimilar portions of the country, such as the Western Cape, led to the loss of life and property. Various investigations have been carried out with regards to climate-linked matters in South Africa, specifically focusing on subsistence and commercial farmers (Hassan & Nhemachena 2008; Yesuf *et al.,* 2008; Bryan *et al.,* 2009; Deressa *et al.,* 2010). Recent micro-econometric studies examined the factors influencing adaptation strategies and highlighted ways in which policymakers can support adaptation through the provision of credit, information, inputs and extension services among other measures (Maddison, 2007; Gbetibouo, 2009; Bryan *et al.,* 2013; Tambo & Abdoulaye, 2012). However, there is a dearth of information on the determinants of adoption of climate adaptation strategies among the beneficiaries of land reforms in South Africa while also accounting for the intensity of adoption of adaptive capacity.

This study focused on the factors influencing farmers' adoption of adaptation strategies and the intensity of adoption at the household level in South Africa, thus, building on previous work by Bryan *et al.* (2013) in Ethiopia and South Africa. This study further expands on previous research by integrating both qualitative and quantitative methods (Thomas & Harden, 2008). The current study's contribution to empirical research is twofold. First, it identified factors influencing farmers' decisions to adopt and examine the determinants of the intensity of adoption of climate change adaptation strategies. Identifying the variables and explaining why farmers choose adaptation options in response to global environmental distress is crucial and can serve as a guide to policymakers on ways to promote farm households' adaptive capacity. Understanding the determinants of constraints to the adoption of adaptation strategies to CC among smallholder

farmers is particularly relevant as an answer to the implementation of CC adaptation strategies (Leclère *et al.,* 2013).

1.2. Problem Statement

The dryland areas of Southern Africa are traditionally and environmentally diverse, characterised by a high number of poor people with inadequate access to basic services, an increased number of unemployed people, an increased level of uneducated people and rising levels of HIV and AIDS (Berrang-Ford *et al.,* 2015). Also, rural farming communities rely on a diversity of natural resources, services and settlements for their livelihoods due to the reduced agricultural production (Berrang-Ford *et al.,* 2015).

Furthermore, Deressa (2007) reported that climatic disasters negatively affect the South African agriculture sector, with drought and flood being the major extreme weather conditions. According to Lobell *et al.* (2011), there is a difference in the propensity of smallholder farmers living in different demographic locations (highveld and Lowveld) of South Africa to acclimatise to climate change shocks. Smallholder farmers in different agricultural zones within rural farming communities have varying perceptions of climate change effects.

Government should prioritise ways of funding to implement climate change adaptation response strategies. Organisations in collaboration with related government departments should try to improve research into water, nutrient and soil conservation technologies, as well as techniques, climate-resistant crops and livestock. Farmers should have or should consider having an agricultural insurance market as an adaptation response. Having insurance can build financial resilience as it helps farmers access credit assistance more easily, allowing them to innovate and invest in technologies that boost productivity (Zwane & Montmasson-Clair, 2016). The departments should hold information sessions about awareness programmes related to climate change risks in order to protect and strengthen food security.

On district level, generally to all the study areas, water remains a challenge and some farmers do not have enough resources to prevent this problem. The major issue concerns the lack of funds and the departments related to agriculture not having enough awareness programmes about climate change risks. Farmers should have alternative water sources such as infrastructure or

building capacity, such as dams. According to the National Development Plan (NDP) report (2011), most of the smallholding farmers in South Africa are engaged in dry and partial-dry agricultural land that involves risks of low and unreliable rainfall. The NDP reported that irrigation schemes reduce the risks of dryland. The National Development Plan (NPC 2011) also states that without major policy interventions, the rural farming communities could continue to decline owing to land degradation. The World Bank report (2009) highlighted the raising of agrarian production nationwide, which leads to improved global monetary development. However, at present, climate change has become a threat to justifiable financial development (World Bank, 2009). The report further indicated that the effect of climate change had been extremely upsetting the economic growth of South Africa in the agricultural sector.

In 2009, Government management proclaimed a new Office of Rural Development and Land Reform. In order to obtain an outcome from this directive, the Sector established the Comprehensive Rural Development Programme (CRDP), which is nowadays a tactical precedence within the Medium-Term Strategic Framework (MTSF) (DRDLR, 2010). The CRDP sites were identified as an effective response against poverty and food insecurity in rural areas (DRDLR, 2016). It was, therefore, expected that the rural development programme would generate communal consistency in rural societies (DRDLR, 2016).

In these smallholder agricultural arrangements, the income of land reform beneficiaries is steadily reliant on the connections amid yield and livestock production and shared natural resource ponds (DRDLR, 2016). The Comprehensive Rural Development Programme (CRDP) remained familiarised in 2010 as an all-inclusive policy that is envisioned to generate communal consistency and growth in pastoral parts (DRDLR, 2016). The policy is based on land reform, agrarian transformation and rural development. Through the employment of the CRDP, the Sector intends to endorse vivacious, reasonable and maintainable pastoral societies and nourishment safety for all pastoral societies (DRDLR, 2016).

According to the DEA report (2013), during the last five decades, the mean average temperature in South Africa has been increasing gradually by 1.5 times the observed global average of 0.65^{o}C. Maximum and minimum temperatures have increased across the country and rainfall has

shown high inter-annual variability and a smaller number of rain days almost everywhere in the country, especially during the autumn months (DEA, 2013).

In order to address this problem, the researcher attempted to address this knowledge gap by studying smallholder farmers in the identified four provinces as a case study on smallholder farmer's choice of adaptation strategies on climate variations in South Africa. Policymakers should understand this diversity and complexity (Senior Managers of the Department of Agriculture, Rural Development and Land Reform) as well as the implementing agents (District Land Project Managers) in order to ensure that the blanket approaches that assume homogeneity amongst smallholder farmers remain ineffective. The DRDLR (2016) report indicated that recent drought disasters in South Africa have led to a decline in crop, with livestock production and smallholder farmers being hit the hardest by the effects of climate change.

Therefore, a better understanding of smallholder farmers on how to assess the adoption of climate change adaptation strategies is important to assist in developing appropriate policies towards the effects of climate change. Free State and North West Provinces are more vulnerable to climate change. In these study areas, the impact of climate change is adversely affecting agriculture as it is a semi-arid area that is prevalent in drought. The existence of warming and rainfall variety leads to a reduction of agricultural production and therefore food security in the country. According to the researcher's knowledge, no earlier study was conducted on assessing the adoption of climate change adaptation strategies of smallholder farmers in the selected study areas.

Based on this knowledge gap, the researcher would, therefore, profile the perception of and adaptation strategies to climate change among the smallholder farmers in the study area and assess and analyse the factors influencing the smallholder farmers' decision to adopt and the intensity of the adoption of climate change adaptation strategies.

1.3 Study Area

The study was conducted within the Comprehensive Rural Development Programme (CRDP) sites for the land reform beneficiaries. CRDP sites are selected because they are situated in the core of rural extents with high climate and weather variations; particularly in terms of droughts,

flooding and bush encroachment (Houghton, 1997; Thow & de Blois, 2008). Figure 1.1 is a map of the four provinces in South Africa, which comprise the study area.

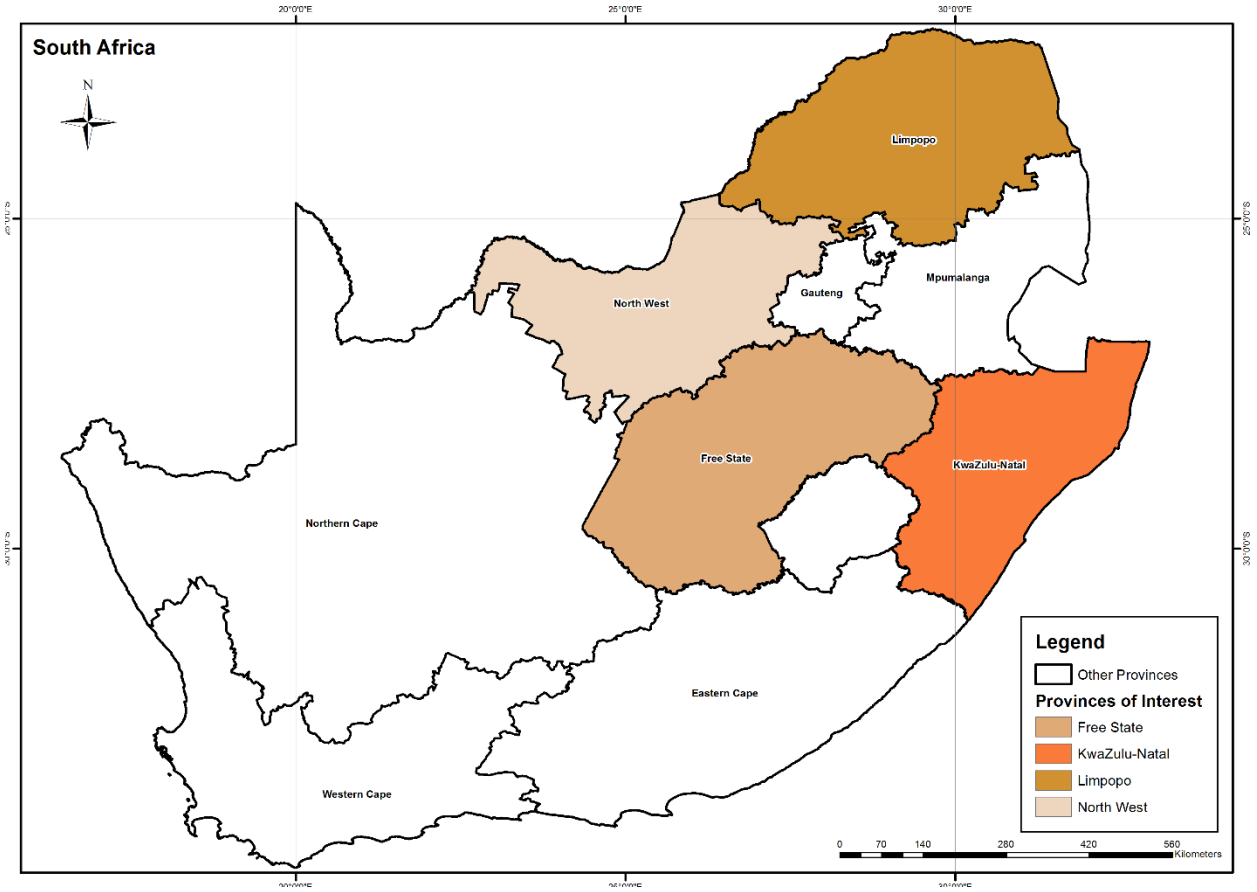


Figure 1.1: Map of South Africa showing the four provinces that constitutes the study areas

Figure 1.1 illustrates the choice of study areas within the four (4) chosen provinces, namely Free State, Kwa-Zulu Natal, Limpopo and the North West provinces. The choice of the study areas was motivated by different demography and topological zones and linked to the priority district municipalities for implementation of the Comprehensive Rural Development Policy (CRDP) Framework, which is a departmental strategy to implement projects and programmes within the prioritised poor districts (DRDLR, 2016) report.

The study further observed that smallholders are heterogeneous and that their differences are often class-based. Thus, necessitating the policymakers to understand this diversity and complexity (Senior Managers of the Department of Agriculture, Rural Development and Land Reform), including the implementing agents (District Land Project Managers); if not, the blanket

approaches that assume homogeneity amongst smallholder farmers will remain ineffective. According to the World Bank (2014), CO2e (carbon dioxide equivalent) emissions are currently 60% higher than the levels in 1990 and growing at about 2.5% per year. Without mitigation, CO2e emissions will continue to rise, driven primarily by the increasing population and economic growth (IPCC, 2014). If the world continues on this trajectory, the Intergovernmental Panel on Climate Change (IPCC) projects that global mean surface temperatures are likely to increase from 3.7 °C to 4.8 °C in 2100 compared to pre-industrial levels (IPCC, 2014).

Climate change poses a significant threat to South Africa's water resources, food security, health, infrastructure, ecosystem services and biodiversity. In South Africa, climate change projections up to 2050 show significant warming (5-8°C) over the interior, a risk of drier conditions to the west and south of the country and risk of wetter conditions along the eastern part of the country (DEA, 2013). Agriculture in South Africa faces a variety of risks associated with climate change, such as changes in rain patterns, increased evaporation rates, higher temperatures, increased pests and diseases and changes in diseases and pest distribution ranges, reduced yields and spatial shifts in optimum growing regions.

The emergence of such risks necessitates urgent, ambitious action to ensure the resilience of South Africa's agricultural sector through adaptation to climate change impacts. Strategic public-private intervention is an instrumental measure in ensuring the long-term sustainability of South Africa's agricultural sector, especially the smallholder farmers.

Environmental change influences agriculture from numerous points of view that incorporate the progressions of temperature, precipitation, atmosphere extremes, changes in diseases and changes in health. Environmental change can emphatically and adversely influence the area, timing and profitability of the product, domesticated animals and fishery frameworks at nearby, national and worldwide scales. Therefore, the researcher attempted to address this knowledge gap by investigating different demographical topology and rainfall patterns in the four identified study areas, as illustrated in Figure 1.2 as a case study on adaptation strategies to climate change.

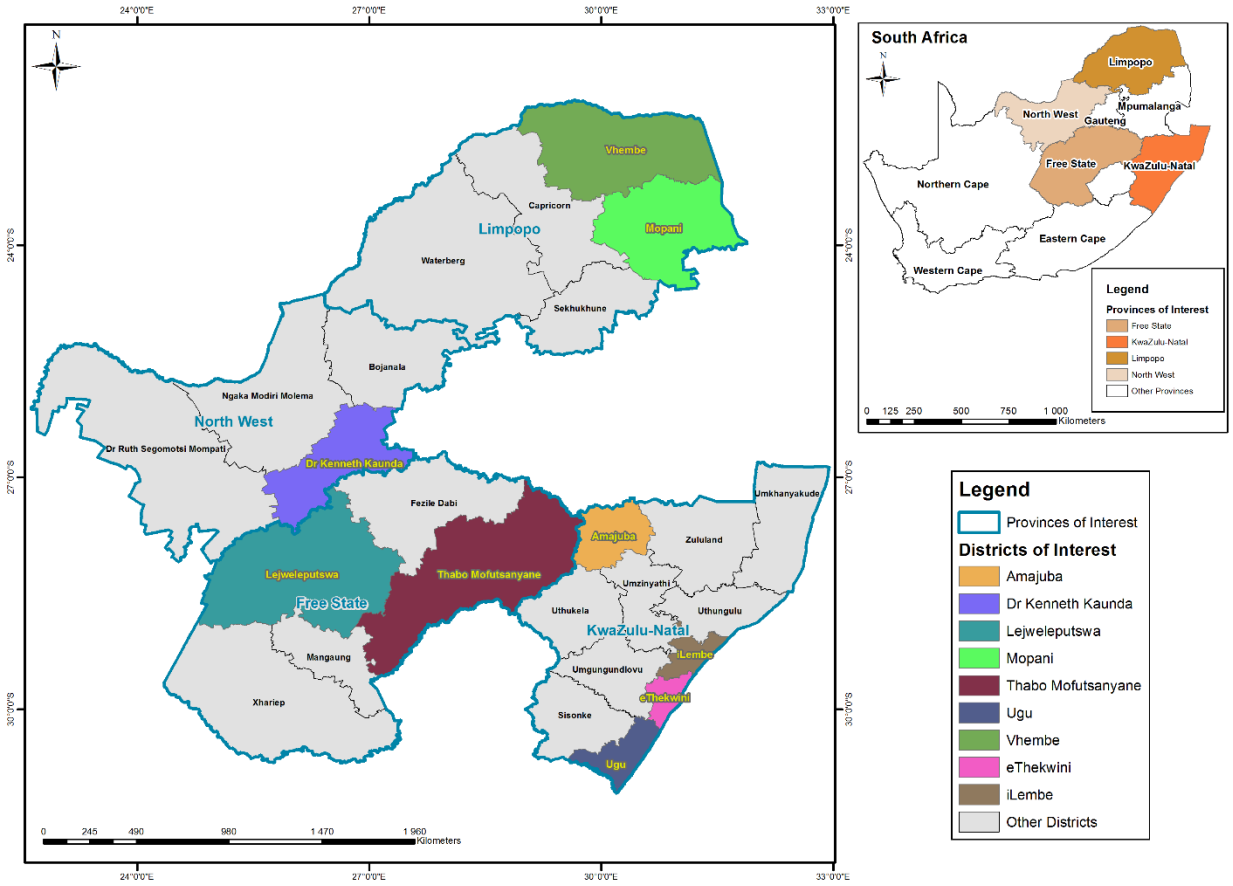


Figure 1.2: The map showing provinces and district municipalities for the study areas in South Africa

1.4 Research Objectives

The main objective of the study was to develop a model of smallholder farmers' disaster risk reduction and adaptation strategies in response to climate change. In order to meet this main objective or aim, the study assessed the choice and intensity of the adoption of smallholder farmers' choice of adaptation strategies in the context of climate change. The specific objectives of the study were to:

i. profile the perception of and adaptation strategies to climate change among the smallholder farmers in the study area;
ii. analyse the factors influencing the smallholder farmers' decision to adopt and the intensity of adoption of climate change adaptation strategies;
iii. estimate factors that constrain smallholder farmers' adaptation to climate change; and
iv. profile the adaptation strategies model for smallholder farmers in response to climate change.

1.5 Research Questions

The study sought to investigate the perception of rural smallholder farmer's choice of adaptation strategies in the context of climate change. This aim further accomplished the objectives by responding to a set of questions:

i. What is the perception of and adaptation strategies to climate change among the smallholder farmers in the study area?
ii. What are the factors influencing the smallholder farmers' decision to adopt and the intensity of adoption of climate change adaptation strategies?
iii. What factors constrain smallholder farmers' adaptation to climate change?
iv. What adaptation strategies model is suitable for smallholder farmers in response to climate change?

1.6 Significance of the Study

Adaptation is an essential strategy to enable farmers to cope with the adverse effect of climate change and variability, which in turn increases the agricultural production of the poor farm households (Yesuf *et al.,* 2008). Similarly, knowledge of the adaptation methods on the side of smallholder farmers may make it better to address the challenge of climate change (Deressa *et al.,* 2009). Climate change is an unexpected impact because it is a natural phenomenon that varies with location, socio-economic and environmental conditions. The capacity to adapt to climate change is unequal across and within societies. Thus, the adaptation measures at micro-level farm households are important for truth and appropriate policies. According to Maddison (2007), a difference exists in the propensity of farmers living in different locations to adapt. Therefore, smallholder farmers in different areas or agricultural zones have an unequal propensity and capacity to climate change impact and adaptation.

The challenges that smallholder farmers reported being faced with, provides background regarding which policies and adaptation strategies to formulate in order to address them. The outcomes from the study also provide a model for adopting disaster risk reduction and adaptation strategies by smallholder farmers in South Africa. Furthermore, the results form a foundation for enhancing the extension officers, as well as land reform project managers in adopting the outcome of the study.

Therefore, a better understanding of smallholder farmers on how to assess the adoption of climate change adaptation strategies is important to assist in developing appropriate policies towards the effects of climate change. Thus, the researcher would profile the perception of and adaptation strategies to climate change among the smallholder farmers in the study area and assess and analyse the factors influencing the smallholder farmers' decision to adopt and the intensity of the adoption of climate change adaptation strategies.

Considering such strategies could potentially be realised by taking practical measures on policy support and institutional building for climate change, knowledge management on adaptation to climate change, filling technological gaps related to agriculture including livestock farming in the context of climate change, applying innovative local-level participatory land-use planning and promoting livelihood diversification initiatives that could enable smallholder farmers to establish assets to enhance their livelihoods.

The findings of the study will consequently provide input in the development and crafting of a climate strong green economic system that could improve ecological steadiness, upsurge flexibility of farming for smallholder farmers, better sustenance security and decrease poverty. In rapports resounding out of this study, aid to create evidences demonstrating level of mindfulness and insight substances as linked to climate change and the features that disturb farmers' selection of adaptation technique for climate change and the blockades to variation, as well as the approaches used for extenuation procedures (Deressa *et al.*, 2009).

Therefore, a better understanding of the local dimensions of climate change is important to develop appropriate adaptation measures and appropriate policies. In this study area, the impact of climate change is adversely affecting agriculture. The existence of warming and rainfall variety leads to the reduction of agricultural production of the smallholder farmers. Thus, the area is seriously affected by climate change and weather variability.

The researcher used different models in analysing the choice and intensity of smallholder farmers' adaptation strategies towards climate change. The significance of the study highlights

the uniqueness thereof in addressing the stated problem by executing different unique descriptive models. The researcher, therefore, believes that this is the first of its kind by using different methods in assessing and analysing the research problems, as well as complimenting the study with other studies for better ways of solving the problem of the study.

The study, therefore, advocates that the Department should mainstream these livelihood barriers and choice of adaptation strategies in their farmer production support unit for successful support and monitoring of smallholder farmers' production. This will assist smallholder farmers in having wider access to markets and more experienced commercial farmers will mentor them. The study concludes that dynamics persuading the choice of smallholder farmers' climate change adjustment strategies have a significant impact on farming systems.

1.7 Thesis Outline

The remaining part of this study is organised under nine chapters. Chapters 2, 3, 4 and 5 comprise literature reviews, including the current introductory chapter. Chapter 2 provides an overview of the conceptual framework of the study and includes definitions of various key concepts and terminologies, which form the basis for the conceptual and theoretical framework. Each of the subsequent chapters answered specific objectives about climate change and the significance of the phenomenon for adaptation, climate change, disaster risks, disaster risk reduction, land redistribution and land restitution for land reform beneficiaries (smallholder farmers).

Chapter Two: This chapter provides an overview of the conceptual and theoretical framework and includes a discussion about climate change and related land reform concepts necessary for completing the study. The connection amid climate change, disasters and attaining development goals is also presented. Views and interaction of disaster risk and climate change linkages are addressed to understand the commonalities and differences in their approaches.

Chapter Three: This chapter encompasses an overview of weather variations in addition to the notions pertinent to climate change, including the perceptions of climate change and disaster risk reduction. The effect of climate change on smallholder farmers' rural livelihoods is also

reviewed. Furthermore, disaster risk reduction and adaptation strategies and mechanisms to climate change are explored. The chapter concludes with discussions about climate change interferences and provision schemes for smallholder farmers in South Africa, as well as equity, poverty, the right to development, the impact and policy responses towards climate change in South Africa and the lawful and recognised settings of climate change in South Africa.

Chapter Four: This chapter reviews the context of land reform by exploring international and local (African) background of land reform, the land reform policies and legislatures, the challenges and the lessons learned. An evaluation of land reform programmes concludes the chapter.

Chapter Five: The objective of this chapter is to explore the real constraints and tasks facing Land reform beneficiaries in Southern Africa, by focusing on the four provinces (Kwa-Zulu Natal, Limpopo, North West and Free State) as a case study. The analysis draws on the Sustainable Livelihoods (SL) Framework attempting to discern the foremost factors that distress the livelihoods of land reform farmers and the relationships between these factors.

Chapter Six: Chapter six comprises detailed discussions about the procedures for selecting study sites, the methodology for data gathering and analysis, as well as the data collection procedures. A presentation of the choice of econometric models used for the analyses is also included.

Chapter Seven: The chapter provides an analysis and discussion of the results. In this chapter, the descriptive and empirical results are discussed to direct the researcher on the development of a model of adaptation for smallholder farmers on climate change, which is outlined in more detail in Chapter 8.

Chapter Eight: This chapter addressed the development of a model for land reform beneficiaries' choice of adaptation strategies on climate variations. The researcher attempted to merge the model of Agri-Park with the proposed model of adaptation and sustainability for the smallholder farmers to be able to cope and adapt to the changes of climate.

It further explored the impact of climate variations on rural smallholder farmers. Also included is discussions about sustainable livelihoods capitals as barriers to climate change adaptation strategies, the causes of climate change adaptation strategies, climate change adaptation responses, climate change strategies used by rural smallholder farmers, developing a model for land reform beneficiary's choice of adaptation to climate change, process flow for the implementation of the land reform beneficiaries' adaptation model, guidelines for the monitoring and evaluation of adaptation strategies, key policy and strategy gaps and recommendations on the review of land reform strategies.

Chapter Nine: This final chapter provides a summary, conclusion, limitations to the study and recommendations for further research, including implementations by the Department of Rural Development and Land reform.

1.8 Summary

In South Africa, numerous challenges influence the growth of smallholder farmers, resulting in impeding their contribution to food security compared to commercial farmers. These constraints hinder their propensity to adopt climate change adaptation strategies because of the substantial capital outlay required. Also, the high transaction costs that they incur due to poor infrastructure are another hindrance in their growth capacity.

Furthermore, these challenges lead to low productivity; for example, unreliable markets and poor road networks are a disincentive to production. These farmers thus resort to local selling, which attracts low prices. Smallholder farmers also face a constraint of high illiteracy and poor technological skills. Most of these targeted land reform beneficiaries lack business skills and often fail to meet quality standards for their produce. It is against this backdrop that this study sought to empirically estimate the determinants of constraints of adoption of CC adaptation strategies among the land reform beneficiaries in South Africa. The climate change effects, therefore, led to advance research questions related to the awareness on the causes of climate change, how smallholder farmers deal with challenges caused by climate change impact, what local knowledge and commercial rural smallholder farmers have developed to adjust to the

changing climate, what trends are observed on climate variables, which segment of the rural community is highly vulnerable to climate change, what influences the adaptive capacity of smallholder farmers to climate change and what institutional arrangements are put in place to enhance adaptation to climate change.

The main objective of the study was to develop a model of smallholder farmers' disaster risk reduction and adaptation strategies in response to climate change. In order to meet this main objective or aim, the study assessed the choice and intensity of adoption of smallholder farmers' choice of adaptation strategies in the context of climate change.

In summary, chapter one provided and articulated the background and rationale of the study, the statement of the problem, the research questions and the hypothesis to be addressed. It also included a conceptual framework that guides the overall research. The following chapter provides a review of related literature to the research theme and establishes the theoretical and empirical foundations on concepts of climate change, impacts of climate change and coping and adaption strategies adopted by farmers. The theoretical and conceptual concepts in the literature review are used to make critical comparisons and discussions against the findings in this study.

Thus, the study aims to contribute knowledge about the influence of climate change in rural livelihoods and strategies adopted. Although the study focused on specific provinces in South Africa, the results of this study will be relevant and helpful to many areas of the country, as well as other countries with similar climatic and socio-economic settings. Essentially the research is important because an understanding of the trend of current climate change, its impacts on livelihoods, current response strategies and identification of vulnerabilities and stressors help to predict the likely future changes, impacts, coping strategies and social vulnerability.

CHAPTER TWO: THE CONCEPTUAL, THEORETICAL AND LEGAL FRAMEWORKS RELATED TO CLIMATE CHANGE ADAPTATION, DRR AND AGRICULTURE

2.1 Climate Change Conceptual Framework

Climate refers to the long-term average weather patterns of a given region (i.e., temperature, pressure, precipitation). In this context, climate change refers to perceived increases in the long-term average temperature of the earth's climate system (IPCC, 2014). The understanding of climate change has been growing and today, there is 95% certainty among scientists that the perceived increases in global temperature are mostly caused by the concentration of Greenhouse Gases (GHG) in the atmosphere, including other human activities (IPCC, 2014). Solar radiation penetrates the earth warming its surface; however, only a fraction of this radiation is returned to space as the accumulation of these GHG gasses traps most of it. The trapped radiation goes back to heat up the earth's surface, increasing its temperature, similar to the workings of a greenhouse.

Most of the GHG are present naturally in the atmosphere in small proportions; however, since the industrial revolution, their concentration has notably risen. This rise has primarily been linked to the combustion of fossil fuels driven by the demand for energy, goods and services, as well as the conversion of natural ecosystems to intensive land use. The IPCC (2007) report indicated that the African continent will be hard hit by the impact of climate change, increasing in temperature and reduction in rainfall thereof. The report further highlighted that agricultural production and food security in many African countries could be affected by climate change and variability (IPCC, 2007). The report (IPCC, 2007) indicated that by the year 2020, some countries' rain-fed agriculture could be reduced by up to 50 percent, with smallholder farmers being the most affected ones. In 2014, the IPCC highlighted that the impact of climate change could be reducing the economic growth in some parts of Africa, even get worse (IPCC, 2014a).

This implies that a reduction in agriculture production of the smallholder farmers would further adversely affect food security. In order to sustain the current demand for food production and to meet the future needs of the smallholder farmers, decision-makers will have to respond to the impact of climate change by adopting a climate change strategy (IPCC, 2014). Generally, climate

change affects all aspects of economic growth, especially in the least developing countries (FAO, 2011). The IPCC fifth assessment report (IPCC, 2014b) and the Sendai Framework for Disaster Risk Reduction 2015–2030 (UNISDR, 2015) have both confirmed that there is a need for integration of CCA and DRM. The next sub-section will briefly discuss the relevant concepts of the study.

2.1.1 Adaptation

The IPPC (2009) report describes adaptation as an initial plan and measures to reduce the vulnerability of natural and human systems against actual or expected stresses (IPCC, 2009). The IPCC (2007) report applies the notion to climate impacts as the ability to bow to climate alteration (together with climate extremes and variabilities) to restrain possible damage, to acquire benefit of occasion or to be able to handle its consequences (*ibid*). Resilience theory defines adaptive capacity as the ability of method players to maintain the scheme's flexibility; flexibility referring to the sum of the transformations that the scheme can cope within the absence of a complete fall apart (Walker & Salt, 2006).

Some influences are limiting adaptive capacity and readiness to accept as a possible source of parameters and obstructions to adaptation. The key restrictions and obstructions to adaptation are biophysical, economic, social and/or technological in nature. This study, therefore, adopts the definition of climate change as mentioned by Walker and Salt (2006) from their study on identifying barriers to local climate change adaptation, which states that: *"Adaptation involves changes in socio-ecological systems in response to actual and expected impacts of climate change in the context of interacting non-climatic changes. Adaptation strategies and actions can range from short-term coping to longer-term, deeper transformations, aim to meet more than climate change goals alone and may or may not succeed in moderating harm or exploiting beneficial opportunities*" (Walker & Salt, 2006).

2.1.2 Adaptive Cycle

Walker and Salt (2006) created the term adaptive cycle (Walker & Salt, 2006). Figure 2.3 demonstrates the two different approaches of the adaptive cycle, which, as put by Walker and Salt (2006), are the expansion or fore-loop and the back-loop. The fore-loop comprises use or speedy development (**r**) and the succession to preservation (**K**). Utilisation (**r**) highlights the

swift colonisation of freshly dispersed regions while **K** refers to the sluggish gathering and storage of energy and materials (Walker & Salt, 2006). The scheme crosses the brink between the **K** and **Ω** boxes, a method that can occur in a heartbeat (Walker & Salt, 2006).

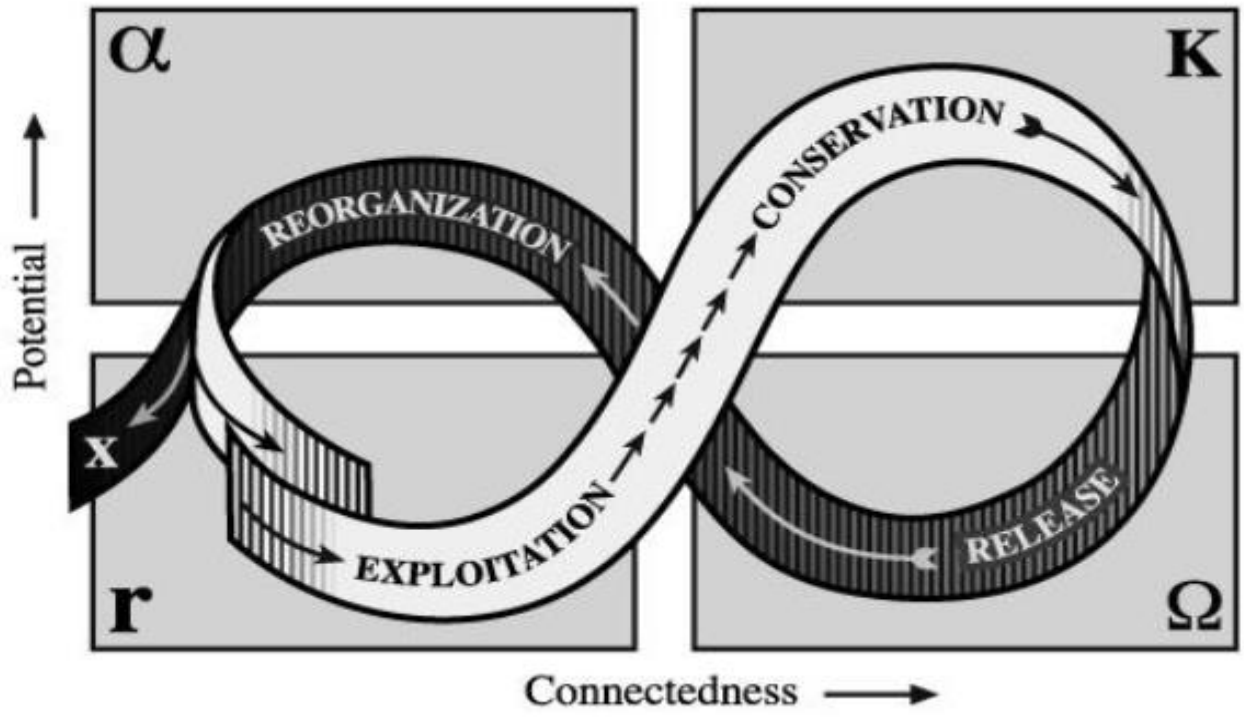


Figure 2.1: Adaptive Cycle
Source: Holling & Gunderson, 2002

The **Ω** stage is referred to as the imaginative demolition stage, and famine is believed to be one of a range of instruments that help in the arrangement discharge (Walker & Salt, 2006). From the **Ω** stage, the scheme develops into the re-organisation and regeneration (**α**) phase where novelty and innovation assist the scheme to re-organise itself and re-enter the sequence or drop its prospective making the likelihood of the scheme turn over into a less creative and structured status, as portrayed by **X** in the illustration above (*ibid*). It is at the **α** stage that financial methods and policies, a reality during financial depression or a social revolution (Walker & Salt, 2006), are put in place to serve the scheme to re-organise itself.

2.1.3 Adaptation strategies

Adger (2005) postulates that adaptive capacity refers to the belonging of a scheme to adapt its features or conduct to enlarge its handling of incurrent climate variability or forthcoming climate circumstances. Efforts have been undertaken to determine how countryside farmers and their communities have adjusted to climate transformation (IPCC, 2009). The IPCC (2009) observes that the ability to cope is vibrant and driven by financial and normal capital, casual associations, entitlements, establishments and control, human resources and technology. Thus, the IPCC (2009) report presents the features of adaptive capacity into the domain of universal progress aims.

The idea and indicators of adaptive capacity nonetheless continue to be valuable, especially in appreciating the constituents and fundamentals for adaptation. Adaptive capacity can be described as *"the ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities or to respond to consequences"* (IPCC, 2014). In contrast to coping, adaptation is focused on reducing risk and minimises the system's sensitivity in the long-term (Bryan *et al.,* 2013).

Thus, the three cornerstones of adaptive capacity are *(1) to reduce the exposure of the system (mitigation), (2) to increase resilience of the system by coping with changes (coping) and (3) to reduce the sensitivity of a system to climate change* (Adger et al., 2005). Since adaptive capacity is a latent system variable, it only becomes apparent after a system has reacted to a stressor (Engle, 2011). Therefore, to make conclusions about adaptive capacity regarding future climate change, Elasha *et al. (*2005) and Engle (2011) recommended using the past coping and adaptation strategies as indicators.

From this time, Engel (2011) supported the latter authors that adaptation strategies are defined as *"adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates, harms or exploits beneficial opportunities"*. An adaptation strategy, therefore, provides a useful entry point to establish an indicator of adaptive capacity. Engel (2011) further measured adaptation and stated that it can be divided into autonomous and planned adaptation measures (Engle, 2011). The first one describes adaptation measures initiated

and realised by the decision-maker him-/herself (Engle, 2011). The IPCC (2007) report defines the Autonomous and Planned adaptations definitions as follows:

Autonomous adaptation – Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or *welfare* changes in *human systems*. Also referred to as spontaneous adaptation.

Planned adaptation – Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain or achieve the desired state (Cooper *et al.,* 2008; Dixon *et al.,* 2014; Keshavarz *et al.,* 2014).

2.1.4 Climate Change

According to the report by Climate Systems Regional Report in South Africa (CSRRSA, 2012), climate change refers to a change in the average weather experienced in a region or location. The change may occur over periods ranging from decades to millennia. It may affect one or more seasons (e.g., summer, winter or the whole year) and involves changes in one or more aspects of the weather such as rainfall, temperature or winds (CSRRSA, 2012).

The causes may be natural (e.g., periodic changes in the earth's orbit, volcanoes and solar variability) or attributable to human activities (e.g., increasing emissions of greenhouse gases such as Co2, land-use change and/or emissions of aerosols). In contemporary society and the context of this report, the term *'climate change'* often refers to changes due to anthropogenic causes (CSRRSA, 2012). Accordingly, changes in rainfall are typically harder to detect due to their greater variability, both in time and space. Where records are of enough length, there have been detectable increases in the number of heavy rainfall events, with the southern hemisphere evidencing moistening of the tropics and subtropics (CSRRSA, 2012).

This has important implications for the seasonality of regional rainfall and together suggests a shorter but more intense rainfall season (CSRRSA, 2012). Besides changes in temperature and rainfall, other aspects of global change are notable, including the following, for example:

- Increases in intensity and spatial extent of droughts since the mid-1970s;
- Decreases in northern hemisphere snow cover;
- Increases in the duration of heatwaves during the latter half of the 20th century;
- Shrinking of the arctic sea ice pack since 1978;
- Widespread shrinking of glaciers, especially mountain glaciers in the tropics;
- Increases in upper-ocean (0-700m) heat content; and
- Increases in sea level at a rate of 1.8 mm yr-1 between 1961 and 2003, with a faster rate of 3.1 mm yr-1 between 1993 and 2003.

The IPCC (2014) further highlighted that this rise has primarily been linked to the combustion of fossil fuels driven by the demand for energy, goods and services and to the conversion of natural ecosystems to intensive land use. The IPCC (2014) report indicated that the globally averaged surface temperature shows a warming of 0.85°C over the last 30 years (IPCC, 2014).

2.1.5 Land Redistribution

Post-apartheid South Africa faces a variety of challenges that emanated from the injustices caused by apartheid. One of the challenges faced by the first democratically elected government of South Africa was how to address the unequal distribution of land in the country (Lubambo, 2011). The South African government has shown commitment to eradicate the inequalities and injustices of the past and by initiating a comprehensive land reform programme with a strong constitutional basis; the programme consists of three pillars, namely restitution, land redistribution and tenure security (Lubambo, 2011).

This section provides a brief overview of land as a programme, which comprises of the three pillars, namely land redistribution, land restitution and the land tenure as sub-programmes of the over-arching programme. The South African Land Reform Programme (LRP) was executed after 1994 by Government to recompense disproportions in land proprietorship which had originated from the racially prejudiced policies of the apartheid Government before 1994 (Lubambo, 2011).

The Land Reform Programme (LRP) is based on three pillars (each has its own set of challenges and dynamics), which are ingrained in the Constitution of the Republic of South Africa, 1996

(DLA, 1997). The pillars constitute: (i) Restitution, which intends to reinstate land or offer similar compensation for rights in land for persons who were evicted after 19 June 1913; (ii) Redistribution, which addresses the numerous wants and ambitions of persons for land, in both rural and urban areas, impartially and reasonably while at the same time donating to poverty mitigation and national financial development; and (iii) Tenure Reform, whose objective is to promote the various land tenure provisions presently limiting tenure safety for the formerly underprivileged, in both urban and rural areas (Lubambo, 2011).

The model adopted for funding land redistribution in the 1997 White Paper was the *Settlement/Land Acquisition Grant (SLAG).* It remained agnostic on key questions of what kinds of farming and social relations would be supported; land redeployment intended to donate to a more expanded size structure in agriculture, where all manufacturers would contest in a liberalised atmosphere. SLAG had numerous unique features. First, it encouraged access to land for poor persons only, being means-tested. Second, it provided an R16 000 household scholarship, originally equal to the urban housing funding, with which persons could purchase land. Third, while the policy fixated on 'communities', numerous diverse welfares were accommodated in the policy, with persons wanting land for their own usage, as well as those wishing to live and use their land together as a community. The SLAG-based reorganisation programme estranged nearly all interest groups (Land Claim Commission, 2012).

In 2000, the World Bank assisted in the design of a revised grant to replace SLAG and aimed to create a new class of Black commercial farmers. The Bank criticised the Government for setting up large, 'rent-a-crowd' collectives unable to manage and use their land and for failing to address the class interests of those with the resources and capacity to become commercial farmers. From 2001, the new *Land Redistribution for Agricultural Development (LRAD*) agenda presented a descending gauge of allowances from R20 000 to R100 000 per individual. It did not address the land needs of people wanting a secure place to live, instead of farming. By 2001, when LRAD was launched, Minister Didiza warned of the dangers of 'squatter farming' on redistributed land. For those without money of their own, it meant that they had to find farms that they could buy, invest in and operate for under R200 000; very few such opportunities existed (Cousins, 2015). This focus on enterprising individuals, meant to be farming full-time, together with the

imposition of income targets, shaped the implementation of LRAD. It favoured businessmen with income from other sources and marginalised most rural farmers, many of whom are women (Cousins, 2015). However, finding aspirant Black farmers with enough capital of their own to invest proved to be a challenging cause. In its first two years, the LRAD programme provided 41% of its grants at the lowest end (R20 000) and 40% at the R30 000 level (Hall, 2008).

Comprehensive Agricultural Support Programme (CASP) funds were also provided to land reform beneficiaries. It is estimated that between 2005 and 2008, there was an annual average of 61 000 CASP beneficiaries and about 2 500 farmers per annum received loans from MAFISA (Lahiff, 2008). According to Lahiff (2008), the bulk of funds went to land reform projects, with communal areas being largely excluded. The implicit criterion for CASP funding was 'commercial viability', and the imperative to spend large budgets resulted in officials scaling down the number of projects and scaling up the size of each project (Lahiff, 2008).

The Proactive Land Acquisition Strategy (PLAS) was launched in 2006, with the state buying farms and leasing them to beneficiaries. From 2011 PLAS replaced LRAD and all other grant-based programmes supporting land redistribution. Government explained this approach as its response to criticism of the 'willing buyer, willing seller' approach and its promise at the National Land Summit that it would now proactively acquire land for redistribution (Commission on Land Claims, 2012).

The *State Land Leasehold and Disposal Policy (SLDP*) were adopted in 2013 and are relevant to farms attained through PLAS. It is intended for Black South Africans and describes four groupings of recipients: (1) families with no or very inadequate admission to land, even for survival manufacture; (2) limited agriculturalists farming for survival and vending a portion of their harvest on the home-grown marketplace; (3) medium-scale moneymaking agriculturalists now farming commercially at a minor gauge and with the ability to enlarge, but forced by land and other capitals; and (4) significant or well-recognised profitable growers farming at a sensible profitable gauge but underprivileged by site, magnitude of land and other properties or surroundings and with the possibility to produce (Cousins, 2015).

According to Cousins (2015), the *Recapitalisation and Development Policy Programme (RDPP)* substituted all prior methods of backing for land restructuring in 2013, with settlement sustenance funding for persons having property reinstated through compensation. Its basis is that numerous land restructuring plans have been unproductive due to insufficient and unsuitable post-settlement sponsorship and are in 'distress' and, therefore, in need of additional boosters of coffers (Cousins, 2015).

The *Agricultural Landholding Policy (ALPF)* of 2013 provides a solution to the notion in the 2011 Green Paper that one 'tier' of land tenure in South Africa will be 'freehold with limited extent'. By 2016 it seemed that this strategy might shortly be given legislative appearance (Cousins, 2013). The rationale is to attain higher levels of efficiency of land use and optimise 'total factor productivity' (Cousins, 2013).

2.1.6 Land Restitution

The *Restitution of Land Rights Act, Act 22 of 1994*, was one of the first laws approved by the new self-governing administration to address the inheritances of the apartheid rule. It declared the right to compensation and described the procedure for lodging their claims. The Act recognised two establishments to propel the development, namely: A Commission on the Restitution of Land Rights (CRLR) and a Land Claims Court (LCC). The timeframe for compensation, as set out in the 1997 White, was 18 years in total. Originally three years were permitted for claims to be lodged, later prolonged to a final target of 31 December 1998 (DLA 1997). Five years were envisioned for the reimbursement of claims and a further 10 years for the operation of all court orders and settlement contracts.

The Restitution Act set out the conditions for suitability as an individual or public who was evicted off property after 1913 because of racially prejudiced commandments or practices and not sufficiently remunerated or the direct progenies or departed estates of such persons (RSA, 1994, Section 2(1). Suitability pivots on offering adequate proof that property rights existed were misplaced due to racially prejudiced laws and practices. Jurisprudence established that compensation is not restricted to those who had been private freehold owners of land but spreads to (former) non-owners since most land held by Blacks had been under forms of customary or informal tenure.

The key restrictions on suitability are the 1913 cut-off date, with 1998 being the deadline for claims to be lodged (until the 2014 Amendment Act). The rationale given by Minister Didiza for not listening to claims predating 1913 was that this would open the way to claims on land now occupied by Blacks, rather than concentrating on White-owned land. There are very limited rural claims in the Western Cape. However, large portions of Limpopo and Mpumalanga (possibly between 50% and 70 % of the farmland in those provinces) are subject to claims. It seems that the massive majority of those affected (along with their descendants) have not ever submitted claims for compensation.

2.1.7 Disaster Risk

The term risk refers to the *"expected losses from a given hazard to a given element at risk"* (UNDRO, 1997; cited by Coburn *et al.,* 1994). This definition focuses on the hazard and its characteristics and the way it affects elements at risk. It also implies that a disaster is the output of the happening of a hazard and its severity and the susceptibility of elements at risk to this hazard. Therefore, the disaster risk definition evolved to encompass three interrelated factors, namely hazard (H), vulnerability (V) and capacity (C). This could hide various types of vulnerability and drive more focus on hazards than associated vulnerabilities. However, since elements at risk could have different capacities to face different hazards and their characteristics, the risk definition has evolved as presented below (UNISDR, 2004). In order to understand the basis of such disproportionate impacts, it is important to unpack the link between hazard occurrence, disaster risk and affected subjects. Thus, a disaster risk can be summarised by the following formula (Fitzgibbon & Crosskey, 2013):

$$\textbf{DISASTER RISK} = \frac{\textbf{H X V}}{\textbf{C1 X C2 X… Cn}}$$

The equation above indicates that the ability to decrease the level of risk within a community or set location is not essentially the same ability required to improve the vulnerability status of the given community or environment. Capacity here could also include the inherent capacities of

individuals, communities and environment systems. It also includes the community structures that are necessary to manage the disaster risk (manageability).

This is in line with the definition, as proposed by UNISDR) (2002), which stated that risk outcomes emanating from the grouping of risks, situations of susceptibility and inadequate ability or steps to cut the possible destructive costs of hazard. Therefore, a disaster risk is the interaction of a hazard with vulnerability that produces an outcome. Disaster risk could be measured in terms of physical (number of deaths and injured) or economic (financial terms and economic values) and damage to human-related systems (Brooks & Adger, 2003) that live in the space at the time of contact to the danger. IPCC defines risk *as "a function of probability and consequences of an event, with several ways of combining these two factors being possible. There may be more than one event, consequences can range from positive to negative and risk can be measured qualitatively or quantitatively*" (IPCC, 3rd assessment report Chapter 2, 2001).

This definition represents a hazard driven approach, where risk is described as a utility of the likelihood of a danger happening and its consequences on the element at risk. A disaster is defined as *"a serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts"* (UN, 2016).

The typology of disasters that affected most people in 2015 alone was caused by droughts (over 50 million people affected), floods (over 27 million people affected) and storms (over 10 million people affected) (UNISDR, 2015a). Furthermore, these hazards pre-dominated the causes of impacts for the period 2005 to 2014. Respectively, floods affected more than 85 million people, droughts more than 35 million people and storms affected more than 34 million people (UNISDR, 2015a). Droughts, floods and storms also represent the typology of hazards that are both induced by weather variability or climate change and affect the agriculture and food sectors.

The 2016 State of Food and Agriculture Report also warned that the agriculture and food sectors are threatened to miss the 2030 Sustainable Development Goals (SDGs) targets of ending hunger and poverty. Such a failure will be favoured by climate change if *"business as usual"* is

maintained in the agriculture and food sectors, irrespective of population growth, ineffective food systems, as well as unsustainable and environmentally unsound practices for land, water, fisheries and forestry management (FAO, 2016a). The frequency and magnitude of climate-related disasters are furthermore expected to increase, resulting in unbearable impacts on many poor rural dwellers and smallholder farmers under business as usual (WB, 2010; Masih *et al.*, 2014; FAO, 2017b).

2.1.8 Disaster risk reduction

Disaster risk reduction refers to the methodical expansion and function of strategies, policies and practices to reduce susceptibility, risks and the unfolding of catastrophe impacts right through a community, in the extensive background of sustainable development (UNISDR, 2004). The idea and way of reducing disastrous risks by methodical means to examine and control the contributory elements of tragedy, including through minimised contact with risks, narrowed susceptibility of persons and possessions, shrewd administration of land and the location, as well as better vigilance for unpleasant actions (UNISDR, 2009). A widespread approach to decrease tragic risks set out in the United Nations-endorsed Hyogo Framework for Action, adopted in 2005, projected that *"The substantial reduction of disaster losses, in lives and the social, economic and environmental assets of communities and countries"* (UNISDR, 2009).

The International Strategy for Disaster Reduction (ISDR) scheme offers means of transport for partnership between civil society, organisations and Government stakeholders to help in the execution of the Framework (UNISDR, 2009). It is important to notice that while the word *"disaster reduction"* is at times used, the word "disaster risk reduction" offers an improved acknowledgment of the in-development character of disaster dangers and the in-progress possibility to decrease these dangers (UNISDR, 2009).

2.2 Theoretical framework: The Hyogo Framework for Action

2.2.1 Hyogo Framework for Action

"The Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters" is a globally accepted strategy outline for disaster risk decrease. It was accepted at the World Conference on Disaster Reduction, Kobe, and Hyogo in Japan 18-22

January 2005 (UNISDR, 2005). According to the UNISDR (2005) report, the Hyogo Framework for Action offers a tactical and all-inclusive worldwide strategy to decrease susceptibility to the usual dangers of disaster risks and symbolises an important re-orientation of concentration in the direction of the original causes of disaster risks as a necessary element of sustainable growth, rather than on catastrophe reaction alone (UNISDR, 2005). The report structure further lays down five main concerns for action (UNISDR, 2005):

i. Guarantee that disaster threat decline is a nationwide and local main concern with a tough institutional foundation for functioning, as well as devotion of enough resources and the institution of coordination apparatus such as state-run podiums for disaster danger decrease;
ii. Recognise, measure and observe disaster dangers and improve before time caution, plus hazard and susceptibility investigation with outreach to communities;
iii. Decrease the fundamental danger elements, in such regions as natural resource administration, socio-economic expansion, physical development and erection; and
iv. Reinforce catastrophe vigilance for successful reaction at all levels, as well as attentiveness preparation and reinforcement of catastrophe retort capability.

2.2.2 The Sendai Framework for Action

The Sendai Framework for Disaster Risk Reduction 2015–2030 was adopted at the Third United Nations World Conference on Disaster Risk Reduction held from 14 to 18 March 2015 in Sendai, Miyagi, Japan, which represented a unique opportunity for countries (UNISDR, 2015):

a. To adopt a concise, focused, forward-looking and action-oriented post-2015 framework for disaster risk reduction;
b. To complete the assessment and review of the implementation of the Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters;
c. To consider the experience gained through the regional and national strategies/ institutions and plans for disaster risk reduction and their recommendations, as well as relevant regional agreements for the implementation of the Hyogo Framework for Action;
d. To identify modalities of cooperation based on commitments to implement a post-2015 framework for disaster risk reduction;

e. To determine modalities for the periodic review of the implementation of a post-2015 framework for disaster risk reduction.

2.2.2.1 Expected outcome and goal

While some progress in building resilience and reducing losses and damages has been achieved, a substantial reduction of disaster risk requires perseverance and persistence, with a more explicit focus on people and their health and livelihoods and regular follow-ups (UNISDR, 2016). Building on the Hyogo Framework for Action, the present framework aims to achieve the following outcomes over the next 15 years:

- The substantial reduction of disaster risk and losses in lives, livelihoods and health, including the economic, physical, social, cultural and environmental assets of persons, businesses;
- The realisation of this outcome requires the strong commitment and involvement of political leadership in every country at all levels in the implementation and follow-up of the present framework (Sendai Framework) and the creation of the necessary conducive and enabling environment (UNISDR, 2016).

In order to attain the expected outcome, the following goal must be pursued:

Support the assessment of global progress in achieving the outcome and goal of the Sendai Framework, subsequently agreeing on seven global targets (UNISDR, 2016). These targets will be measured at the global level and will be complemented by work to develop appropriate indicators. National targets and indicators will contribute to the achievement of the outcome and goal of the Sendai Framework. The framework outlined the following global targets (UNISDR, 2016):

i. Substantially reduce global disaster mortality by 2030, aiming to lower the average per 100 000 global mortality rate in the decade 2020–2030 compared to the period 2005–2015;
ii. Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100 000 in the decade 2020–2030 compared to the period 2005–2015;

iii. Reduce direct disaster economic loss concerning the global gross domestic product (GDP) by 2030;
iv. Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030;
v. Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020;
vi. Substantially enhance international cooperation in developing countries through adequate and sustainable support to complement their national actions for implementation of the present framework by 2030;
vii. Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030.

2.2.2.2 Priorities of Action for the Sendai framework

Taking into account the experience gained through the implementation of the Hyogo Framework for Action and in pursuance of the expected outcome and goal, the report (UNISDR, 2016) indicated that there is a need for focused action within and across sectors by states at local, national, regional and global levels in the following four priority areas (UNISDR, 2016):

i. Priority 1: Understanding disaster risk.
ii. Priority 2: Strengthening disaster risk governance to manage disaster risk.
iii. Priority 3: Investing in disaster risk reduction for resilience.
iv. Priority 4: Enhancing disaster preparedness for effective response and to *"Build Back Better"* in recovery, rehabilitation and reconstruction.

In their move towards disaster risk reduction, national, regional and global groups and other appropriate players ought to take into reflection the crucial performances scheduled below each of these four main concerns and put it into practice as suitable, considering abilities and potentials, in conjunction with state laws and systems (UNISDR, 2016). In order to reduce disaster risks, the Sendai Framework for Disaster Risk Reduction 2015-2030 provides global guidance through four priorities, specifically on understanding disaster risk (Priority 1), strengthening disaster risk governance to manage disaster risk (Priority 2), investing in disaster

risk reduction (DRR) for resilience (Priority 3) and enhancing disaster preparedness for effective response and to *"Build Back Better"* (Priority 4).

Remarkable progress was noted under Priority 2 of the Sendai Framework. At the regional (continental) level, the Africa Union Commission has developed a Programme of Action for the Implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 (AU, 2016). Three main models were found in setting up a DRR coordinating institution: in a line ministry (such as in the Ministry of Home Affairs or the Ministry of Agriculture), at a higher level (related to the Office of the Prime Minister) or as a separate Ministry with mandate to coordinate disaster risk management in collaboration with other sectors' ministries (AU, 2016).

The challenges cut across the four priorities of the Sendai Framework. In order to address these obstacles, this research study recommends the following measures, grouped into seven main themes (AU, 2016):

i. making early warning effective for early action in agriculture;
ii. addressing population dynamics and constraints on natural resources;
iii. developing risk-informed sector-specific disaster risk management plans;
iv. financial resource allocation and mobilisation for DRR;
v. linking the development and humanitarian efforts;
vi. transcending socio-cultural barriers; and
vii. infrastructure development and technology transfer that is appropriate to the agro-ecologies and climatic risks.

The Sendai Framework was thus further expanded with the following six (6) objectives: (1) increase political commitment to disaster risk reduction; (2) improve identification and assessment of disaster risks; (3) enhance knowledge management for disaster risk reduction; (4) increase public awareness of disaster risk reduction; (5) improve governance of disaster risk reduction institutions; and (6) integrate disaster risk reduction in emergency response management (AU, 2016). The strategy was adopted at the 10th Meeting of the African Ministerial Conference on the Environment (AMCEN) in July 2004 (AU, 2016). In an attempt to facilitate the implementation of the regional strategy, a Programme of Action for the Implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 in Africa was formulated (AU, 2016).

2.3 Linking Disaster Risk Reduction, Development and Climate Change

Despite the relationship between DRR, resilience and development, this relationship has not been adequately exploited in the MDGs and now the SDGs. Disasters can erode and destroy decades of development gains, while development can create or increase vulnerability (UNISDR/WMO, 2012). Belle (2016) argued that disasters and poverty are greatly linked because the poor and most marginalised are the worst prone to disaster areas, suffer the impacts most and are the least to recover from disastrous events with no means to diversify risks of disaster through measures such as insurance.

Furthermore, Belle (2016) agreed with Mitchell *et al.* (2014) that disasters exacerbate vulnerabilities and social inequalities and harm economic growth; disasters can destroy years of economic gains of a country or community; disasters can also increase impoverishment of many people within the disaster-stricken area by bringing many victims of disasters who were formerly above the poverty line to below the poverty line (Mitchell *et al*., 2014). Therefore, sustainable development planning and programmes must integrate DRR and CCA (Mitchell & Van Aalst, 2008).

DRR is a cross-cutting issue and in the context of sustainable development, it is an important element for the achievement of internationally agreed-upon MDGs and the SDGs (Renaud *et al*., 2013; UNISDR, 2005; UNDP, 2015). It is therefore imperative to mainstream DRR into

development policies, planning and programmes in order to achieve sustainable development (UNISDR, 2013). The South African Local Government: Municipal Systems Act, Act 32 of 2000 and the IDP can assist implementers by guiding them on the operationalisation of DRR and development, but experience has shown a lack of integration and implementation on the ground and grassroots levels do exist. The UNISDR/WMO (2012) report highlighted that reducing the risks of disasters through prevention, preparedness and early warning systems measures for predictable events such as cyclones, large storms, heavy precipitation events, droughts, heatwaves and cold fronts, would help to protect both human and economic assets.

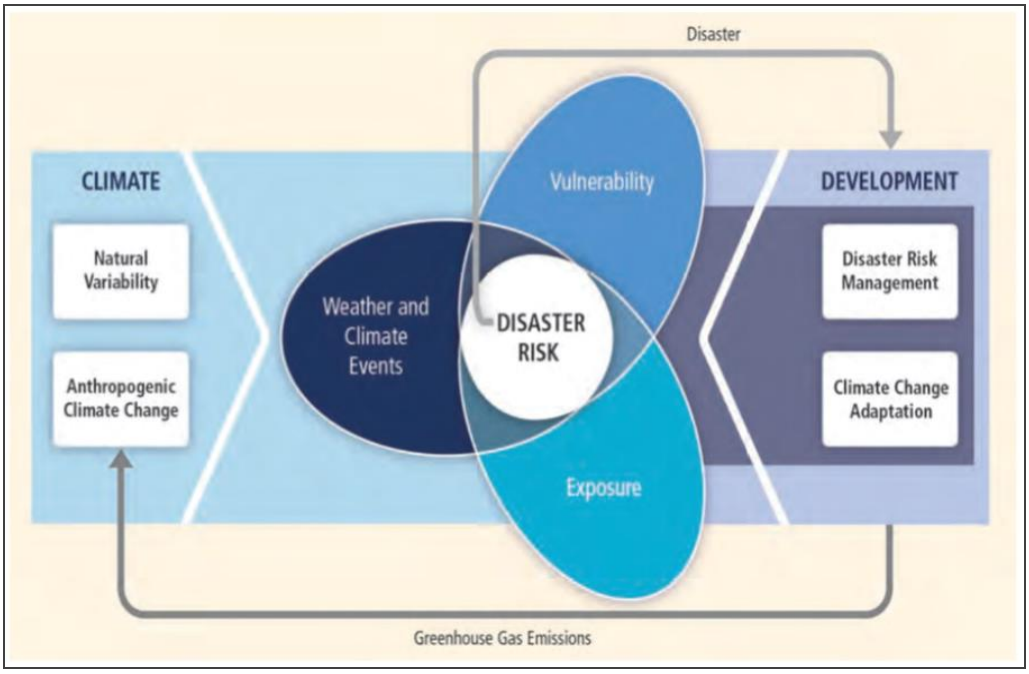
Mostly, suitable DRR planning and implementation can aid in building resilient communities and thus resilient communities are better prepared to carry out sustainable development and DRR measures, thus creating the relationship between DRR, resilience and sustainable development. Therefore, this is the focus theme of the HFA 2005−2015. The multi-stakeholder and multi-sector HFA should serve as the guiding instrument for international cooperation enabling DRR and resilience building to provide guidance on how DRR can contribute towards achieving sustainable development objectives (UNISDR/WMO, 2012). DRR is developmental when policies and strategies for risk reduction (preparedness, hazard mitigation and human vulnerability reduction) are integrated into development policies and practices such as the recommended practice of *'Build Back Better'* during reconstruction following a disaster. This practice is also aligned to the MDGs, the Poverty Reduction Strategy Papers and now the Sustainable Development Goals (Pelling & Holloway, 2006; UNISDR, 2013; UNDP, 2015).

The Rio+20 Conference explicitly links DRR, sustainable development and climate change. It also advocates for more comprehensive and coordinated strategies that integrate DRR and CCA into public and private investment for development (Belle, 2016). The relationship between DRR, CCA and sustainable development is well-articulated in this section on linkages of DRR and CC. CCA and DRR are critical elements for meaningful development because CCA and DRR reduce the negative effects of climate change and disaster risks on humans, their assets, environment and the overall development of the affected communities (Belle, 2016).

Belle (2016) also found that globally, risk reduction initiatives have failed to keep pace with the increasing exposure to natural hazards and higher levels of vulnerability (IFRC, 2013; IPCC, 2012; UNISDR, 2013). Climate change is changing the face of disaster risk, not only through

increased frequency and severity of hydro-meteorological events, sea level and temperature rise (IPCC, 2012; IPCC, 2007) but also through an increase in societal vulnerabilities (IFRC, 2013; Wisner *et al.*, 2013). As a result of global warming, climate-related hazards such as floods, droughts, heatwaves, tropical cyclones/hurricanes and storms are expected to become more frequent and more intense (Belle, 2016).

Climate change has and will continue to damage livelihoods, increase poverty and affect food security. Some climate-related hazards such as tropical cyclones, storms, floods, droughts, heatwaves and cold fronts will affect places that have not experienced them before. All of these will lead to increased vulnerabilities (IFRC, 2013). Belle (2016) is convinced that DRR is an important element of CCA and may be *vice versa*, while both contribute to healthy environments and sustainable development. On the other hand, healthy environments are central to DRR and CCA which together form the foundation for sustainable development goals. The central message and main aim of this section are to highlight the critical and cyclical connection between ecosystems, DRR and CCA for development within the current changing local and global environment (Belle, 2016), as presented in Figure 2.2.



Source: IPCC (2012)

Figure 2.2 The link between climate change, disasters and development

Climate change effects can produce extreme climate events that can be caused by natural climate change, but most importantly, by anthropogenic climate change (IPCC, 2012). Such extreme climate events can easily lead to a disaster where both exposures to the extreme event and the vulnerability of the people and assets are high. Belle (2016) acknowledges that disasters can set back many years of development efforts, but at the same time, the integration of disaster risk management, including better environmental management and CCA strategies into development plans, can drastically reduce disaster risk and produce lasting and sustainable development.

Belle (2016) further agreed that it is imperative that climate change specialists, disaster management specialists, development planners and environmentalists work in close cooperation to synergise efforts and tackle climate impact, disaster, environment and development issues in a holistic approach. The whole essence of the special report on managing the risks of extreme events and disasters to advance climate change adaptation (also known as the SREX report) is further supported by (IPCC, 2012), which is based on building such synergy and adopting the holistic approach.

2.4 Characteristics, Similarities and differences between Disaster Risk Reduction and Climate Change Adaptation

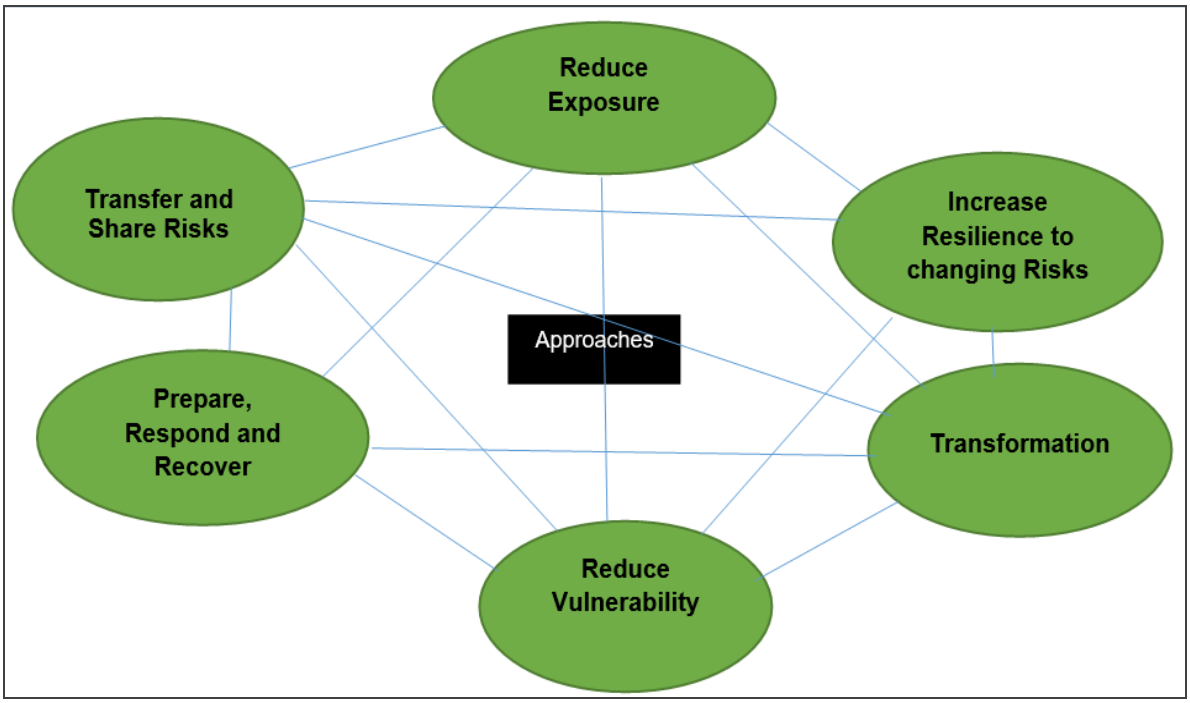
There is increasing acknowledgement of the strong interaction between DRR and CCA initiatives (Doswald and Estrella, 2015; IPCC, 2014). DRR and CCA have always grown in silos with different stakeholders, expert groups, funding mechanisms and processes. However, Belle (2016), as well as the PEDRR (2014) maintained that the Rio+20 outcomes emphasised that DRR and CCA should be institutionally linked to encourage more integrated planning, efficient and effective results, leverage financial resources and investment, reduce redundancies and administrative bottlenecks at national and international levels, as well as donors and multilateral agencies.

Also, the DRR measures can deal with current climate change and act as the first line of defence against climate change impact, which is part of adaptation (Belle, 2016). He further emphasised that for DRR to be successful, it needs to accommodate the shifting risks associated with climate change and ensure that DRR measures do not increase vulnerability to climate change in the medium to long term (Belle, 2016). Furthermore, despite these intersections, DRR addresses a

much wider range of hazards than those relating to climate change (Belle, 2016), while CCAs scope extends to issues beyond DRR, such as changes and loss of biodiversity (Twigg, 2009).

DRR and CCA have been handled as two parallel issues at international level by both the UNISDR and the UNFCCC (Mitchell & Van Aalst, 2008). At national levels the same is replicated where CCA and DRR typically have separate institutional *'cupboards'*, often ministries of environment for CCA and ministries of the interior, civil protection units or similar agencies for DRR, each with their own intersectoral coordination groups, their own channels of funding and each with separate entry points into different international agreements, mainly UNFCCC and UNISDR (Mitchell & Van Aalst, 2008). Thomalla *et al*. (2006) argue that since DRR and CCA communities have been working in isolation, they have thus failed to reduce increasing vulnerability because the scale and the underlying causes of vulnerability have often been ignored (Thomalla *et al*., 2006). However, the close relationship between DRR and CCA are interdependent to each other in such a way that one cannot talk about DRR without implicitly including CCA in the discussion. They both focus on reducing exposure to hazards, vulnerability and thus increasing resilience to the potential adverse impacts of stressors (IPCC, 2012).

The IPCC (2016) report suggested that adaptation, as well as mitigation strategies, are known to significantly reduce the risks of climate change and other non-climate change-related risks (IPCC, 2012; Mitchell & Van Aalst, 2008; World Risk Report, 2011). Belle (2016) found that the Bali Action Plan as per the report by Mitchell & Van Aalst (2008) emphasised the importance of using disaster reduction strategies and further address negative impacts associated with climate change. DRR and CCA are intertwined, but the problem lies in the recognition and approach of both. The IPCC (2012) proposes approaches to address disaster risk and adapt to climate change as indicated in Figure 2.3:



Source: Belle (2016); IPCC (2012)

Figure 2.3 Interlinked approaches to manage disaster risk and adapt to climate change

Belle (2016) and Spiekerman *et al*. (2015) acknowledged that climate change is one of the drivers of disaster risk, with CCA being included in DRR. He further indicated that the issue of whether DRR is included in CCA or *vice versa* is not clear among scientists, as the two continue to have different institutional and focal orientation at national and international levels. However, there appear to be more similarities than differences in the aims and application of DRR and CCA measures (Birkmann *et al*., 2013; Doswald & Estrella, 2015; Mitchell & Van Aalst, 2008), although the two are under different international supra-structures of UNCCC and UNISDR, respectively. Table 8.5 illustrates the general characteristics of CCA and DRR.

TABLE 2.1: GENERAL CHARACTERISTICS OF DISASTER RISK REDUCTION AND CLIMATE CHANGE ADAPTATION

Climate Change Adaptation	Disaster Risk Reduction
1. Approach	
• Risk management • Strong scientific basis • Environmental science perspective • Highly interdisciplinary • Vulnerability perspective • Long-term perspective • Global scale • Top-down	• Risk management • Engineering and natural science basis • Traditional focus on event and exposure and technological solutions • Shift from response and recovery to awareness and preparedness • Short-term but increasingly longer term • Local-scale

	• Community-based
2. Organisations and institutions	
• Intergovernmental Panel on Climate Change (IPCC) • United Nations Framework Convention on Climate Change (UNFCCC) • Academic research • National environment and energy authorities	• United Nations International Strategy for Disaster Reduction (UNISDR) • ProVention Consortium (World Bank) • International Federation of Red Cross and Red Crescent Societies (IFRC) • International, national and local civil society organisations • National civil defence authorities
3. International Conferences	
• Conference of the Parties (COP)	• World Conference on Disaster Reduction
4. Assessment	
• PCC assessment reports	• IFRC Vulnerability and Capacity Assessment (VCA) • IFRC World Disasters Report • International disasters databases: EM-DAT NatCatSERVICE (Munich Re) Sigma (Swiss Re)
5. Strategies	
• National communications to the UNFCCC • National Adaptation Plans of Action (NAPA) for Least Developed Countries	• UN International Decade for Natural Disaster Reduction (IDNDR) • Yokohama Strategy and Plan of Action for a Safer World • UN International Strategy for Disaster Reduction (ISDR) • Hyogo Framework for Action 2005−2015 • Sendai Framework for Disaster Risk Reduction 2015−2030
6. Funding	
• Special Climate Change Fund • Least Developed Countries Fund • Kyoto Protocol Adaptation Fund	• National civil defence/emergency response • International humanitarian funding (e.g., UN Office for the Coordination of Humanitarian Affairs (OCHA) • Multilateral banks • Bilateral aid
Emerging Programmes	
Ecosystem-based Adaptation (EbA)	Ecosystem-based Disaster Risk Reduction (Eco-DRR)

Source: Adopted from Belle (2016)

Belle (2016) argued that even though some of these characteristics such as academic research apportioned only to CCA can be questioned, they do paint a good picture of the two. He agreed

with Mitchell and Van Aalst (2008) that despite their overlaps, DRR is not the same as CCA. Thus, to have a better understanding of their characteristics, a summary of their similarities and differences is depicted in Table 2.2, as adapted from Belle (2016).

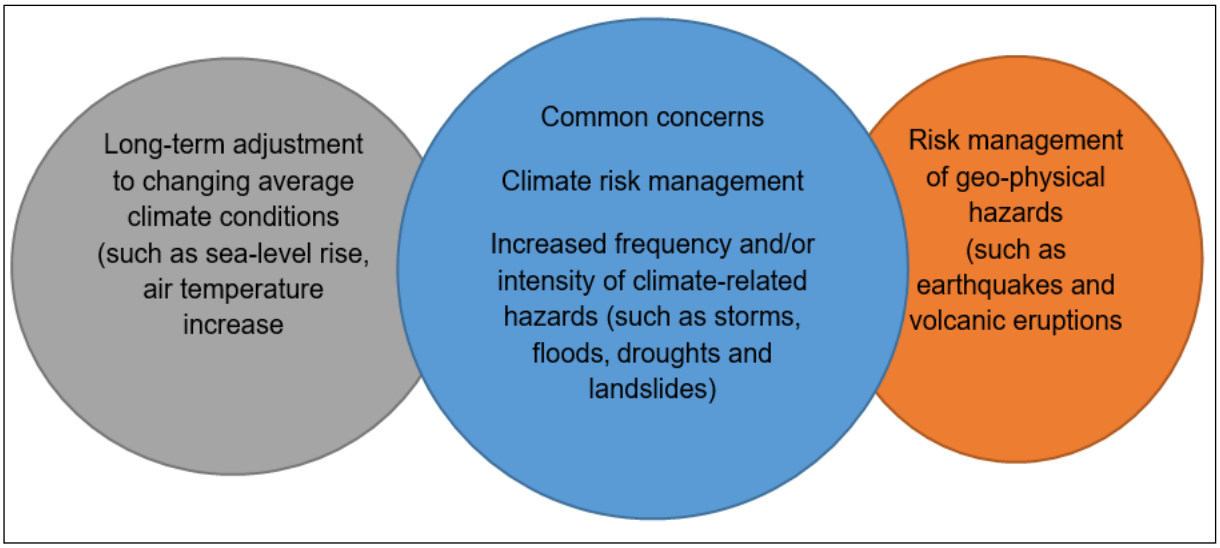
TABLE 2.2: SIMILARITIES AND DIFFERENCES BETWEEN CLIMATE CHANGE ADAPTATION AND DISASTER RISK REDUCTION

Similarities	Differences
DRR and CCA have common concerns in managing climate-related risks. DRR and CCA share a common goal of reducing vulnerability and achieving sustainable development. They share a common conceptual understanding of the components of risk (product of exposure and vulnerability to hazards) and the processes of building resilience. DRR is often the first line of protection against weather- and climate-related disasters. For DRR to be efficient, it must take into account climate-related risks or be climate-smart. Climate change adaptation specialists are now being recruited from engineering, agriculture, health and DRR sectors. DRR is increasingly forward-looking with existing climate variability as an entry point for CCA. Both are examples where the integration of scientific knowledge and traditional knowledge provides learning opportunities. There is increasing recognition that more adaptation tools are needed and must learn from DRR. DRR community now beginning to engage in CCA funding mechanisms. Both communities have developed a range of analytical tools and methodologies based on risk management approaches to assess risk and vulnerability and to identify opportunities for action. The disaster risk management community is Increasingly adopting a more anticipatory and forward-looking approach, bringing it in-line with the longer-term perspective of the climate change community on future vulnerabilities. Climate change adaptation increasingly emphasises the improvement of the capacity of governments and communities to address existing vulnerabilities to current climate variability and climatic extremes, bringing it within the remit of the disaster risk management community. For both communities, poverty reduction is an essential component of reducing vulnerability to natural hazards and climate change because poverty is both a condition and determinant of vulnerability.	DRR deals with all hazards, including hydro-meteorological and geophysical hazards, while CCA deals exclusively with climate-related hazards associated with changes in the average climate conditions. DRR tackles the risks of geophysical hazards (e.g., volcanoes and earthquakes), whereas adaptation does not. Adaptation considers the long-term adjustment to changes in mean climatic conditions, including the opportunities that this can provide, whereas DRR is predominantly interested in extreme climate events. DRR has its origin and culture in humanitarian assistance following a disaster event, while CCA had its origin and culture in scientific theory. DRR is mostly concerned with the present by addressing existing risks, while CCA is mostly concerned with the future by addressing uncertainty and new risks. For DRR traditional/indigenous knowledge at community level is a basis for resilience, while for CCA traditional/indigenous knowledge at community level may be insufficient for resilience against types and scales of risk yet to be experienced. DRR traditionally focuses on vulnerability reduction, while CCA traditionally focuses on exposure. In DRR community-based process stems from experience, while for CCA community-based process stems from policy agenda. DRR has a full range of established and developing tools, while CCA has a limited range of tools under development. DRR produces incremental development with low to moderate political interests, while CCA is a new and emerging agenda with high political interests. DRR funding streams are often *ad hoc* and insufficient, while CCA funding streams are sizeable and increasing, though still not proportionate to the size of the problem. The actors for DRR traditionally come from humanitarian sectors and civil protection, while those for CCA traditionally from the scientific and environmental community. DRR activities are generally more wide-ranging, from disaster preparedness (early warning, contingency planning), prevention, disaster response, recovery, rehabilitation and

Similarities	Differences
Both communities increasingly recognise the importance of sustainable resource management and biodiversity for ecological resilience and livelihood security. Climate change adaptation and disaster risk management both need to be linked or mainstreamed into sectoral activities and development processes.	reconstruction, while those of CCA are more restricted to prevention, mitigation, preparedness and building adaptive capacities, typically excluding post-disaster activities. Many countries prepare National Adaptation Plans (NAPs) following the Cancun Adaptation Framework adopted in 2010, while many countries prepare DRR plans following the HFA adopted in 2005 and succeeded by the SFDR adopted in 2015.

Source: Adapted from Belle (2016)

Most CCA measures, such as early warning systems, risk assessment and the sustainable use of natural resources, are in practice with DRR activities as well (Belle, 2016). Belle (2016), Doswald and Estrella (2015), as well as UNEP/UNISDR (2008) maintained that the first step towards CCA implementation is to address existing vulnerabilities to extreme climatic events. Belle (2016) further argued that DRR is all about reducing vulnerabilities because disasters entail the vulnerabilities of people, their assets, their livelihoods and their environment. There is, therefore, much convergence between the two practices and this is why both DRR and CCA were incorporated in this research, as indicated in Figure 2.8 (Belle, 2016).



Source: Belle (2016) Adapted from IFRC (2013); Mitchell & Aalst (2008)

Figure 2.4 Overlap between disaster risk reduction and climate change adaptation

2.4 The legal framework

The United Nations Framework Convention on Climate Change (UNFCCC, 2007) is a global accord that emerged from the Earth Summit (*officially known as the United Nations Conference*

on Environment and Development (UNCED)), which took place in Rio de Janeiro in 1992 (UNFCCC, 2007). It outlines strategies to lessen global warming and to deal with the unavoidable temperature increases (UNFCCC, 2007). As per Article 4 of the Convention, the industrialised countries need to provide for the LDCs with financial resources to assist them to adapt to climate change (UNFCCC, 2007).

The United Nations Framework Convention on Climate Change (UNFCCC), synonymous with the Kyoto Protocol, burdened the early action on developed countries citing common but differentiated responsibilities (Mace, 2003; Baer *et al*, 2008). The UNFCCC conditions in Article 3.1 state that *"Climate change protection must have an equitable basis in accordance with the parties, common but differentiated responsibilities and respective capacities"* (UNFCCC, 2007); also see Article 3.4. In the case of adaptation, UNFCCC through its articles 4.8 and 4.9 and 3.14 of its Kyoto Protocol states that parties are required to employ initiatives to reduce the harsh impacts of climate change on third-world countries (Belle, 2016).

2.4.1 Policy frameworks and responses to climate change adaptation in South Africa

Numerous climate change policies and regulatory frameworks are in existence in South Africa and they encompass key universal, country level and sectoral policy instruments and other regulatory frameworks that support environmental protection. Mokoena (2009) indicated that a good example is the trilateral agreement with India and Brazil that is based on the signing of the Kyoto Protocol (UNFCCC, 2011). One major part of this agreement (Kyoto Protocol) was to strengthen the trio's commitment to combating climate change impact and advancing the sustainable development goals within (UNFCCC, 2011).

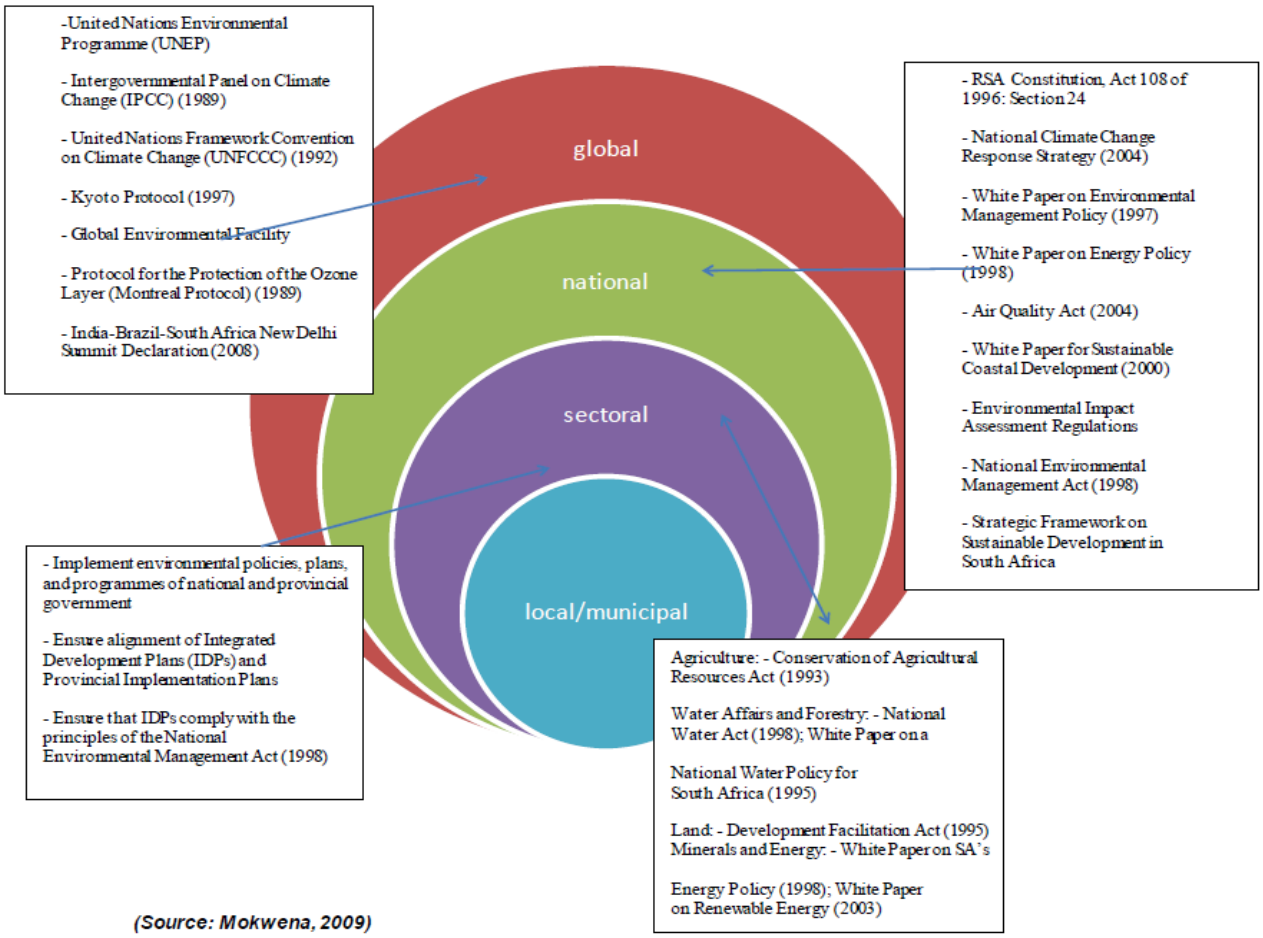


Figure 2.5 An outline of Climate Change Related Policies and Legal Acts (Mokoena, 2009)

The legal framework to respond to climate change and related environmental challenges by the Government of South Africa is provisioned for in Act 108 0f 1996 of its constitution. In South Africa, agriculture's contribution to the GDP is low compared to other sectors and this could be the reason that the country currently is more focused on main sectors contributing to economic development, resulting in some disparities in agricultural policies and strategies on climate change adaptation (UFFCCC, 2011). The South African's agricultural key guiding policies and strategies are documented in the country's Integrated Growth and Development Plan (2012). The policy addresses three out of the strategic framework's twelve targeted outcomes as per DRDLR (2012):

i) to achieve decent employment through inclusive economic growth;

ii) to have vibrant, equitable and sustainable rural communities contributing towards food security for all; and

iii) to protect and enhance the country's environmental assets and natural resources.

Adding to realising the essential challenges posed by climate change, the policy undoubtedly grips the necessity for significant public and private investments in irrigation and other innovations to enhance smallholder farmers' adaptation (DRDLR, 2012). This framework consequently is well fused with the Comprehensive Rural Development Programme (CRDP). The CRDP is a programme by the Department of Rural Development and Land Reform (DRDLR, 2012), which has its emphasis on three main pillars, namely land reform, rural transformation and development (Government Gazette of South Africa, 2009).

2.4.2 Policy context and Mandate for adaptation in South Africa

The importance of climate change has dramatically increased in the field of sustainable development, with UNDP (2007) referring to it as *"one of the defining forces shaping prospects for human development in the 21st Century"*. Furthermore, the Commission for Africa (2010) and the World Bank (2010) indicated that the unmitigated or controlled climate change impacts threaten the hard-won development gains achieved internationally since the middle of the twentieth century. According to the UNEP (2011), the crisis has led to a questioning of prevailing growth models, as well as to provide the opportunity for some stakeholders to argue for short-term expansionary policies that would simultaneously address lingering concerns about the environmental sustainability of growth over the long term.

The Rio Outcome Document emphasises that the green economy should *"contribute to eradicating poverty, as well as sustained economic growth, enhancing social inclusion, improving human welfare and creating opportunities for employment and decent work for all, while maintaining the healthy functioning of the Earth's ecosystems"* (UNCSD, 2012).

The following are pieces of legislations governing climate change adaptation in South Africa such as International Conventions and Agreements; United Nations Framework Convention on Climate Change (UNFCCC); Adoption of the Kyoto Protocol at a meeting of the UNFCCC in Kyoto, Japan in December 1997; Cop 15 outcomes in Copenhagen (2009); Cop 16 outcomes in Cancun (2010); Cop17 in Durban (2011); Cop 21-Paris Agreement; Section 24 of the Constitution of the Republic of South Africa; National Environmental Management Act

(NEMA) and Specific Environmental Management Acts (SEMAS) (e.g., NEMBA, NEMWA, NEMAQA); Sector Departments Legislation and Policies; and National Climate Change Response White Paper. An overview of legislations governing climate change adaptation in South Africa, which is in line with the International Conventions and Agreements, is presented below.

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted in 1992 during the Earth Summit in Rio de Janeiro, Brazil. Herein the UNFCCC signatory countries undertake to stabilise greenhouse gas (GHG) concentrations at a level that would prevent dangerous anthropogenic interference with the climate system. Following this historic event, the question of global warming has increasingly taken centre stage on the international agenda.

The UNFCCC came into effect on 21 March 1994, and since then, the parties have been engaged in international negotiations to strengthen the global response to climate change. The first session of the Conference of the Parties to the UNFCCC (COP1) was held in Berlin in 1995. Within this framework and to supplement the commitments made in Rio, the 3rd Conference of the Parties to the UNFCCC (COP3) adopted the Kyoto Protocol in December 1997. This obliges the parties included in Annex I of the UNFCCC (developed countries) that have ratified the Protocol to reduce the emission level of six GHGs jointly by at least 5% compared with the 1990 level in the period 2008-2012.

The Marrakech Accords, adopted in 2001, finally allowed the adoption of operationalisation modalities for the Kyoto Protocol. However, the Protocol only came into force in February 2005 and its implementation was delayed in most countries. Australia only endorsed it in December 2007, while Canada withdrew in 2011. Intending to continue to combat climate change after the first commitment period of the Kyoto Protocol (2008-2012) and formalise the contribution made by developing countries to mitigation and adaptation efforts, the parties embarked on a dialogue about long-term cooperation in 2005. COP13 (2007) provided a two-year road map on these issues known as the Bali Action Plan. This aimed to reach an agreement in 2009 in Copenhagen on a post-2012 climate regime under the Convention. However, the parties did not manage to reach a detailed agreement on the planned date.

The negotiations, therefore, continued during the next COP (in Cancún in 2010 and Durban in 2011) before being concluded in Doha in 2012. At the same time, the parties, acting as a Meeting of the Parties to the Kyoto Protocol, agreed on an amendment to the Protocol providing for GHG reduction targets during a second commitment period from 2013 to 2020.

With these decisions, the 18th Conference of the Parties (COP18) to the UNFCCC and the 8th session of the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol (CMP8) in Doha brought the mandates of the Ad Hoc Working Group under the Convention (AWG-LCA) and the Ad Hoc Working Group under the Kyoto Protocol (AWG-KP) to an end. At the same time, a new stage had commenced with the creation of the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP) in 2011. This group has been working for more than three years on preparing an agreement that it hoped would be adopted at the COP21 in Paris and expected to enter into force and be applied by 2020.

In 2015, this process resulted in the adoption of the first universal agreement on climate at COP21 in Paris. Less than one year after it was adopted, the Paris Agreement came into effect on 4 November 2016, a few days after COP22. The Marrakech Conference (COP22, 7-18 November 2016) paved the way for progress to be made for the implementation of the Paris Agreement, by setting 2018 as the target date to define the procedures to implement the said agreement. Figure 30 presents a summary of the international climate negotiations, specifically the main stages ranging from 1988-2015.

Section 24 of the Constitution of the Republic of South Africa

The environmental right is contained in the Constitution of the Republic of South Africa, Act 108 of 1996 (hereafter referred to as *"The Constitution").* Section 24 now enshrines environmental rights in South Africa. This right is interpreted to have a two-fold purpose. The first part guarantees a healthy environment for every person. The second part mandates the State to ensure compliance with the first part mentioned above. The State is prohibited from infringing on the right to environmental protection and is further required to provide protection against any harmful conduct towards the environment. Section 24 states as follows:

Everyone has the right –

(a) To an environment that is not harmful to their health or well-being; and

(b) To have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –

(i) prevent pollution and ecological degradation;

(ii) promote conservation; and

(iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

National Environmental Management Act (NEMA) and Specific Environmental Management Acts (SEMAS) (e.g., NEMBA, NEMWA, NEMAQA)

National Environmental Management Act (NEMA) 1998, (Act No. 107 of 1998), provides for cooperative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote cooperative governance and procedures for coordinating environmental functions exercised by organs of state. National Environmental Management Amendment Act 2003 (Act No. 46 of 2003), deals with compliance and enforcement and provides for Environmental Management Inspectors (EMIs).

Chapter 5 of the Act lays down procedures with which the Minister or MEC must comply before listing or delisting an activity. National Environment Laws Amendment Act 2008 (Act No. 44 of 2008), amends the National Environmental Management Act 1998, to clarify any uncertainty in the Act; authorises the Minister of Water Affairs and Forestry to designate persons as environmental management inspectors; provides for environmental management inspectors to be regarded as peace officers as contemplated in the Criminal Procedure Act 1977.

National Environmental Management: Biodiversity Act (10 of 2004) (NEM:BA)

Section 45I on the contents of biodiversity management plans provides that biodiversity management plans must be consistent with– *(v) any plans issued in terms of Chapter 3 of the National Environmental Management Act;* Section 48(1) The national biodiversity framework, a bioregional plan and a biodiversity management plan prepared in terms of this Chapter may not be in conflict with– *(a) any environmental implementation or environmental management plans prepared in terms of Chapter 3 of the National Environmental Management Act.*

Section 48(2) on coordination and alignment of biodiversity plans provides that an organ of state that must prepare an environmental implementation or environmental management plan in terms of Chapter 3 of NEMA and a municipality that must adopt an integrated development plan in terms of the Local Government: Municipal Systems Act 2000, must – *a) align its plan with the national biodiversity framework and any applicable bioregional plan; b) incorporate into that plan those provisions of the national biodiversity framework or bioregional plan that specifically apply to it; and c) demonstrate in its plan how the national biodiversity framework and any applicable bioregional plan may be implemented by that organ of state or municipality.*

National Environmental Management: Air Quality Act (39 of 2004), known as the NEM:AQA

The provinces are responsible for preparing an environmental implementation plan or environmental management plan in terms of Chapter 3 of the National Environmental Management Act and must include an air quality management plan. Section 16(1)(a) an air quality management plan must be within the domain of the relevant national department, province or municipality and seek – *i) to give effect, in respect of air quality, to Chapter 3 of the National Environmental Management Act to the extent that that Chapter is applicable to it.*

National Environmental Management: Waste Act (59 of 2008), known as the NEM:WA

Section 11 provides that: *(1) The Department and the provincial departments responsible for waste management to prepare integrated waste management plans. (2) A provincial department may incorporate its integrated waste management plan in any relevant provincial plan. (3) The Department may incorporate its integrated waste management plan in any relevant national environmental plan.*

Section 12(1)(b) on the contents of integrated waste plans, provides that an integrated waste management plan must at least, within the domain of the Department, provincial department or municipality, set out how that Department, provincial department or municipality intends— *i) to give effect, in respect of waste management, to Chapter 3 of the National Environmental Management Act.*

National Climate Change Response White Paper

The policy outlined in this White Paper embodies South Africa's commitment to a fair contribution to stabilising global GHG concentrations in the atmosphere and to protecting the country and its people from the impacts of inevitable climate change. The White Paper presents the South African Government's vision for an effective climate change response and their plans for the long-term, including the transition to a climate-resilient and lower-carbon economy and society. South Africa's response to climate change has two objectives:

- Effectively manage inevitable climate change impacts through interventions that build and sustain South Africa's social, economic and environmental resilience and emergency response capacity.
- Make a fair contribution to the global effort to stabilise greenhouse gas (GHG) concentrations in the atmosphere at a level that avoids dangerous anthropogenic interference with the climate system within a timeframe that enables economic, social and environmental development to proceed sustainably.

This response is guided by principles set out in the Constitution, the Bill of Rights, the National Environmental Management Act, the Millennium Declaration and the United Nations Framework Convention on Climate Change. These principles are detailed in Section 3. The overall strategic approach for South Africa's climate change response is needs-driven and customised, developmental, transformational, empowering and participatory, dynamic and evidence-based, balanced and cost-effective, as well as integrated and aligned.

In terms of strategic priorities, the White Paper sets out South Africa's climate change response strategy to achieve the National Climate Change Response Objective in a manner consistent with the outlined principles and approach and which is structured around the following strategic priorities: risk reduction and management; mitigation actions with significant outcomes; sectoral responses; policy and regulatory alignment; informed decision-making and planning; integrated planning; technology research, development and innovation; facilitated behaviour change; behaviour change through choice; and resource mobilisation. The key elements in the overall approach to mitigation will be:

- Notwithstanding these ongoing international negotiations, reaffirms that, in terms of the provisions of Articles 4, 5, 6 and 12 of the UNFCCC, as well as Article 10 of the Kyoto Protocol, South Africa already has existing international legally binding obligations to:
- Formulate, implement, publish and regularly update policies, measures and programmes to mitigate its emission of GHGs and adapt to the adverse effects of inevitable climate change;
- Monitor and periodically report to the international community the country's GHG inventory; steps taken and envisaged to implement the UNFCCC; and any other information relevant to the achievement of the objective of the UNFCCC, including information relevant for the calculation of global emission trends;
- Sustainably manage, conserve and enhance GHG sinks and reservoirs, including terrestrial, coastal and marine ecosystems, biomass, forests and oceans;
- Develop climate change response plans to address integrated coastal zone, water resources, agriculture and land protection and rehabilitation;
- Mainstream climate change considerations into social, economic and environmental policy;
- Promote and cooperate in the development, application, diffusion and transfer of GHG emission mitigation technologies, practices and processes; and
- Develop and implement education, training and public awareness programmes on climate change and its effects to promote and facilitate scientific, technical and managerial skills, as well as public access to information, public awareness of and participation in addressing climate change.

2.5 Evaluation of South African Land Reform situation in South Africa

Descriptions of land compensation, land reallocation and land tenure restructuring are provided. Also, the Land Reform Programmes are assessed to determine whether the Land Reform Programme in South Africa is delivering results or deteriorating.

2.5.1 Evaluating Land Restitution

The nature and extent of the problem to address inland compensation are enormous and intricate, as this agenda concentrates on reinstating land back to persons who have been evicted off their

land rights since 1913, under racially selective laws. The populace is categorised as Blacks and Coloureds in South Africa (Department of Land Affairs, 1997). The compensation procedure got underway not targeting to meet any mark for the redeployment of land, with fruitful land claims possibly being settled with returning land, alternative land and various forms of recompense or reimbursement of cash (Department of Land Affairs, 1997).

Thus, well-organised organisational aid would be desired and ought to be given to the applicants. Some applicants regrettably lack the information and comprehension of the compensation claiming procedure (Department of Land Affairs, 1997). The Land Restitution Programme has a plan in place, according to the White Paper on South African Land Affairs (RSA, 1997); Government has set itself the following time limits:

- A 3-year retro for the lodgement of entitlements;
- A 5-year retro for the Directive and the Law court to decide all entitlements; and
- A 10-year passé for the application of all Law court commands.

Thus, the Regime must have well-organised and operative service delivery provisions and outlines in place to deliver services to the persons (Department of Land Affairs, 1997). The clientele to be attended is Black, Coloured and Indian persons or relations who were dispossessed of their land since 1913. The services provided to the clientele are as follows:

- *The Dispensation of Land Rights:* The Directive would aid with support applicants with creation rights; constructing entitlements precedence and support in promulgation the Land Compensation procedure;
- *Implementation of Court Orders:* Court instructions will be executed by the subdivision and the subdivision will supervise the application of the law court instructions;
- *Claims outside the Restitution of Land Rights Act:* Events for rights that are not in the Act will be attended to by the subdivision; and
- *Communication:* Communiqué is of standing and the subdivision will broadcast the compensation procedure (White Paper on South African Land Affairs, 1997).

2.5.2 Evaluating Land Redistribution

The nature and extent of the problem that the Land Redistribution Programme needs to address have demonstrated to be intricate (Anseeuw & Mathebula, 2008). The features of the populace in

need are: persons must be underprivileged and deprived persons must be city and countryside very poor, women, labour tenants and farmworkers, Black, Coloured and Indian farmers, as well as new contestants in agriculture. Redistributive land restructuring is based on willing-buyer and willing-seller provisions (Anseeuw & Mathebula, 2008). Those that need to be assisted by the Land Redistribution Programme are: formerly underprivileged, countryside and city poor, Black farmers, Coloured farmers, Indian farmers, labour tenants and new entrants into the agricultural market (Cousins, 2009).

These individuals thus differ significantly and the services offered to them might pose challenging to develop, resulting in difficulties, if not performed correctly (Cousins, 2009). Government offers help to people in need such as land attainment, transference, help with elementary desires facility and land growth. Assistance to permit recipients to meet elementary requirements and exploit the land in a maintainable means is also desired (Cousins, 2009). From 2005 to 2009, there has been a stable upsurge in reallocating land (291 155 hectares) to recipients. The Land Redistribution Programme attempted to support recipients in refining existing ideals, as well as trying to advance income safety and employment (Cousins, 2009). The mark up to 2007 was established at 19 728 million ha, thus leaving a deficit of 17 429 million hectares of land that must have been reallocated.

2.6 Chapter Summary

This chapter presented the conceptual, theoretical and legal frameworks related to climate change adaptation, DRR and agriculture. The chapter also included discussions about the concept of adaptation and disaster risk reduction (DRR) as being interdependent. Furthermore, conventional farming practices have contributed to the environmental challenges the world is facing today and adopting such measures mentioned above will ensure that the Sustainable Development Goals and MDG are met and achieved.

This chapter examined the constraints confronting smallholder farmers in South Africa. It also explored the linkages of adaptation, disaster risk reduction and agriculture. The key highlights of this chapter include land reform programme pillars, characteristics, similarities and differences between disaster risk deduction and climate change adaptation and the legal framework, which constitutes different pieces of legislations governing climate change in South Africa. This

chapter also presented discussions about smallholder farming that should be encouraged and supported by the South Africa government as it has the potential to fight poverty, promote rural economic development and combat environmental degradation through sustainable farming.

CHAPTER THREE: LITERATURE REVIEW

3.1. Overview of Climate Change adaptation in South Africa

The understanding of climate change has been growing and today, scientists are 95% certain that the perceived increases in global temperature are mostly caused by the concentration of Greenhouse Gases (GHGs) in the atmosphere, including other human activities (IPCC, 2014). The ARC (2015) report indicated that most of the GHGs are present in the atmosphere in small proportions; however, since the industrial revolution, their concentration has notably increased (ARC, 2015). The ARC (2015) report indicated that this rise has primarily been linked to the combustion of fossil fuels driven by the demand for energy, goods and services and to the conversion of natural ecosystems to intensive land use.

The globally averaged surface temperature shows a warming of 0.85°C over the last 30 years (IPCC, 2014). Mitigation plans for a substantial emission reduction of GHG are needed around the globe to limit the warming below 2°C (DEA, 2013). South Africa may be one of the few African countries that could contribute to mitigating climate change, as its carbon intensity economy places the country at the number 12 contributor world wide of Co2 emissions (WDI, 2011). Any change in this average weather over a long period, which can be attributed to either natural variability or human activities, is, therefore, identified as climate change (ADB 2015; UNFCCC, 2011; WWF, 2015; IPCC, 2013). Due to the rising levels of Co2 and other heat-trapping gases in the atmosphere, the world today is characterised by vagaries that include extreme temperatures, floods, droughts, storms and rising sea levels (Mulkern & Climate-Wire, 2013; UNFCCC, 2011; DEA, 2010).

The IPCC (2013) reported that these climatic changes negatively impact people's livelihoods and other natural resources, including freshwater supply and agriculture, which are crucial for their survival. These negative impacts of climate change are especially felt by the smallholder farmers who comprise the vulnerable rural groups who mostly depend on agriculture for their livelihoods (Osbahr *et al.*, 2010 (2013). As compared with commercial farmers, rural smallholder farmers' adaptation to climate change is aggravated by their characteristics, which include weak

institutions, the already degraded ecosystems, low levels of primary health care, low incomes, low education levels and lack of markets and infrastructure (Osbar *et al.*, 2010). Apata *et al.* (2009) maintain that smallholder farmers in semi-arid regions exercise mostly a rain-fed type of farming and have limited or no access to irrigation services. In areas such as these, rainfall is unequally spread with an average yearly rainfall of about 500mm or less resulting in poor moisture available for crops and resulting in little harvest and amplified susceptibility of the smallholder farmers (Churi *et al.*, 2013).

South African smallholder farmers are resource-poor and lack institutional support as they receive no assistance from extension officers, thus it is hard for them to manage and become accustomed (Mudhara, 2013). Consequently, smallholder farmers have more exposure to climatic shocks, which might worsen their susceptibility. On the opposite, the business farmers are incorporating fresh tactics such as diversification of crops, shifting planting and harvesting dates as appropriate adjustment tactics to climate change, as well as obtaining infrastructural and knowledge management support systems from the government (Below *et al*., 2010). However, even beyond the 21st century, climate change threatens to be the main danger to smallholder farming systems and food security (IPCC, 2013).

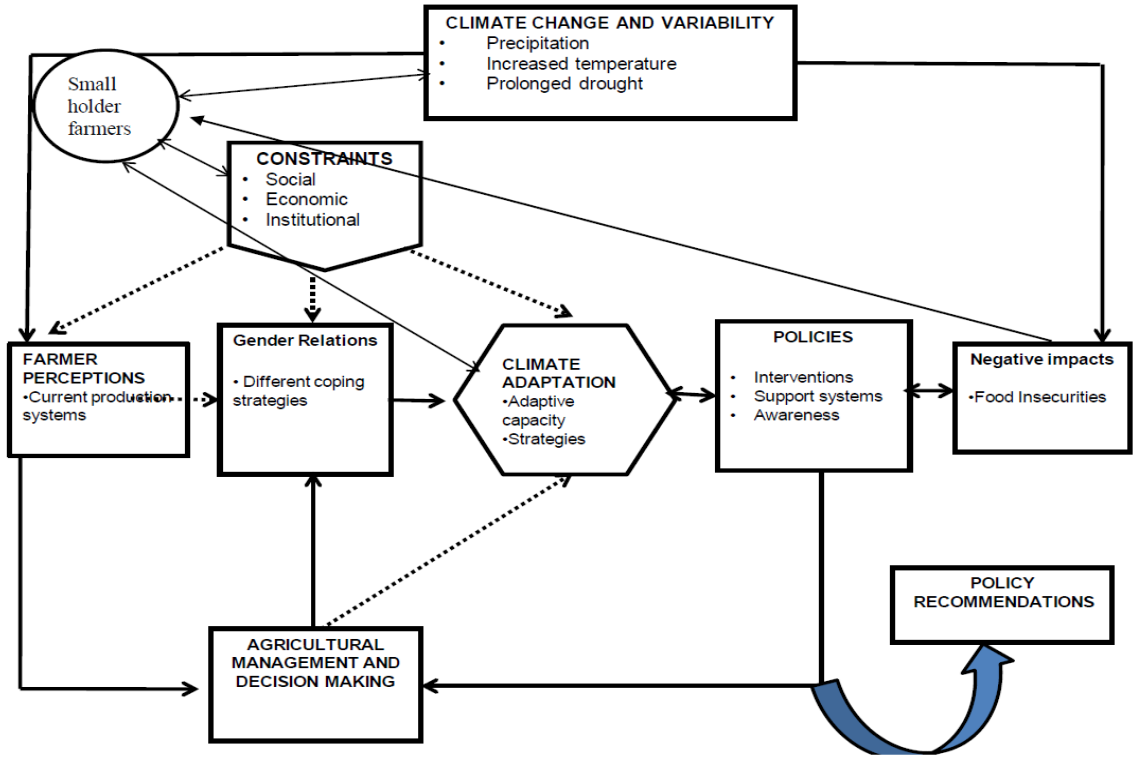


Figure 3.1: Adapted climatic change conceptual Framework – (Adapted from Agrawal, 1995)

Figure 3.1 above illustrates the relationship presented in climate change and variability and smallholder farmers and further links it to their social, economic and institutional constraints. It further shows that the smallholder farmers' production system is negatively affected by climate change and variability.

3.2 Climate change in Southern Africa

According to Stoker *et al.* (2013), the body of knowledge of historical climate trends has been steadily and continuously increasing during the last decade. They further indicated by supporting the latter statement that global mean annual temperatures have increased by 0.85°C since 1880 and are projected to increase by 0.3 to 2.5 °C by 2050, relative to the 1985-2005 climatological average (Stocker *et al.,* 2013). The regional distribution of temperature increase is not uniform, however, with some regions experiencing greater change than others. For the African continent, the recent studies of Jones *et al.* (2012) and Engelbrecht *et al.* (2015) are indicative of drastic increases in surface temperature (twice the global rate of temperature increase).

Over southern Africa, a decrease in late summer rainfall has been reported over the western regions including Namibia and Angola (Niang *et al.,* 2014). Southern Africa has a warm climate, with the greater part of the region experiencing an average annual temperature above 17°C. In summer, temperatures are highest over the desert regions of Namibia and Botswana and exceed 40°C during the day (Engelbrecht *et al.,* 2015).

Recent studies for South Africa have detected decreases in rainfall and the number of rainfall days over parts of the country (MacKellar *et al.,* 2014). Between 1960 and 2010, decreases in rainfall and the number of rainfall days have been observed over parts of the country (MacKellar *et al.,* 2014). Positive trends in annual rainfall totals over the southern interior of the country and a drying trend in the north and north-east were observed for the period 1921 to 2015 (Engelbrecht *et al*., 2016).

3.2.1 South Africa: Local Climate

South Africa is divided into 11 climatic regions (see Figure 3.2). The average annual rainfall is 495 mm (<100 mm/year in the western deserts and 1200 mm/year in the east). Only 35% of the country has a precipitation of 500 mm or more, while 44% has a precipitation of 200-500 mm and 21% has a precipitation of less than 200 mm (CSRRSA, 2012). Figure 3.2 shows the seasonality variation during the two rainy seasons; winter in the southwest and eastern coastal regions, and summer for the eastern half of the country (CSRRSA, 2012). The temperatures indicate considerable seasonal variation, but the annual means are generally temperate (see Figure 3.3).

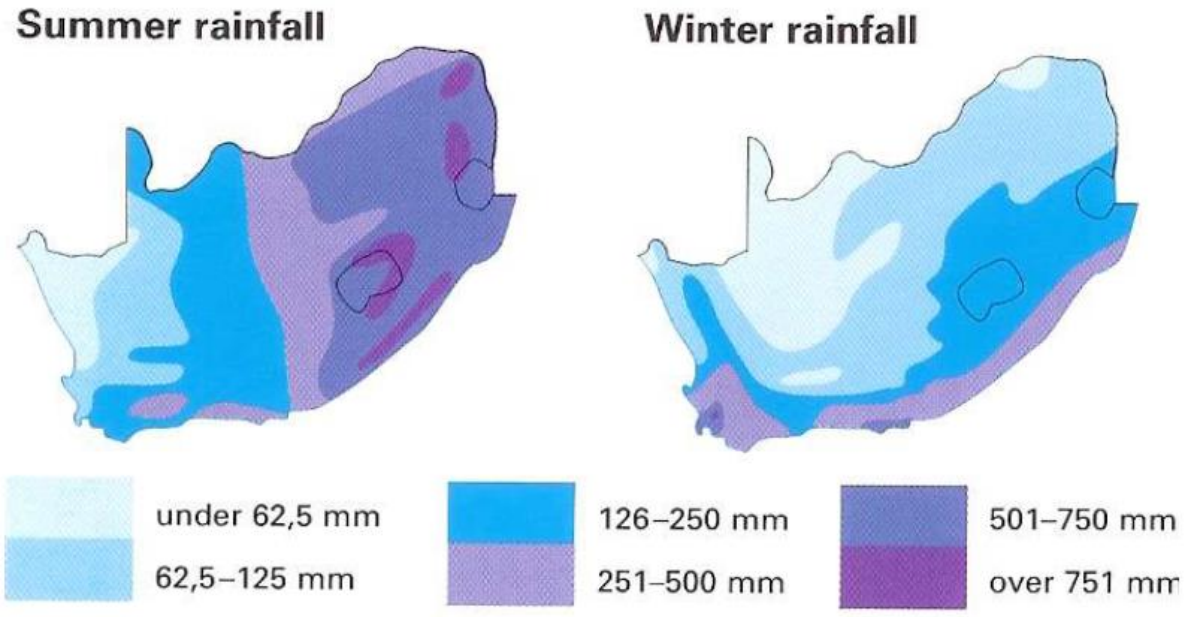


Figure 3.2: Rainfall seasonality (source: http://www.suncape.com/maps.php?ln=en)

Summer temperatures vary from 15ºC at night to 30ºC at noon (October to March) and winter temperatures range between 0ºC at night and 18ºC at noon (April to September). Winter temperatures in the interior often drop below zero and frost is common (CSRRSA, 2012).

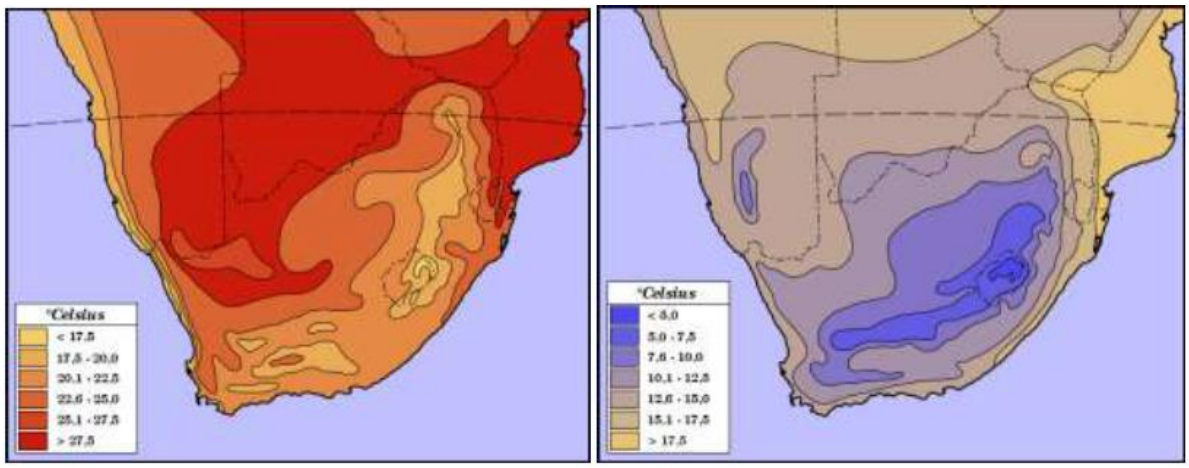


Figure 3.3: Average Temperature January and July– South Africa (Source http://www.suncape.com/maps.php?ln=en)

Defining and monitoring drought is a difficult task due to its diverse geographical and temporal distribution (SAWS, 2015). The South African Weather Services (2015) reported that based on rainfall events projected, the *Standardised Precipitation Index* is the most used tool to investigate drought. The SPI illustrates the deviation of rainfall events in a selected time scale from the long-term mean. An example of SPI calculated for South Africa is displayed in Figure 3.4.

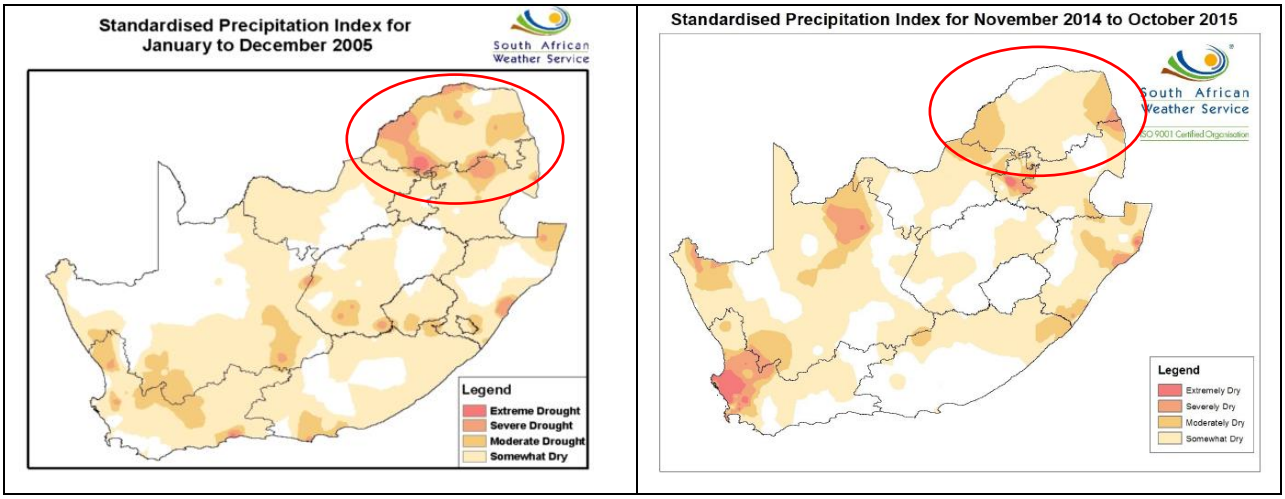


Figure 3.4 Standardised Precipitation Index for South Africa for period January-December 2005 (left), November 2014-October2015, *(SAWS, 2015)*

3.3 Climate change and the rural agricultural communities

The agricultural sector remains at the centre of emerging nations' financial prudence. It shows a serious character in food safety for all anthropological existences. Despite their developmental

meaning, the rural societies are similarly characterised by poverty and demotion, which exacerbate and are intensified by the special effects of climatic variations, periodic variations and doubt produced by climate variation (FAO, 2011).

Smallholder farmers in other areas tend to momentarily benefit from the consequences of Co2 emissions in the form of higher yields, according to FAO (2011). This is contrary to the universal understanding that effects of climate change are usually unpleasant, especially for the underprivileged and peripheral communities who happen to make up the majority population of countryside agricultural societies (FAO, 2011). The main reason being the rural, smallholder farmers that are dependent on the fragile agricultural activities for their means of livelihoods and they are in areas of high environmental risk and climatic exposure and easily affected by natural hazards (FAO, 2011).

Furthermore, the survival of these societies is mostly resource-based. More powerful and unsure climate patterns coupled with tremendous occurrences such as drought and floods add to the depletion of water sources, land degradation, desertification, deforestation, infrastructural and social damage, for example (FAO, 2011). This not only erodes local income but eventually influences the capability of the farming communities to find an answer to the threats being instituted by climate change (FAO, 2011). It incorporates the sustainable development of economic, social and environmental by equally tackling climate change and food security challenges (FAO, 2011).

The FAO (2010) indicated that climate-sensitive farming is a move towards expanding the policy, technical and investment environs to attain sustainable farming development for food safety under climate change. The climate-sensitive farming system is intended to identify and operational sustainable farming growth within the clear premises of climate alteration (FAO, 2010).

3.4 Smallholders farmers perception on climate change

Smallholder farmers' adaptation choices of decisions are guided by their perception of climate change and climate-related disaster risks (Moyo *et al.*, 2012). They (smallholder farmers) need to

identify the changes already taking place in their farms and institute various coping and climate change adaptation strategies. Moyo *et al.* (2012) and Kihupi *et al.* (2015) highlighted a smallholder farmer's ability to perceive climate as a pre-requisite for their choice to cope and adapt. Therefore, coping and adaptation strategies of smallholder farmers depend largely on their perception knowledge level on climate change (Kihupi *et al.,* 2015).

It is in this regard that adaptation to climate change requires smallholder farmers first to realise that the climate has changed and they need to identify and implement potential useful adaptations. Consequently, without adaptation, the vulnerability of rural smallholder farmer's households that depend mostly on agriculture would increase with climate variability. However, these smallholder farming communities have coped and adapted to the effects of climate change over the years (Li *et al.,* 2013). This creates the need for understanding the perception and choice of the smallholder farmers' decisions to adapt to climate change and the impacts of climate change at the local level (Shemdoe, 2011; Kassie *et al.,* 2013).

3.5 Climate Change adaptation strategies used by smallholder farmers

Numerous researches that investigate smallholder farmers' adaptation to climate change have been performed globally (Deressa *et al*., 2009; Mertz *et al*., 2009; Hisali *et al*., 2011; Kemausuor *et al*., 2011; Below *et al.,* 2012). They have concluded that indeed farmers perceive climate change and are consequently employing some adaptation strategies to mitigate the impact. Below *et al,* (2010) have identified a couple of these adaptation strategies, generally characterised as government intervention, diversification of farm and off-farm activities, farm technical and financial management, knowledge management and networks and governance (Osbahr *et al.,* 2010). The most common adaptation strategies employed by farmers in the continent are crop varieties and livelihoods even though the actual choice of these options is influenced by different contextual factors (Gbetibouo *et al.,* 2010; Hisali *et al.,* 2011; Below *et al.,* 2012).

More adaptation strategies comprise of shifting planting dates, use of different crop varieties, diversification of activities or completely shifting to off-farm activities, mixed cropping and mixed farming (Gbetibouo *et al.,* 2010). In some cases, farmers change crops completely to those that are heat tolerant. Furthermore, various studies have shown that amongst the smallholder farmers, there is a tendency of adopting the generally inexpensive strategies such as shifting

planting dates and crop diversification as compared to the capital-intensive ones such as the introduction of irrigation (Below *et al.*, 2012).

However, IFAD (2010) emphasises that adaptation alone cannot avoid all climate change impacts; there is a need for awareness as well to support local communities in dealing with this phenomenon fully. According to Osbahr *et al.* (2010), for an adaptive action to be regarded as a success, it needs to be able to sustain collective action and to encourage system resilience and authentic institutional transformation. Below *et al.* (2010) and Osbahr *et al.* (2010) further argue that any interventions from externals that seek to enhance the communities' adaptation must be those that complement the farmers' own strategies.

3.6 The South African Climate Change Response Strategy

Responses to climate change have been commonly categorised as either aimed at reducing the rate at which climate is changing to levels that occur naturally (and especially reducing the atmospheric concentrations of GHGs, so-called "mitigation") or responding to the adverse effects of climate change *("adaptation").* In addition, there is also the issue of managing any unintended negative consequences of climate change policies and measures, widely referred to as "response measures", on other countries. However, an effective South African climate change response requires economic, social and environmental interventions that integrate mitigation and adaptation elements within a developmental framework.

Furthermore, an effective South African climate change response requires management to respond to the response measures of other countries that could have negative consequences for the country. Categorising responses as either mitigation or adaptation responses can obscure the real and potential positive combined impact of these responses. Thus, although this policy still retains the mitigation and adaptation categories for the sake of clarity, the policy also reflects a strategic approach referred to as *"climate change resilient development"* (UNFCCC, 2017).

For further clarity, the climate change response makes use of the following time-bound planning perspectives:

- Short-term – five years from the date of publication of the policy.

- Medium-term – twenty years from the date of publication of the policy.
- Long-term – a planning perspective that extends to 2050.

3.6.1 Overall Approach towards implementing the CCA Strategy

Climate change resilient development refers to all interventions – mitigation, adaptation or both that contribute to a fair and effective global solution to the climate change challenge while simultaneously building and maintaining South Africa's international competitiveness, its social, environmental and economic resilience to the adverse effects of global climate change and any unintended consequences of global climate change response measures.

In this regard, the policy develops a *"win-win"* strategic approach that is:

- *Needs-driven and customised* – Employing a wide range of different types of adaptation and mitigation approaches, policies, measures, programmes, interventions and actions consistent with the principles outlined above, in particular meeting the special needs and circumstances of those most vulnerable, as well as being specifically tailored to the potential, best available solutions and other relevant conditions related to the specific actor, organisation, sector or sub-sector concerned;
- *Developmental* – Prioritising climate change responses that have both significant mitigation and adaptation benefits, with significant economic growth, job creation, public health, risk management and poverty alleviation benefits;
- *Transformational, empowering and participatory* – Implementing policies and measures to address climate change at a "scale of economy" that enables and supports the required level of innovation, sector and skills development, finance and investment flows needed to reap the full benefit of a transition to a lower-carbon, efficient, job-creating, equitable and competitive economy. This policy is, therefore, part of the broader social and economic transformation as envisaged by the New Growth Path (NGP) and is fundamentally underpinned by a major shift towards sustainable consumption and production patterns, which decouples growth and development from any negative impacts on the environment and society;

- *Dynamic and evidence-based* – Recognising that this policy has not been developed in a vacuum and many sectors have already researched and had experience in implementing policies and measures to address the challenges of climate change.
- Therefore, this policy takes an approach of immediate implementation of near-term priority flagship programmes comprising of continued implementation of existing successful policies and measures with only policy alignment and integration intervention needed.
- Scaled-up roll-out of those existing successful policies and measures, which have completed a demonstration phase, where feasible; Implementation of proven "no-regret policies and measures" in the immediate and near-term (e.g., best available technologies and best practices), particularly those that are well researched or understood, have socioeconomic developmental and job creation benefits and negative-cost, zero-cost or low-cost implications for the economy and society;
- Simultaneously, further researching, consulting on, developing and demonstrating the detail of additional policies and measures consistent with the provisions of this policy, for implementation in the short-, medium- and longer-term, as and when ready; and
- Rigorously monitoring and evaluating the effectiveness of implemented policies and measures to improve efficiency through adjustments or discard those that are ineffective;
- *Balanced and cost-effective* – Implementing a balanced approach to both climate change mitigation and adaptation responses in terms of cost-benefit, prioritisation, focus, action and resource allocation; and
- *Integrated and aligned* – Providing for the integration of sector-related climate change responses into the relevant sector planning processes and their developmental policies and measures. Where cross-cutting climate change responses are called for, this policy provides for their inclusion in, and consideration by, the relevant national, provincial and/or local planning regime, as well as coherent alignment with the relevant policies and legislation.

3.6.2 Strategic Priorities towards implementing CCA strategies

This White Paper sets out South Africa's climate change response strategy to achieve the National Climate Change Response Objective in a manner consistent with the principles and

approach outlined above and which is structured around the following strategic priorities (UNFCCC, 2017):

- *Risk reduction and management* – prioritise near-term adaptation interventions that address immediate and observed threats to the economy, ecosystem services and the health and well-being of South Africans, while researching and developing short-, medium- and longer-term climate resilience, risk and vulnerability management policies and measures.
- *Mitigation actions with significant outcomes* – prioritise cost-effective and beneficial mitigation policies, measures and interventions that significantly contribute to the country's deviation from the GHG emission *"business as usual trajectory"* as measured against a benchmark "peak, plateau and decline" GHG emission trajectory where GHG emissions peak between 2020 and 2025, plateau for approximately a decade and begin declining in absolute terms after that.
- *Sectoral responses* – prioritise, following the provisions of this policy, the requirement for all key actors, organisations or participants in relevant sectors or sub-sectors to prepare, submit, implement, monitor and report the implementation of detailed climate change response strategies and action plans that clearly articulate their roles, responsibilities, policies, measures and interventions or actions to contribute to the achievement of the National Climate Change Response Objective in a measurable way.
- *Policy and regulatory alignment – firstly,* prioritise interventions already envisaged by national policies, legislation or strategies that have climate change co-benefits, particularly those that contribute towards the national priorities of job creation, poverty alleviation or have other positive socio-economic benefits. *Secondly,* review existing national policies, legislation or strategies, to optimise and maximise the climate change co-benefits of their interventions. *Thirdly,* integrate into the relevant existing or new policies, legislation or strategies those climate change response interventions that stimulate new economic activities, as well as those that improve the efficiency and competitive advantage of existing activities.
- *Integrated planning* – prioritise the mainstreaming of climate change considerations and responses into all relevant sector, national, provincial and local planning regimes such as but not limited to, the Industrial Policy Action Plan, Integrated Resource Plan for

Electricity Generation, Provincial Growth and Development Plans and Integrated Development Plans.

- *Informed decision-making and planning* – prioritise research, systemic observation, knowledge generation, information management and early warning systems that increase one's ability to measure and predict climate change and the implications of its adverse effects on the economy, society and the environment.
- *Technology research, development and innovation* – prioritise cooperation and the promotion of research, investment in and/or acquisition of adaptation, lower-carbon and energy-efficient technologies, practices and processes for employment by existing or new sectors or sub-sectors.
- *Facilitated behaviour change* – prioritise the use of incentives and disincentives, including regulatory, economic and fiscal measures, to promote behaviour change towards a lower-carbon society and economy.
- *Behaviour change through choice* – prioritise education, training and public awareness programmes to build the general public's awareness of climate change to empower all South Africans to make informed choices that contribute to an economy and society that is resilient to climate change.
- *Resource mobilisation* – prioritise the development of comprehensive resource and investment mobilisation strategies, capacities, mechanisms or instruments that support and enable implementation of climate change responses at the scale required, including, but not limited to, public and private financial resources, incentives, non-market and market-based instruments, technical cooperation and partnership agreements, as well as technology transfers at domestic, sub-regional, regional and international levels.

3.7 Climate Change interventions and support systems for smallholder farmers in South Africa

Governments, climate change scientists and international organisations are agitating for adaptation as an appropriate sustainable reaction to the impacts of climate change. There is an imperative necessity to shift towards climate-smart farming, which can be attainable by creating and fostering policy-friendly settings for adaptation (IIED, 2013). As stated earlier, adaptation entails identifying and coping with the consequences of climate change. It cannot be treated in

isolation as a phenomenon independent of other policies and institutional imperatives (Osbahr *et al.*, 2010).

This notion is supported by the International Institute for Environment and Development (IIED) report (2013), which encourages serious participation of farming communities, as well as efficient public involvement in developing national policy. According to Policy Brief (2013), there is a pressing need for the assistance of South Africa's execution of adaptation methods that improve agriculture and farmers 'resilience for increased food security. This can be achieved by efficient exploitation of native information and maximum stakeholder commitment in decision-making processes.

3.8 Chapter Summary

This chapter encompassed a literature review related to climate change adaptation in South Africa. The chapter illustrated that the concept of adaptation and disaster risk reduction are interdependent. This chapter also examined the constraints confronting smallholder farmers in South Africa. The key highlights of this literature review entailed smallholder farmers being faced with enormous problems that include lack of land, lack of support from the government, farming in fragile and infertile land and lack of access to loans and markets. This chapter also presented a discussion about smallholder farming that has to be encouraged and supported by the South Africa government as it has the potential to fight poverty, promote rural economic development and combat environmental degradation through sustainable farming.

Furthermore, this chapter provides the general background to the more specific literature covered in the result chapters that follow in Chapter 7. The first part of the literature review provides an overview of the causes of climate change in South Africa, its adverse effects on socio-economic development activities by focusing on agriculture globally and to the southern and South African context.

This is followed by issues addressing perception on climate change and CCA strategies, as well as the response strategy in South Africa. This is followed by a discussion about how South Africa approach CC effects and their strategic priorities in implementing the strategy. The later sections concern the South African context by addressing issues related to agriculture and

climate change, climate and weather systems, agro-ecological features of the country, past and future trends of climate change in the country, and also the interventions and support system for smallholder farmers in South Africa's response to climate change.

CHAPTER FOUR: THE CONTEXT OF LAND REFORM IN SOUTH AFRICA

4.1 Overview of land reform in South Africa

According to Boyce *et al.* (2005), land reform is defined as *"the reallocation of rights to establish a more equitable distribution of farmland"* and further argue that it can be a strategy which is powerful in the promotion of the development of economy, its transformation and environmental quality (2005:1). Adams (2000: ii), however, defines land reform as the *"redistribution and confirmation of rights in land for the benefit of the poor"*. It has become a tendency across the world that smallholder farmers grow larger inputs per hectare than large farms. Boyce *et al.* (2005) further perceive with caution that when a family of farmers has secured land rights, they tend to be more cautious about damaging the environment, they protect it and improve soil fertility, the quality of water, as well as biodiversity (Boyce *et al.*, 2005).

Klopper and Pienaar (2014) reported that post-apartheid South Africa faces a variety of challenges that emanated from the injustices caused by apartheid before the 1994 democratic elections of South Africa. One of the earliest challenges faced by the first democratically elected government of South Africa was how to address the unequal distribution of land in the country. The South African government through the ruling party, African National Congress (ANC) has shown commitment to eradicate the inequalities and injustices of the past and has initiated a comprehensive land reform programme with a strong constitutional basis (a programme which has to date not been concluded); the programme consists of three pillars, namely restitution, land redistribution and tenure security (Klopper & Pienaar, 2014).

The constitutional basis for the land restitution programme is found in Section 25(7) of the Constitution (Republic of South Africa, 1996), which states that: "*A person or community dispossessed of property after 19 June 1913 because of past racially discriminatory laws or practices is entitled to the extent provided by an Act of Parliament, either to restitution of that property or to equitable redress".* Similarly, Section 25(5) of the Constitution introduced the second pillar of land reform, which is commonly referred to as the Land Redistribution programme. In terms of this section, the state is under the constitutional obligation to take

"reasonable legislative and other measures, within its available resources to foster conditions which enable citizens to gain access to land on an equitable basis" (RSA, 1996).

However, the slow pace of these two land reform programmes is not the only challenge faced by the government of South Africa (Kloppers, 2012). SAPA (2010) reported that more than 90% of agricultural land transferred in terms of these two programmes is not being used productively (SAPA 2010). This situation is not only contributing to increasing levels of poverty and unemployment among these smallholder farmers but also threatens food security (SAPA, 2010). A factor that further compounds the crisis is the recent calls by different political parties and politicians inciting landless South Africans to illegally occupy land owned by White farmers, creating a potentially volatile situation. These challenges faced by DRDLR are in urgent need of attention.

Furthermore, a progressive change process ought to profit both smallholder farmers and up-and-coming African commercial farmers who must be equipped with the appropriate expertise to help them not only to own land but to also contribute to food safety within the state (Moyo, 2013). The outcome of the ANC (2016) Lekgotla indicated that the apartheid administration had equated state food safety with large-scale commercial farming, a division dominated by the White population. The resolution outcome further indicated that the prospect for millions of African smallholders' farmers to increase manufacture, increase earnings and generate greatly required jobs was ignored (ANC, 2016).

South Africa had put into practice land restructuring since 1994, when the Land Redistribution Programme was initiated to permit persons and grouping to acquire a Settlement Land Acquisition Grant (SLAG) (DRDLR, 2012). In 2012 the Land Redistribution for Agricultural Development (LRAD) grant was established by the Department of Rural Development and Land reform to institute and encourage up-and-coming Black farmers. However, the sluggish speed of land restructuring, as highlighted at the 2005 Land Summit, led to the initiation of the Proactive Land Acquisition Strategy (PLAS), which was meant to speed up land reform relocation (DRDLR, 2012).

This chapter will explore the approaches to land reform, as well as an overview of an international perspective on land reform with special reference to the Philippines, Mexico, Malawi and Zimbabwe and the subsequent lessons learned. The researcher will, therefore, conclude this chapter by exploring the prominent features of the land reform programme, including the policy and legislative requirements of land reform in South Africa.

4.2 Approaches to land reform

The implementation of land reform around the world has been dominated by two different modus operandi, namely one that places more importance on economic development than any other aspect of land reform and the other being more concerned with human rights (EI-Ghonemy, 2001).

These different approaches to land reform have displayed themselves as land market reform and redistributive land reform, respectively. The Food Agriculture Organisation (FAO, 1998) reported that redistributive land reform is a process where land is taken from commercial farmers and given to the landless poor and previously disadvantaged communities. El-Ghonemy (2001) also support redistributive land reform as it promotes social transformation and poverty alleviation especially since land market reform is out of reach as the poor battle to afford land at market prices.

Redistributive land reform can reduce poverty by triggering increased agricultural production (2004). According to El-Ghonemy (2001), redistributive land reform has been very successful in several countries such as Egypt, China, South Korea and India. El-Ghonemy (2001) demonstrated that in South Korea, poverty dropped by 50% as a result of successful redistributive land reform. Land market reform or market-led reform, also known as the willing-buyer/willing-seller approach in South Africa. According to El-Ghonemy (2001) and Karumbidza (2002), this is presently the most common mode of conducting land reforms.

The global market has pressured governments to opt for land market reform (El-Ghonemy, 2001). Karumbidza (2002) highlighted that the International Monetary Fund and the World Bank had played a role in the deregulation of land markets. They have ensured that the loan applications were declined unless their circumstances of land market *'liberalisation'* were recognised (El-Ghonemy, 2001). Thus, this tends to provide permitting circumstances for settlers

rather than the local poor rural communities (Karumbidza, 2002). Theoretically, market-led land reform makes land available to those who are too disadvantaged to enter into normal land market businesses (FAO, 1998).

Government's role is to provide the former owner with reimbursement at market or close to market value as a poor farmer is incapable of doing so. Although market-led land reform aims to provide land to the poor, it has fought throughout the world to meet the set targets (El-Ghonemy, 2001; Karumbidza, 2002). According to Aliber and Mokoena (2002:4), there is growing opposition to market land reforms as the willing-buyer/willing-seller approach *"redistributes little land and benefits few landless families"* in South Africa. Karumbidza (2002) highlighted that the slow impact of market-led land reforms often result in thorough campaigns for land reform, even though the land reform objectives are driven by the principles of social justice and basic needs as opposed to market forces and thus market value remains as a basis for paying owners for their properties because of the problems in calculating a productive value for land (Aliber & Mokoena, 2002).

As the National Land Committee (2003:122) states: *"The market is not a solution for a fair land redistribution after the apartheid ... markets are never truly free"*. Sunstein (1997) also acknowledges that free markets can preserve prejudice. This indicates that land is procured for redistribution before applicants have indicated their wish to acquire it. In South Africa, land redistribution is presently demand-driven, with beneficiaries finding land and approaching the DLA to buy it for them. In theory, the supply-led redistribution could increase the speed of distribution of land to beneficiaries as land would be accessible to beneficiaries on claims. It could also enable land to be acquired more reasonably, as concessions could begin before redistribution. Lastly, supply-led initiatives could safeguard the purchase of high-quality land. However, this would necessitate Government to be strategic in their thinking about where to reallocate.

Aliber and Mokoena (2002) and Cousins (2007) emphasised that there is no shortage of willing sellers; Government can buy land for redistribution in strategic land areas where demand is high and high soil fertility and infrastructure, as well as support is reachable. According to Walker (2000), land reform is complex and there is no one ideal method to land reform as both redistributive land reform and land market-led reform are open to exploitation. Thus, the collapse

of land market-led reform and the subsequent debated redistributive land reform in Zimbabwe has confirmed fears of non-market approaches to land reform. Therefore, market approaches to land reform often exclude the very same people land reform is supposed to benefit from. The obligation of land reform in redressing human rights violations of the past and to concurrently satisfy market requirements is complex as the two perspectives are often in conflict. Cousins (2007:19) found that *"Political dynamics, rather than rational arguments, are likely to be the key determinant of the content of land and agrarian reform in South Africa in years to come"*. Therefore, until political prerogatives change, it seems that land reform in South Africa will remain a predominantly market-orientated and demand-driven approach.

4.3 Overview of Land Reform: International Context

This section provides a brief overview of some of the countries that were affected by colonialism and land reform in international and African countries such as Asia (India), Latin America (Mexico), Africa (Malawi) and SADC (Zimbabwe). These sections are discussed for comparative reasons and to highlight how patterns of land ownership are concerned.

Land reforms have played a central role in the political economy of many countries in the world and have been subject to massive disagreements between different political interest groups and ideologies (Ravallion, 2009). The 20th Century included many of the largest social land reform experiments in history, such as in the earlier Soviet Union, Eastern Europe, China, Mexico, India and Ethiopia (Ravallion, 2009). Many of these reforms have later partly been reversed. In other countries with a colonial history, there have been tensions between property rights established during the colonial period and traditional (customary) land rights, including how to adapt these to changing conditions (Schoneveld, 2011). According to Benjaminsen *et al.* (2009), various factors influence the interests in land reforms around the world, which include amongst others:

- The Millennium Development Goals sharpened the international focus on poverty reduction and legal empowerment of the poor as seen by the establishment of the Commission for Legal Empowerment of the Poor (CLEP);
- Excessive regulations of land transactions in some countries in Asia (e.g., India, Nepal and the Philippines) have created both inefficiencies of land use and inequity of operational land distribution;

- Economic growth in Asia has led to changes in food habits towards more land-demanding foods (meat and milk), and growing land and water scarcity; and
- Increasing demand for land for food and energy production has spurred a new landrace to ensure national food security in countries with increasing food deficits.

According to Arezki *et al.* (2011), land reforms have been promoted by international institutions, such as the World Bank and UN organisations, donor countries, new governments and pressure groups within countries. The primary motive of land reform throughout the world was regarded as the same, especially in Africa. The accomplishment seen with the government-led approach is based on its capability to dispense the great size of agricultural land. Borras and McKinley (2006) emphasised the accomplishment of government-led land restructuring (see Table 4.1).

Table 4.1: Land redistribution outcomes of state-led land reform program in selected countries

Country	Period	Redistributed land as %of total agricultural hh	No. of beneficiaries as % of total agricultural household
Cuba	1959	80	75
Bolivia	1952-77	74.5	83.4
Rep. of Korea	1945`	65	77
Taiwan	1948-53	48	48
Peru	1963-76	42.4	32
Mexico	!970	42.9	43.4
Philippines	1972-2005	Nearly half	Two-fifths
Brazil	1964-2005	7.6	18.5
Egypt	1952-61	10	9

Source: Borras and McKinley (2006)

According to Bhatta (2010), the government of South Africa approved the rule of *"willing-seller-willing-buyer"* for the development of land restructuring during the land summit in 2005. In South Africa, redeployment sub-programmes such as LRAD and SLAG were at the front position in pressing forward the functioning of a market-led method (Bhatta, 2010). Table 4.2 demonstrates the market-led method results highlighting the period between 1997 and 2005, where Brazil dispersed only 0.4% of its land while Namibia dispersed not more than 6% of its land between 1990 and 2005 and South Africa dispersing less than 1.6%.

Table 4.2: Land Redistribution outcomes of major Markets-Led Agrarian Reform Programmes in Several Countries

Country	Period	Redistribution as % of total agricultural land	No. of beneficiaries as % of total agricultural household
Brazil	1997-2005	0.4	1.32
Colombia	1994-2001	0.22	0.32
Guatemala	1997-2005	4.0	1.30

Philippines	2007-2005	0.01	0.03
South Africa	1994-2005	1.65	4.1
Zimbabwe	1980-1996	16.6	5.83
Namibia	1990-2005	6.0	0.16

Source: Borras and McKinley (2006)

4.3.1 Land Reform in the Philippines

Since 1988, the Philippines have had one of the world's longest state-led land restructuring scheme, namely The Comprehensive Agrarian Reform Programme (CARP). It was introduced with a 20-year authorisation to reallocate private and public lands to peasant recipients (MST, 2009a). The scheme was completed in 2008 with varied marks. Over 1 million hectares of private lands had survived redeployment and confidential pacts were intentionally instituted to immediately take benefit of the restructuring scheme's ending; a new proposal was affected into law in 2009 (MST, 2009a). The Philippines' land restructuring circumstances vary from the happenings in Brazil by the MST over the past 25 years (MST, 2009a). The background for agrarian restructuring in the Philippines commences decisively with the U.S. imposing control from the end of the 19th Century (Franco, 2000; Borras, 2008).

This barred the inclinations or viewpoints of farmers themselves, whose supposed primitive nature was an issue in their very omission (Calderon, 1978). Also, the intricacy and cost of eventualities such as credit, substructure, post-harvest amenities, advertising and biochemical contributions required in the extended period to style a victory of the restructuring programme excluded any peasant involvement (Calderon, 1978: 5). Up to April 1994, 1.5 million hectares of land had been dispersed, which accounted for 39% of the total 10-year target of 3.8 million hectares (Elvinia, 2008). However, this section has recently risen to stand for half of that dispersed per annum. The CARP comprised of three key components (Elvinia, 2008):

- Land tenure improvement, dealing with the acquisition of land;
- Provision facilities, which involve delivery of extension services, credit and substructure to recipients; and
- Delivery of agrarian justice to address clearance of cases connecting to landlord-tenant association and matters related to land assessment and disagreements.

A strategy of Agrarian Reform Communities (ARCs) was introduced in 1993 to optimise the use of limited financial and material resources (Elvinia, 2008). Agrarian affairs in the Philippines allocate features with both Latin American and Asian nations. There are hacienda-type estates and small subsistence-oriented labourer occupancy, with an assortment of land tenancy provisions (Elvinia, 2008). According to Elvinia (2008), the key influence for the restructuring of the agricultural estate is the extremely seasonal employment they offer and the restrictions obligated on local food output by over-specialisation (e.g., sugar, bananas, pineapples), generating stern adversity when global prices fall and employment is laid off. Plantations are ever trickier to rationalise in the face of increasing land shortage and rural joblessness (Elvinia, 2008).

The largely significant grouping for restructuring is the landlord estate, from which occupants regularly can be dispossessed at will. The restructuring of tenancies moves income to the tenant and generates incentives for investment. Land restructuring is high on the programme of armed groups, adding importance to the conquering completion of the land restructuring. Up to April 1994, 1.5 million ha had been dispersed, which explained 39% of the total 10-year target of 3.8 million ha (Elvinia, 2008).

Also, this element has risen to symbolise half of that dispersed per annum. Herein the key matters are (i) social fairness and disparity, (ii) little output, (iii) absence of governor by the countryside crowds over them exists and purpose, (iv) under-industrialisation, (v) ecological collapse, and (vi) overseas command. CARP similarly illustrates the purposes of its agricultural rearrangement outline:

- To handover land-owning prosperity and control over the land and its harvest to the real tillers;
- To permitted and grow the creative controls of agricultural workforces, and fisher folk from the forces that rob them of capitals and inventiveness;
- To grow the instruments for person authorisation by generating self-directed decision-making physiques of the rural grassroots;
- To encourage nationalist mechanisation by spreading the nation-wide marketplace, re-channelling the agrarian excess into manufacturing savings and employment for

manufacturing expansion, and the founding of independent local businesses controlled by the countryside multitudes;

- To preserve the normal atmosphere so that it might help the brief and long-term wants of the Filipino persons; and
- To do away with overseas regulator over normal possessions. When an unsatisfactory CARP law (RA 6657) was passed by formerly President Corazon Aquino in June 1988, an irate CARP delivered the *"People's Agrarian Reform Code"* (PARCODE) in the similar month as a counter-programme and straight enterprise degree with the subsequent basic mechanisms (Elvinia, 2008).

4.3.2. The Land reform in Mexico

This segment addresses the challenges in the background of a case of land restructuring in Mexico. The challenges are twofold. *Firstly,* why was land restructuring in Mexico unsuccessful in stimulating lasting economic development? Land redeployment in many countries has made important offerings to financial development by creating superior fairness of affluence (Alesina and Rodrik 1994, Lipton 2009), for example, China, Japan, South Korea, Taiwan and the United States. Besley and Burgess (2000) have demonstrated that additional concentrated land restructuring across Indian states improved development and cut down shortages.

The righteous effects of land restructuring in Mexico are explained by the fact that land can be used as a type of guarantee for credit and peasants can be employed in output enhancing employment and sharecropping contracts (Bardhan & Mookherjee, 2006). *Secondly,* why did Mexican land restructuring have such odd properties? Rather than scheming private markets, where the new landholders obtained title to the land, might use their land as security for finance and can lease and retail the land, Mexican land restructuring made useless shared property rights subject to an extensive array of boundaries, including the exclusion of using land as security, lease and retail (Bardhan & Mookherjee, 2006). Mexican land restructuring eventually ensnared peasants into reliance on the country, rather than, as in another place, becoming a major factor ensuring lasting financial growth. Land beneficiaries turn out to be reliant on a stream of federal monetary capital and financial backing to stay alive (Lipton 2009).

4.3.2.1 Land Administration for Communal Land: Lessons from the Ejidos in Mexico

Mexico is approximately the same size as Saudi Arabia and consists of 31 states governed under a federal system with the federal capital located in Mexico City. After Brazil, Mexico is by far the most populous country in Latin America. The indigenous population is, surprisingly, the largest in Latin America with several well-known indigenous groups (e.g., Maya, Aztecs and Zapotecs) (World Bank, 2001).

4.3.2.2 Lessons learned from Mexico

The ejido land tenure system in Mexico demonstrates that it is not necessary to view land tenure as either private individual or communal. Both types of tenure co-exist within ejidos in Mexico for more than 70 years in most cases. What can be observed, however, is that land use is a powerful determinant of whether the land will be treated individually or communal? Agriculture and urban lots are typically allocated on an individual basis, while common pool resources (Ostrom, 1990) are generally retained in communal tenure. These include rights to forests, pasture land and water. Some of the most successful ejidos have extensive forest resources and have managed to engage the community in collective action to manage these resources both profitably and sustainably.

The legal framework underlying the *ejido* system recognises that this tenure system will change through time and consequently provides mechanisms for converting ejido land tenure into private individual tenure, provided most of the community leaders elect to do so. The dual land registration system is designed to cater to these two tenure systems. However, it is clear from various studies that there is an active land market in the majority of ejidos and this is taking place outside of the two registry systems (Yuňez & Paredes, 2006). There are clearly regional differences in *ejidos*, especially in terms of their natural resource base, governance effectiveness, ethnicity, livelihood options and attitudes towards land tenure. Depending on their location and other factors, ejidos are also subject to different external pressures (e.g., urbanisation, tourism), although NAFTA seems to have had an overall negative effect on ejidos as small farmers have been unable to compete with cheap imports from the US (Yuňez & Paredes 2006).

4.4 Land Reform: African Perspective

4.4.1 Land Reform in Malawi

Malawi is located on the eastern side of South Africa, adjoining Mpumalanga Province. Similar to most African states, Malawi underwent the programme of land restructuring. In 2002 a National Land Policy was incorporated in Malawi. Malawian land restructuring policy, as explained by Silungwe (2009), is a human-driven and pro-poor financial development programme. In the 1950s land restructuring focused more on the customary land tenure scheme and by the 1990s the focal point was more on sweeping financial alteration (Silungwe, 2009). The land restructuring support within Malawi centred on the notion that restructuring should centre its methods to rights in land, promote pro-poor financial development and not be motivated by financial prescription, as well as be familiar with the multiplicity in the concept of property right (Silungwe, 2009).

The features of Malawi's land restructuring is demonstrated in the Presidential Commission of Inquiry on Land Reform of 1996 and the National Land Policy of 2002 (Silungwe, 2009). The land restructuring policy in Malawi is seen by many as faulty due to the focus of its focal point being the land law project principle (Silungwe, 2009). The main concern with Malawi land restructuring is the ratification of laws, which are not necessarily constant with the facing of the bulk on the ground (Silungwe, 2009). A study conducted by Silungwe (2009) shows that the bulk of Malawi populace still cannot be involved in land restructuring in its existing structure motivated by willing-buyer-willing–seller law. It was understood that between 1992 and 1994, the law of land restructuring was based on fair rearrangement form (Silungwe, 2009). The existing outline of land restructuring is characterised by a union of a power struggle rather than leadership in law or policy. There are some similarities between the South African and Malawian land restructuring methods. The techniques for land restructuring can be singled out as follows:

- The land redeployment models are founded on the enthusiastic vendor/enthusiastic purchaser tactic; and
- The land compensation models are grounded on a historicised and contextualised method and both officials restructuring of land tenancy indorse the restructuring of a customary land tenancy.

The scrutiny of land restructuring in Malawi exposed that the actuality of landless does not gain in the way as expected (Silungwe, 2009). Furthermore, there is some level of scheming and price management that guide plenty of infertile land to be put on the market (Silungwe, 2009).

4.4.1.1 Redistributive land reform in Malawi

In order to address the extremely uneven allocation of its congested arable terrestrial, which coexists with underutilised large-scale farms, Malawi piloted a land restructuring plan in 2004 with financial support from the World Bank (2004). The pilot venture intended to amplify the revenue of approximately 15 000 countryside deprived families through a reorganised, community-based and unpaid method in four regions, modelled on Brazil's market-based method to land restructuring (Simtowe, Mangisoni & Mendola, 2011). The experiment had three chief fundamentals: (i) charitable attainment by groups of land traded by enthusiastic land proprietors; (ii) relocation and on-farm expansion, with conveyance of settlers, formation of housings and acquisition of rudimentary donations and essential advice-giving services; and (iii) investigation and registering of reallocated property (Simtowe, Mangisoni & Mendola, 2011).

According to impact assessment studies, the assignment attained inspiring marks, augmenting 40% in agricultural incomes for recipients between 2005/06 and 2008/09, an economic rate of return of 20% and positive impacts on the livelihoods of beneficiaries and nearby neighbourhood in landholdings, land tenure security, crop production and productivity and subsequently on income and food safety (Simtowe, Mangisoni & Mendola, 2011). These grades leave no uncertainty that Malawi's redistributive land restructuring model is one upon which SSA states ought to address land ownership disparity and landlessness (Simtowe, Mangisoni & Mendola, 2011).

4.4.1.2 Lessons from Malawi

These grades leave no uncertainty that Malawi's redistributive land restructuring model is one that SSA should utilise to address land ownership disparity and landlessness (Simtowe, Mangisoni & Mendola, 2011). Key lessons learned include:

- Community-driven land redeployment agendas are conceivable and can be financially worthwhile in SSA;

- Capping the maximum sum of the recipient funding that can be expended on land attainment yet permitting suppleness to apply funding cash on relocation and land/farm expansion is an operative device to inspire recipients to pursue and negotiate for lesser valued property;
- The market-assisted enthusiastic seller–enthusiastic buyer (WSWB) method is usually real but might not be ideal if there are no levies (ground rent) on land if duties are very low and/or ill-imposed or if large-scale farming is funded through ownership land (as in Malawi) (World Bank, 2009);
- Land reorganisation agendas must be entrenched within wider agendas of rural expansion to safeguard that recipients can improve the aids of such agendas;
- Those poor republics with a very large population, rare off-farm chances and a past of tyrants aggravating interior separations face the greatest severe land complications of all;
- Sweeping answers may be inevitable and persons can inverse previous past (e.g., by moving to Mozambique); and
- That the British colonial tradition, when challenging a problematic subject of location up a directive to investigate the subject for as long as conceivable (World Bank, 2009).

4.4.2 Land reform in Mozambique

According to Tanner (2002) and Van den Brink (2008), the General Peace Agreement signed in October 1992 in Mozambique ended 17 years of civil war and 25 years of armed conflict. They further indicated that competition for land quickly became a major issue as millions of refugees and internally displaced persons (IDPs) returned home. Furthermore, more investors were encouraged to bring abandoned and empty land into production again, but later, they realised that returning refugees are claiming a right to the land again (Tanner, 2002).

According to Tanner (2002), the 1995 Land Policy recognised and accepted customary systems of land allocation and conflict resolution and provided for their accommodation in land legislation. These goals were protected in the Land Law, no. 19/1997 (Government of Mozambique, 1997), which *"aimed to achieve a balance between safeguarding the interests of communities and facilitating investors' access to land [and] to halt speculative land grabs that*

were leading to increased landlessness among the poor" (Van den Brink, 2008). There are three land tenure types:

- Occupation of land by a community governed under customary law (a customary DUAT);
- Occupation of land for an uninterrupted period of 10 years as if the occupier was the owner (so-called 'good faith' occupation); and
- Allocation of a 50-year lease by the State to a private investor, after consultation with the affected local community (granted DUATs).

Following its obligation under Section 25 (9) of the South African Constitution, the State has passed several laws to improve tenure security for people whose tenure is insecure due to apartheid discrimination: the Land Reform (Labour Tenants) Act 3 of 1996; The Interim Protection of Informal Land Rights Act 31 of 1996 (IPILRA); the Extension of Security of Tenure Act 62 of 1997 (ESTA); the Prevention of Illegal Eviction Act 19 of 1998 (PIE). Of these, only IPILRA applies to customary areas (Cousins, 2016). There is a gap in the legislation that needs to be filled (High Level Panel, 2017) because the people affected comprise nearly 60% of the population of South Africa (Hornby *et al.,* 2017).

However, the policy-development procedure led to the crafting of the 1995 National Land Policy, which is still in power today and which steers a path between protected local rights, obtained through traditional occupation and encouraging new private investment (Duvane, 2008). This law is normally considered to be a good basis for protecting the land rights of poor and vulnerable groups because:

- It identifies the land privileges of peoples and persons as developed by habitual or long-term occupation and gives such rights complete lawful equivalence to state-allocated DUAT; and
- The civil liberties of women about land are guarded by legal provisions that take primacy over possibly injurious customary norms and performs (Duvane, 2008).

4.4.2.1 Challenges from Mozambique

Mozambique, similar to any other country on the African continent, has been on their own journeys towards improved tenure security and economic growth (Royston *et al.,* 2017). Accordingly, the country has faced numerous challenges, setbacks and restarts in the past. However, the glaring difference between their experiences is that, while South Africa's legislative code is incomplete concerning land (Royston, *et al.,* 2017; Hull & Whittal, 2018), it took Mozambique only two years to draw up their 1997 Land Law, including a broad and exemplary participatory and consultative process (Tanner, 2002).

4.4.2.1 Lessons learned from Mozambique

In a study conducted by De Wit, Tanner and Norfolk (2009), the following lessons learned from Mozambique were identified:

- That overlying overseas entitlements to land can rise wherever administrations are feeble and administrators effortlessly tainted;
- That administration must be careful of conceivable overseas stakeholders looking for a clutch grip of shorelines, game parks or forests;
- That the reimbursement of White South African agriculturalists in overseas republics is not a respectable impression and will not produce sworn assistances;
- Land restructuring was not used for political gains;
- Land inhabitants did not claim right over the land. Administration only administered the procedure of relocation; it did not consume consigned attention;
- Administration must frame strategies for land restructuring;
- Minor household ranch properties must be fashioned to grow rural populations economically; and
- For farming to flourish, the administration must support agriculturalists in countryside zones who act as security systems for food.

4.4.3 Land Reform (Redistribution) in Zimbabwe

According to Moyo (2004), under President Mugabe's led regime (Zanu-PF), the administration sought to pace up land handovers, as the land was not being shifted from White agriculturalists to Black agriculturalists *"fast"* enough. White farmers also did not place their farms on the

marketplace. This, in turn, directed to additional malfunction in the land restructuring procedure of Zimbabwe. White agriculturalists and their folks were enforced off their farms by the armed forces and Zanu-PF war veterans. This was carried out in aggressively threatening conducts, offering the White farmers and their folks no option but to surrender their farms due to fear. Moyo (2004) also highlights that the land rearrangement quandary remains a fragile and complex subject in Zimbabwe even at present.

The Zimbabwean establishment was confronted with several encounters that broke the frequency of land renewal (Lahiff, 2003). According to Lahiff (2003), the following are some of the challenges that emerged:

- Inadequate economic funds for land restructuring;
- White profitable agriculturalists not enthusiastic about selling their farms;
- White agriculturalists overvaluing their farms; and
- The administrative procedures of land redeployment.

4.4.3.1 Legal framework for land reform in Zimbabwe

Constitutional provisions of significance to land transformation are the consequence of efforts by the administration of Zimbabwe over the last 20 years to deal with the uneven and racially tilted sharing of land and wealth (Hammar & Raftopoulos, 2003). Regardless of its numerous democratic tenets, the Constitution that escorted Zimbabwe to freedom in 1980 offered no optimism for an urgent improvement of that legacy (Hammar & Raftopoulos, 2003).

Section 52 (3) (b) (i) together with subsection (4) of that Constitution set that requirements about basic rights (which comprised the property rights implied in Section 16) cannot be rewritten for 10 years (depriving an assenting vote of all the members of the National Assembly), a body that assured 20 seats to Zimbabwe's White population during these first 10 years (Hammar & Raftopoulos, 2003).

4.4.3.2 Lessons learned from Zimbabwe

According to Mamdani (2008), the following lessons were learned from Zimbabwe:

- Legal land redeployment for agrarian resolutions needs a factual pledge from the White agriculturalists and administration to generate an organised culture;

- Administration, civil movements and White agriculturalists have to draw and settle on the strategies of land rearrangement; some participants require that they realise land redeployment is not traversable;
- The agenda of land redistribution in precisely land relocation for agronomic resolutions is essential and should be fast-tracked;
- That an extremely noticeable condition in which a few White agriculturalists (whose precursors grabbed the land by subjugation) remain to own a big portion of a republic's greatest prolific agrarian land will not ever be recognised at an essential level by the popular;
- That abandoning to challenge tenancy subjects in communal parts does not wipe them away;
- That presiding privileged *('week-end farmers'*) regularly obtain land for standing or venture, rather than for manufacture;
- That a comparatively efficacious relocation agenda may not suffice either at home or abroad; and
- That in a multifaceted and separated state, it may be virtuous to draw up a National Land Policy before 19 years have elapsed.

4.5 Lessons learned from Land Reform efforts of other Countries

Table 4.3 Lessons from Land Reform efforts of other Countries

Proper and well-coordinated post-settlement support	properly funding to include non-land costs and create certainty about availability of funds	Insufficient financial assistance by the public sector is often insufficient	Restrictions on land use to limit the success of land reform programmes	Land reform programmes often succeed in redistributing land	A wrong choice of farms	Prompt release of funds is critical	Access to land has tangible benefits within a short period	Access to land opens other growth opportunities to beneficiaries
Binswanger *et al.* (2009) confirm that existing exercises and history are full of instances where post-settlement assistance has been mournfully insufficient (e.g., Brazil, Colombia, South Africa and Zimbabwe).	To achieve redistribution objectives, expenditures sometimes focus on land transfer–related costs, leaving insufficient budgets for non-land costs. Global experience highlighted that in a characteristic market-based land restructuring scheme, the land costs are only part (30–40%) of the total costs of land reform	The literature review in chapter 3 and 4 indicated that unless land reform beneficiaries gain access to credit from the private sector, financial assistance provided by government will be insufficient for their needs.	Land reform programmes have not been particularly successful in African countries that have limited functioning of markets to enable farmers to sell or rent their land.	Unless land reform beneficiaries can generate profit from their farming operations and production is unlikely to continue. This often results in the collapse of land reform programmes as has been observed in some land reform projects in South Africa. Ensure that the production model is designed to generate benefits for land reform beneficiaries.	Land reform beneficiaries have often found it difficult to farm profitably because farms allocated to them are characterised by low-quality soils, located too far from markets and have poor infrastructure. Therefore, care should be taken when selecting farms for redistribution to ensure that the farms are not marginally productive.	Delays in releasing funds for land reform beneficiaries have been identified as one of the main reasons for the collapse of land reform projects, Delays in releasing funding can be disastrous for land reform beneficiaries, sometimes leading to permanent closure of their farms.	Land reform programmes are often implemented to help the poor in many countries. Farming communities cannot afford to spend long periods working their land without benefits.	Market-based transformation, if unaccompanied, is inefficient. Suitable regulation and its laborious request are desired, as are detailed requirements on the privileges and responsibilities of numerous parties, including the government, assets holders and budding recipients. Highlight and encourage more creative usage of land. Solidification, the volume of government activities, is critical. Civil society needs to be tangled in alerting and educating the negotiating abilities of recipients.

Source: Binswanger *et al.*, 2009; Jacobs, 2003; Deininger, 1999; Hall, 2004; Lahiff, 2008.

4.6 Land Reform in South Africa: Prominent Features of Land Reform Programmes in South Africa

Table 4.4 Prominent features of land reform programmes from other countries

Features	India	Mexico	Philippines	Mozambique	Malawi	Zimbabwe	SA
Private ownership	private individual or communal land; peasants work collectively;	private individual or communal land; peasants work collectively;	redistribute private and public lands to peasant beneficiaries; eviction and transplantation of tenant farmers;	Small family farm holdings;	redistribute private and public lands to peasant beneficiaries; eviction and transplantation of tenant farmers;	redistribute private and public lands to peasant beneficiaries; eviction and expropriation of land; tenant farmers;	Land and building is close proximity to agricultural areas. More secure tenure; Less risk for the inefficient and slow processes of bureaucracies.
Lease household and private use	Limited regulations Reduction in land prices which will stimulate a free market system;	Limited regulations Reduction in land prices which will stimulate a free market system;	Support services, which entail provision of extension services, credit and infrastructure, etc. to beneficiaries;	contracts represent perhaps the first concrete examples of the kinds of partnerships that,	Limited regulations; Reduction in land prices which will stimulate a free market system;	Limited regulations Reduction in land prices which will stimulate a free market system; Planned and controlled land development is easier; Equity to disadvantaged groups.	Reduction in land prices which will stimulate a free market system; Planned and controlled land development is easier; Monitoring and land transactions are easier with leasehold clauses (e.g. speculation in sites and services schemes).
Large groups/ corporative collective	Individuals	Individuals	Individuals	Individuals	Individuals	Individuals; Cooperatives	Individuals
Extension support	Training skills, Agricultural equipment	credit, insurance, seeds and fertilizers	Longest state-led land reform	grant money; willing buyer, willing seller; freehold land; no taxes;	grant money; willing buyer, willing seller; freehold land; no taxes;	Grants, loans and tax	State ownership and leasehold model-not viable. Later freehold was recommended
Capital investment	Tax from the land remained a primary source of revenue	Grants, loans and tax	Grants, loans and tax; complexity and cost of contingencies like credit,	Grants, loans and tax; infrastructure, post-harvest facilities,	Loans and tax	Grants, loans and tax	Grants, loans and tax
Leasehold and state-owned	State-led land reforms; mass peasant mobilizations,	market-let Loan and government grant.	market-let Loan and government grant.	State led;	Market based land	More consistent with traditional control over, and allocation of land.	Market led land reform offers landowners absolute discretion
	Market based land Willing buyer, willing seller	State led land reform	Willing buyer, willing seller	Market led land reform Willing buyer, willing seller	Willing buyer, willing seller	Market based land	Willing buyer, willing seller (expropriation/ confiscation approach)
	Customary law	Customary law	Customary law	Communal law	Customary law	Willing buyer, willing seller	Land tenure system
	Expropriation of land	Expropriation of land	Expropriation of land	Expropriation of land	Self-enriching land policy	Expropriation of land	Propose expropriation of land
	Proposed civil movement	Proposed civil movement	Proposed civil movement	Proposed civil movement	Proposed civil movement	Proposed civil movement	SLAG grant
Successful	Land tenure improvement, dealing with the acquisition of land; marketing and chemical inputs needed in the long term to make a success of reform initiatives, effectively crowded out any peasant participation	Land tenure improvement, dealing with the acquisition of land; marketing and chemical inputs needed in the long term to make a success of reform initiatives, effectively crowded out any peasant participation	Land tenure improvement, dealing with the acquisition of land; marketing and chemical inputs needed in the long term to make a success of reform initiatives, effectively crowded out any peasant participation	customary rights; democratic and participatory way; private owned;	and voluntary approach; market-based approach; grant money; willing buyer, willing seller; freehold land; no taxes	Customary law Communal land	Active land market and a well developed market infrastructure,
Failures	slow pace of redistribution of land, Willing seller, willing buyer	Willing seller, willing buyer	Willing seller, willing buyer	Willing seller, willing buyer	slow pace of redistribution of land is worsening expropriation; funding poor families through decentralised, community-based,	Willing seller, willing buyer Limited budget for land reform. White commercial farmers not willing to sell their farm. White farmers over- valuing of their farms. The bureaucratic processes of land redistribution.	Willing seller, willing buyer; slow pace of redistribution of land; Post settlement support failure; lack of coordination and communication between and within government departments during pre-settlement

4.7 Policy and legislative requirements of land reform in South Africa

4.7.1 The Constitution of the republic of South Africa, Act No 108 of 1996

The significance of the Constitution of the Republic of South Africa, Act 1996 (hereafter referred to as the Constitution) on land restructuring cannot be over-emphasised (SA, 1996). It was one of the largest public involvement programmes ever occurred in South Africa. After almost two years of rigorous meetings, political parties represented in the Constitutional Assembly negotiated the final construction of the manuscript of the Constitution (SA, 1996). Section 25 of the Constitution addresses the property rights of people in South Africa as follows (SA, 1996):

- That no one in South Africa could be disadvantaged of assets except in relations to law of over-all application and that no law could licence ignorant denial of assets;
- Also, that the administration must frame realistic law-making and implementation procedures, within its obtainable law-making margins, to encourage circumstances which allow residents to increase admission to land on an impartial foundation for self-sustainable expansion;
- Blacks who were evicted off land and property according to the racial prejudiced rules of 1913 and 1936 need to be recompensed to secure tenancy civil liberties;
- After 1994, persons who had standing civil liberties on land were certain of their rights; and
- Regime consequently has a legitimate responsibility to create all land strategies and laws to talk to the unfairness of the historical in a means that will donate to rebuilding and synchronisation of all South Africans (De Beer, 2001).

4.8 Implementation of land reform policy (1994 -2011)

A brief outline will be provided of the key law-making aspects regarding the territorially segregationist strategies and the original policies framed by the post-1994 government to address the subject of land restructuring. The expansion of the Land Reform Policy emanated from the 1994 democratic elections. Policy formulation is one of the six general roles of Public Administration (MAFISA, 2006). The post-1994 period in South Africa was followed by a series of policies framed to address the pre-1994 government actions (MAFISA, 2006). The necessity for land restructuring to recompense the legacy of the ancient is recognised in Section 25 of the Constitution 1996.

The Provision of Certain Land Rights for Settlement Act 1993 (Act 126 of 1993), provides a description of land for settlement resolutions and financial support to persons obtaining land for farming energies, while the Advancement of Land Tenure Rights Act 1993 (Act 112 of 1993) and the Labour Tenants Act 1996 (Act 3 of 1996) collected form portions of the legislatures that address the WPSALP (1997) objectives toward guaranteeing protected tenancy. These were joined with the creation of programmes, such as Broadening Access to Agricultural Thrust (BATAT, 1996), Land Reform for Agricultural Development (LRAD, 2001), Comprehensive Agricultural Support Programme (CASP, 2004), Micro Agricultural Finance Institutions of South Africa (MAFISA, 2006) and Accelerated Shared Growth Initiative of South Africa (ASGISA, 2006).

The RSAC (1996) identifies and guards current land ownership but created a responsibility to guarantee that land restructuring in Chapter 25 (the property clause), Chapter 25(1) specifies that no one may be disadvantaged of a property except in terms of law of universal application and no law may license arbitrary deprivation of property (RSAC, 1996). This constitutional obligation directed the enactment of the following Land Reform Acts approved since 1994:

- The Restitution of Land Rights Act (Act No. 67 of 1994). This Act facilitates the compensation of rights to land to persons evicted from land in terms of ethnically constructed strategies of the ancient;
- The Development Facilitation Act (Act No. 67 of 1995), which announces procedures to speed up land expansion, particularly the delivery of repaired land for low salary housing;
- The Extension of the Security of Tenure Act (Act No 62 of 1997) projects to guarantee that the rights preserved in Section 26(3) of the RSAC, which forbids removals deprived of court orders, are compulsory;
- The Land Administration Act (Act No 2 of 1995), which made delivery for the task and allocation of controls to the suitable establishments;
- The Land Reform (Labour Tenants) Act (Act No. 3 of 1996), which affords for the safety of tenancy of land occupants and persons lodging or using land because of their association with employment tenants; and to offer for substances associated in addition to that;

- The Interim Protection of Information land Right Act (Act No 31 of 1996), is an instrument to guard persons with unconfident tenancy against losing their civil liberties to and absorbed in land awaiting long-term restructuring procedures; and
- The Communal Property Association Act (Act No. 28 of 1996), which allows societies or groups to obtain, grip and administer assets under a printed constitution; and Communal Land Rights Act (Act No. 11 of 2004), which object to offer for lawful safety of tenancy by transporting shared land, including KZN Ingonyama land, to societies or by offering similar compensation.

4.8.1 Restitution of land rights Act No. 22 of 1994

The Restitution of Land Rights Act offers compensation of land or a grant of impartial compensation to people or groups disposed of land because of historical racially biased laws or reform (Du Plessis, 2004). The Restitution of Land Rights Amendment Act 2003 (Act No. 48 of 2003), also authorises the Minister of Rural Development and Land Reform to procure and obtain in any other way or seize land or rights in land for the drive of compensation grants or any connected land reform purpose (DRDL, 2010). Table 4.12 provides a summary of land reform policies in South Africa.

Table 4.5: Land Reform legislation 1993 – 2005

Legislation	Purpose
Provision of land and assistance Act 126 of 1993	Empower the Minister of Land Affairs to make grants for land purchase and related purposes to individuals, household or municipalities.
Restitution of Land Rights Act 22 of 1994	Establish the right of people dispossessed of property after 1913 to restitution of that land or alternate redress.
Land Reform (Labour Tenant) Act 3 of 1996	Provides tenure rights to labour tenants living on private farms and enables them to apply to acquire full ownership of the land they already reside on and use.
Communal Property Association Act 62 of 1997	Enables groups of people to hold and manage their land jointly through a legal entity registered with the Department of Land Affairs.
Interim Protection of Informal Land Rights Act 31 of 1996	A temporary holding mechanism to protect the tenure rights of people who occupy land in the former homelands without formal documented rights, pending promulgation of an Act regulating communal land tenure rights and renewed annually.
Extension of Security of Tenure Act 62 of 1997	Protects farm dwellers from arbitrary eviction and enable them to acquire long-term secure tenure rights, either on the farm where they currently reside or elsewhere.
Transformation of Central Rural Areas Act 94 of 1998	Revokes the rural areas Act 9 of 1987 and establishes procedures for upgrading the tenure rights of residents to commonage and residential land in the 23 former Coloured reserves.
Restitution of Land Rights Amendment Act 48 of 2003	Empower the Minister of Land Affairs to expropriate property without a court order for restitution of other land reform purposes.
Communal Land Rights Act 11 of 2004	Provides for the transfer in ownership of land in the former homelands to communities residing there, or alternative redress, on the instigation of the Minister.

Source: Hall (2004)

4.9 Legislative framework for territorial segregation

This section provides a brief overview of the historical background of the discriminatory laws and practices related to land, which gave rise to the need for land reform. Also, an outline will be provided of the main legislative frameworks for the territorial segregationist policies and the initial policies formulated by the post-1994 government to address the issue of land reform. The then National Party government's strategy of territorial segregation, population resettlement and political exclusion was founded on a history of conquest and dispossession enforced through oppressive land laws (Kloppers & Pienaar, 2014).

According to Van der Walt (1991), South African land law has also been employed to entrench the political ideology of racial segregation through spatial separation of race groups, thus creating a controversial body of statutory law, known as apartheid law. The effect of this racially-based segregation legislation was to force Black people to be "perpetual tenants" with very limited rights. The first of these racially based segregation laws was the Natives Land Act 27 of 1913, which in the year of this special edition celebrates its centenary.

4.9.1 The natives land Act 27 of 1913

The Natives Land Act laid the foundation for apartheid and territorial segregation and, for the first time, formalised limitations on Black land ownership. The Act introduced ethnic differentiation based on the mistaken belief that differentiation between dissimilar races was fundamentally desirable. According to Section 1(1) of the Act, except with the approval of the Governor-General, a native shall not enter into any agreement or transaction for the purchase, hire or other acquisition from a person other than a native of any such land or of any right thereto, interest therein or servitude thereover.

The Act *"laid down an absolute barrier in law between Black and non-black landholding"*. The aim of the Act was further strengthened by Section 1(2) of the Act, as set out above. The Act (Natives Land Act 27 of 1913) made provision for the establishment of a commission tasked with the identification of areas within which Black people would not be permitted to acquire or hire land or any interest in land, as well as areas where persons other than Black people would be prohibited from acquiring or hiring land or any interest in land. The Act effectively prohibited sharecropping contracts between White landowners and Black farmers, resulting in many Black farmers losing a substantial portion of their income, which resulted in further economic hardship for them. This Act (Natives Land Act 27 of 1913) represented

the first step in effecting racially based segregation, a system which was advanced through the Native Trust and Land Act 18 of 1936.

4.9.2 Native trust and land Act 18 of 1936

The Native Trust and Land Act made provision for the establishment of the South African Native Trust, a state agency to administer trust land and *"to be administered for the settlement, support, benefit and material welfare of the natives of the Union"*. The Act abolished individual land ownership by Black people and introduced trust tenure through the creation of the South African Development Trust, which was a government body responsible for purchasing land in *"released areas"* for Black settlements. In terms of Section 2(1) of the Act, certain areas of land (including land identified in the Natives Land Act) were transferred to the Native Trust to be administered by the Trust. Vested in the Trust was land reserved for the occupation of natives and land within the scheduled native areas, as identified in the Natives Land Act.

The Act created *"reserves"* for Black people and increased the 8% of land reserved by the Natives Land Act to 13%, confining 80% of the population to this area. In order to achieve the objectives of the Act, Section 13 empowered the trustees of the Trust to expropriate land owned by natives outside a scheduled area for reasons of public health or for any other reason which would promote public welfare or be in the public interest. The Act stripped Black South Africans of their right to own land or even to live outside demarcated areas without proper authorisation by the relevant authorities. This Act advanced the objective of racial segregation, which eventually necessitated the need for land reform.

4.10 A summary of evolution Rural Development and Land Reform Policies and Legislations

Table 4.6 Summary of evolution of rural development and land reform Policies

Year	1994	1999	2000	2001	2005	2006	2007/2008	2009	2010	2011	2013	2014	2015	2016/17	2018
Minister	Hannekom	Hannekom	Didiza	Didiza	Didiza	Xingwana	Xingwana	Nkwinti	Nkwinti	Nkwinti	Nkwinti	Nkwinti	Nkwinti	Nkwinti	Maite
Approving Structure	Minister	Minister	PGC	PGC	PGC	PGC	PGC	PGC	PGC	NLACC born	NLARCC-RADP intr	NLARCC	NLARCC	NLARCC	NLAACC
Delegated Authority	Minister	Minister	Provincial Director	Provincial Director	Provincial Director	CDPSSC	CDPSSC	CDPSSC	CDPSSC	DDG:LRD	DDG:LRD	DDG:LRD	DDG:LRD	DDG:LRD	DDG:LR
Delegations	Minister	Minister	Mutingati/DPSSC	Mutingati/DPSSC	Mutingati/DPSSC	Mutingati/DPSSC	Delegations 2007 Lulu	Delegations 2007 Lulu	Delegations 2007 Lulu	Delegations 2007 Lulu	Delegations 2007 Lulu	Nkwinti Delegat	Nkwinti Delegat	Nkwinti Delegat	Maite but Signed twice
Policy Land	SLAG	SLAG	LRAD/Comm/Sett	LRAD/Comm/Sett	PLAS born	LARP	PLAS signed	CRDP/PLAS/G&S	DG Circ /PLAS	PLAS	PLAS	PLAS	PLAS	PLAS	PLAP
Policy RAPD	Did not Exist	Did not Exist	Did not Exist	Did not Exist	Did not Exist	Did not Exist	Did not Exist	25% Policy Maint	25% Policy Main	RADP born	RADP Amend/Radp Guidelines	RADP	RADP	1H1H	1H1H
Policy Leasing	Did not Exist	Did not Exist	Did not Exist	Did not Exist	Did not Exist	Did not Exist	Did not Exist	Policy Lease Management	Policy Lease Management	Policy Lease Management	State Land Lease & Disposal Policy	State Land Lease/SOP	SLDP/ALHA Ass Man	SLDP/ALHA Ass Man	ALHA Ass Man, Conditions SLDP
District Stuctures	Households	Households	Households	Households	Households	Households	Households	Households	Households	Applicant	Applicant	Applicant	DLRC	DLRC	

No Land Acquisition Policy	Really existed after 2009
PLAS was used as a guide	albeit it clearly stipulated in the preamble that it's a Strategy and that Planners were free to adapt it accordingly given different Provincial dynamics
District Structures as far as	allocation is concerned were to be established by the CD as per Delegation in the Policy Lease Managemet, these never existed
District structures only	considered the acquisition of land and not allocation
District Managers adjudicated	and recommended applicants and those who sponsored land in their application were preferred
The NLACC establishment	letter, puports that the body also interview candidated but this was never done, they left it to the province and only introduced allocation in the Memo after the 2013 Policy

4.11 Chapter Summary

This chapter provides a brief overview of the legislation predominant to land reform that brought about racial segregation or apartheid during the previous government of South Africa prior to 1994. The aim of this chapter, within the context of land reform in South Africa and international countries such as Mexico, Philippines, Zimbabwe, Mozambique and Malawi, is to familiarise researchers and other authors with the historical prelude that gave rise to the need for land reform in the new constitutional dispensation. The researcher will, therefore, conclude this chapter by exploring the prominent features of the land reform programme, as well as the policy and legislative requirements of land reform in South Africa.

The next section will include a presentation of the insights into the global and home (African) background of land restructuring, land reform policies and government, the challenges, lessons learned and conclude with assessing land reform programmes. Consultation on worldwide countries (African and southern African) will assist the reader to expand an appreciative of the rationale for land restructuring in other countries. Also, the level of achievement or disappointment of land restructuring and the motivations for achievement or disappointment of land restructuring in other countries, as well as the lessons learned will be highlighted.

CHAPTER FIVE: THEORETICAL FRAMEWORKS: DISASTER RISK REDUCTION, SUSTAINABLE LIVELIHOOD APPROACH AND CLIMATE CHANGE CONVENTION

5.1 Introduction

This chapter includes a discussion about the main theoretical foundations utilised in the current study. These include the Disaster Risk Reduction framework, which offers the Hyogo Framework for Action adopted in 2005 with the objectives of building the Resilience of Nations and Communities to Disasters until 2015; The Sendai Framework following on the Hyogo Framework for Action (HFA) adopted in 2015-2030 and which aims to build back better; the Sustainable Livelihoods Approach (SLA), which offers a comprehensive framework for understanding the complex multi-dimensionality of poverty from global to local level; and the United Nations Framework Convention on Climate Change (UNFCCC) which provides the basis for concerted international action to mitigate climate change and to adapt to its impacts. Its provisions are far-sighted, innovative and firmly embedded in the concept of sustainable development.

5.2 Disaster Risk Reduction framework

This section encompasses a discussion about the 2005-2015 Hyogo Framework for Action, with the theme, Building the Resilience of Nations and Communities as well as the Sendai Framework for Disaster Risk Reduction 2015-2030 was adopted at the 3rd UN World Conference in Sendai, Japan, on 18 March 2015.

5.2.1 Hyogo Framework for Action

"The Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters" is a globally accepted strategy outline for disaster risk decrease. It was accepted at the World Conference on Disaster Reduction, Kobe and Hyogo in Japan 18-22 January 2005 (UNISDR, 2005). According to the UNISDR (2005) report, the Hyogo Framework for Action offers a tactical and all-inclusive worldwide strategy to decreasing susceptibility to the usual dangers of disaster risks and symbolises an important re-orientation of concentration in the direction of the original causes of disaster risks as a necessary element of sustainable growth, rather than on catastrophe reaction alone (UNISDR, 2005).

5.2.1.1 Challenges posed by disasters

The UNISDR (2005) reported that disaster loss is on the rise with grave consequences for the survival, dignity and livelihood of individuals, particularly the poor and hard-won development gains. The report further indicated that disaster risk is increasing in global concern and its impact and actions in one region can have an impact on risks in another, and vice versa (UNISDR, 2005). This, compounded by increasing vulnerabilities related to changing demographics, technological and socio-economic conditions, unplanned urbanisation, development within high-risk zones, under-development, environmental degradation, climate variability, climate change, geological hazards, competition for scarce resources and the impact of epidemics such as HIV/AIDS, points to a future where disasters could increasingly threaten the world's economy, its population and the sustainable development of developing countries (UNISDR, 2005). In the past two decades, more than 200 million people have been affected by disasters every year.

Disaster risk arises when hazards interact with physical, social, economic and environmental vulnerabilities. Events of hydrometeorological origin constitute the large majority of disasters. Despite the growing understanding and acceptance of the importance of disaster risk reduction and increased disaster response capacities, disasters and in particular, the management and reduction of risk, continue to pose a global challenge (UNISDR, 2005). There is now international acknowledgement that efforts to reduce disaster risks must be systematically integrated into policies, plans and programmes for sustainable development and poverty reduction, including support through bilateral, regional and international cooperation, as well as partnerships (UNISDR, 2005).

Sustainable development, poverty reduction, good governance and disaster risk reduction are mutually supportive objectives, thus in order to meet the challenges ahead, accelerated efforts must be made to build an approach to be recognised as an important element for the achievement of internationally agreed development goals, including those contained in the Millennium Declaration (UNISDR, 2005).

The importance of promoting disaster risk reduction efforts on the international and regional levels, as well as the national and local levels has been recognised in the past few years in several key multilateral frameworks and declarations (UNISDR, 2005).

5.2.1.2 The Yokohama Strategy: lessons learned and gaps identified

The Yokohama Strategy for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation and its Plan of Action *("Yokohama Strategy"),* adopted in 1994, provides landmark guidance on reducing disaster risk and the impacts of disasters (UNISDR, 2005). The review of progress made in implementing the Yokohama Strategy identifies major challenges for the coming years in ensuring more systematic action to address disaster risks in the context of sustainable development and in building resilience through enhanced national and local capabilities to manage and reduce risk (UNISDR, 2005).

The review emphasises the importance of disaster risk reduction underpinned by a more pro-active approach to informing, motivating and involving people in all aspects of disaster risk reduction in their own local communities (UNISDR, 2005). It also highlights the scarcity of resources allocated specifically from development budgets for the realisation of risk reduction objectives, either at the national or the regional level or through international cooperation and financial mechanisms, while noting the significant potential to better exploit existing resources and established practices for more effective disaster risk reduction (UNISDR, 2005). Specific gaps and challenges are identified in the following five main areas:

(a) Governance: organisational, legal and policy frameworks;
(b) Risk identification, assessment, monitoring and early warning;
(c) Knowledge management and education;
(d) Reducing underlying risk factors; and
(e) Preparedness for effective response and recovery.

5.2.1.3 Objectives

The World Conference on Disaster Reduction was convened by decisions of the General Assembly, with five specific objectives:

- To conclude and report on the review of the Yokohama Strategy and its Plan of Action, to update the guiding framework on disaster reduction for the twenty-first century;
- To identify specific activities aimed at ensuring the implementation of relevant provisions of the Johannesburg Plan of Implementation of the World Summit on Sustainable Development on vulnerability, risk assessment and disaster management;

- To share good practices and lessons learned to promote disaster reduction within the context of attaining sustainable development and to identify gaps and challenges;
- To increase awareness of the importance of disaster reduction policies, thus facilitating and promoting the implementation of those policies;
- To increase the reliability and availability of appropriate disaster-related information to the public and disaster management agencies in all regions, as set out in relevant provisions of the Johannesburg Plan of Implementation of the World Summit on Sustainable Development.

5.2.1.4 Priorities for action 2005–2015: General considerations

In determining appropriate action to achieve the expected outcome and strategic goals, the Conference reaffirms that the following general considerations will be taken into account:

(a) The Principles contained in the Yokohama Strategy retain their full relevance in the current context, which is characterised by an increasing commitment to disaster reduction;

(b) Taking into account the importance of international cooperation and partnerships, each State has the primary responsibility for its own sustainable development and for taking effective measures to reduce disaster risk, including for the protection of people on its territory, infrastructure and other national assets from the impact of disasters.

(c) An integrated, multi-hazard approach to disaster risk reduction should be factored into policies, planning and programming related to sustainable development, relief, rehabilitation, and recovery activities in post-disaster and post-conflict situations in disaster-prone countries;

(d) A gender perspective should be integrated into all disaster risk management policies, plans and decision-making processes, including those related to risk assessment, early warning, information management and education and training;

(e) Cultural diversity, age and vulnerable groups should be taken into account when planning for disaster risk reduction;

(f) Both communities and local authorities should be empowered to manage and reduce disaster risk by having access to the necessary information, resources and authority to implement actions for disaster risk reduction;

(g) Disaster-prone developing countries, especially least developed countries and small island developing States, warrant particular attention given their higher vulnerability and risk levels, which often greatly exceed their capacity to respond to and recover from disasters;

(h) There is a need to enhance international and regional cooperation and assistance in the field of disaster risk reduction through:

- The transfer of knowledge, technology and expertise to enhance capacity building for disaster risk reduction;
- The sharing of research findings, lessons learned and best practices;
- The compilation of information on disaster risk and impact for all scales of disasters in a way that can inform sustainable development and disaster risk reduction;
- Appropriate support in order to enhance governance for disaster risk reduction, for awareness-raising initiatives and capacity-development measures at all levels, in order to improve the disaster resilience of developing countries; and
- Financial assistance to reduce existing risks and to avoid the generation of new risks.

(i) The promotion of a culture of prevention, including through the mobilisation of adequate resources for disaster risk reduction, is an investment for the future with substantial returns;
(j) There is also a need for proactive measures, bearing in mind that the phases of relief, rehabilitation and reconstruction following a disaster provide opportunities for the rebuilding of livelihoods and the planning and reconstruction of physical and socio-economic structures, in a way that will build community resilience and reduce vulnerability to future disaster risks;
(k) Disaster risk reduction is a cross-cutting issue in the context of sustainable development and therefore an important element for the achievement of internationally agreed development goals, including those contained in the Millennium Declaration.

5.2.2 Sendai Framework for Action

The Sendai Framework for Disaster Risk Reduction 2015-2030 was adopted at the 3rd UN World Conference in Sendai, Japan, on 18 March 2015. It is the outcome of stakeholder consultations initiated in March 2012 and inter-governmental negotiations from July 2014 to March 2015, supported by the United Nations Office for Disaster Risk Reduction at the request of the UN General Assembly. The Sendai Framework is the successor instrument to the Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters.

The HFA was conceived to provide further impetus to the global work under the International Framework for Action for the International Decade for Natural Disaster Reduction of 1989 and the Yokohama Strategy for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation and its Plan of Action, adopted in 1994 and the International

Strategy for Disaster Reduction of 1999. The Sendai Framework is built on elements which ensure continuity with the work done by states and other stakeholders under the HFA and introduces several innovations as called for during the consultations and negotiations (UNISDR, 2005).

Furthermore, the scope of disaster risk reduction has been broadened significantly to focus on both natural and man-made hazards and related environmental, technological and biological hazards and risks (UNISDR, 2005). The Sendai Framework also articulates the following: the need for improved understanding of disaster risk in all its dimensions of exposure, vulnerability and hazard characteristics; the strengthening of disaster risk governance, including national platforms; accountability for disaster risk management; preparedness to *"Build Back Better";* recognition of stakeholders and their roles; mobilisation of risk-sensitive investment to avoid the creation of new risk; resilience of health infrastructure, cultural heritage and work-places; strengthening of international cooperation and global partnership and risk-informed donor policies and programmes, including financial support and loans from international financial institutions (UNISDR, 2005).

5.2.2.1 Hyogo Framework for Action: lessons learned, gaps identified and future challenges

Since the adoption of the Hyogo Framework for Action in 2005, as documented in national and regional progress reports on its implementation, as well as in other global reports, progress has been achieved in reducing disaster risk at local, national, regional and global levels by countries and other relevant stakeholders, leading to a decrease in mortality in the case of some hazards (UNISDR, 2005). There is also a clear recognition of the Global Platform for Disaster Risk Reduction and the regional platforms for disaster risk reduction as mechanisms for coherence across agendas, monitoring and periodic reviews in support of UN governance bodies (UNISDR, 2005).

Overall, the Hyogo Framework for Action has been an important instrument for raising public and institutional awareness, generating political commitment and focusing and catalysing actions by a wide range of stakeholders at all levels. Also, it is necessary to continue strengthening good governance in disaster risk reduction strategies at the national, regional and global levels and improving preparedness and national coordination for disaster response, rehabilitation and reconstruction, as well as use post-disaster recovery and reconstruction to *"Build Back Better",* supported by strengthened modalities of international

cooperation (UNISDR, 2005). Disaster risk reduction practices need to be multi-hazard and multisectoral, inclusive and accessible in order to be efficient and effective (UNISDR, 2005).

There is a need for the public and private sectors and civil society organisations, as well as academia and scientific and research institutions, to work more closely together and to create opportunities for collaboration, as well as for businesses to integrate disaster risk into their management practices (UNISDR, 2005). International, regional, sub-regional and transboundary cooperation remains pivotal in supporting the efforts of states, their national and local authorities, as well as communities and businesses, to reduce disaster risk (UNISDR, 2005).

The seven global targets include:

(a) Substantially reduce global disaster mortality by 2030, aiming to lower the average per 100 000 global mortality rate in the decade 2020–2030 compared to the period 2005– 2015;

(b) Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100 000 in the decade 2020–2030 compared to the period 2005–2015;

(c) Reduce direct disaster economic loss concerning the global gross domestic product (GDP) by 2030;

(d) Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030;

(e) Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020;

(f) Substantially enhance international cooperation in developing countries through adequate and sustainable support to complement their national actions for implementation of the present Framework by 2030; and

(g) Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030.

5.2.2.2 The Four Priorities for Action

Priority 1. Understanding disaster risk

Disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics

and the environment. Such knowledge can be used for risk assessment, prevention, mitigation, preparedness and response.

Priority 2. Strengthening disaster risk governance to manage disaster risk

Disaster risk governance at the national, regional and global levels is very important for prevention, mitigation, preparedness, response, recovery and rehabilitation. It fosters collaboration and partnership.

Priority 3. Investing in disaster risk reduction for resilience

Public and private investment in disaster risk prevention and reduction through structural and non-structural measures are essential to enhance the economic, social, health and cultural resilience of persons, communities, countries and their assets, as well as the environment.

Priority 4. Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction

The growth of disaster risk means there is a need to strengthen disaster preparedness for response, take action in anticipation of events and ensure capacities are in place for effective response and recovery at all levels. The recovery, rehabilitation and reconstruction phase is a critical opportunity to build back better, including through integrating disaster risk reduction into development measures.

5.2.2.2 Implementation guides for the Sendai Framework

The Sendai Framework for Disaster Risk Reduction charts the global course over the next 15 years. During the consultations and negotiations that led to its finalisation, strong calls were made to develop practical guidance to support implementation, ensure engagement and ownership of action by all stakeholders and strengthen accountability in disaster risk reduction.

Paragraph 48 (c) of the Sendai Framework calls upon "the United Nations Office for Disaster Risk Reduction (UNISDR), in particular, to support the implementation, follow-up and review of this framework through generating evidence-based and practical guidance for implementation in close collaboration with states and through mobilisation of experts; reinforcing a culture of prevention in relevant stakeholders. In order to support the process, several targeted Sendai Framework implementation guides shall be developed.

5.2.2.3 Support from international organisations

In order to support the implementation of the present Framework, the following is necessary:

(a) The United Nations and other international and regional organisations, international and regional financial institutions and donor agencies engaged in disaster risk reduction are requested, as appropriate, to enhance the coordination of their strategies in this regard;

(b) The entities of the United Nations system, including the funds and programmes and the specialised agencies, through the United Nations Plan of Action on Disaster Risk Reduction for Resilience, United Nations Development Assistance Frameworks and country programmes;

(c) The United Nations Office for Disaster Risk Reduction, in particular, to support the implementation, follow-up and review of the present Framework by preparing periodic reviews on progress, especially for the Global Platform for Disaster Risk Reduction and, as appropriate, promptly, along with the follow-up process at the United Nations, supporting the development of coherent global and regional follow-up and indicators, and in coordination, as appropriate, with other relevant mechanisms for sustainable development and climate change and updating the existing web-based Hyogo Framework for Action.

(d) International financial institutions, such as the World Bank and regional development banks to consider the priorities of the present Framework for providing financial support and loans for integrated disaster risk reduction to developing countries;

(e) Other international organisations and treaty bodies, including the Conference of the Parties to the United Nations Framework Convention on Climate Change, international financial institutions at the global and regional levels and the International Red Cross and Red Crescent Movement to support developing countries, at their request, in the implementation of the present Framework, in coordination with other relevant frameworks;

(f) The United Nations Global Compact, as the main United Nations initiative for engagement with the private sector and business, to further engage with and promote the critical importance of disaster risk reduction for sustainable development and resilience;

(g) The overall capacity of the United Nations system to assist developing countries in disaster risk reduction should be strengthened by providing adequate resources through various funding mechanisms, including increased, timely, stable and predictable contributions to the United Nations Trust Fund for Disaster Reduction and by enhancing the role of the Trust Fund concerning the implementation of the present Framework;

(h) The Inter-Parliamentary Union and other relevant regional bodies and mechanisms for parliamentarians, as appropriate, to continue supporting and advocating disaster risk reduction and the strengthening of national legal frameworks;
(i) The United Cities and Local Government organisation and other relevant bodies of local governments to continue supporting cooperation and mutual learning among local governments for disaster risk reduction and the implementation of the present Framework.

5.3 The Livelihood Approach

The livelihoods approach emerged in the late 1990s and has since been central in rural development thinking and practice. Initially, it was promoted by the British state development cooperation agency, the Department for International Development (DFID), who used it as their main poverty alleviation strategy. According to De Haan (2012), the intentions behind the framework were to create a *'Third Way'* for the new Blair administration that would function as the middle way between the old labour ideology and the previous neoliberal policies of the conservative government.

The livelihood approach is an attempt to understand how different people live their lives in different places. The literature shows a variety of definitions of the concept *'livelihoods'*, which at its most basic, 'the means of gaining a living' (Chambers in Scoones 2009). However, the most commonly used definition of Sustainable Livelihoods emerged in Chambers and Conway's working paper for the Institute of Development Studies in 1992 and captures the broad notion of livelihoods as understood in this thesis: *"A livelihood comprises of the capabilities, assets (including both material and social resources) and activities for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base".*

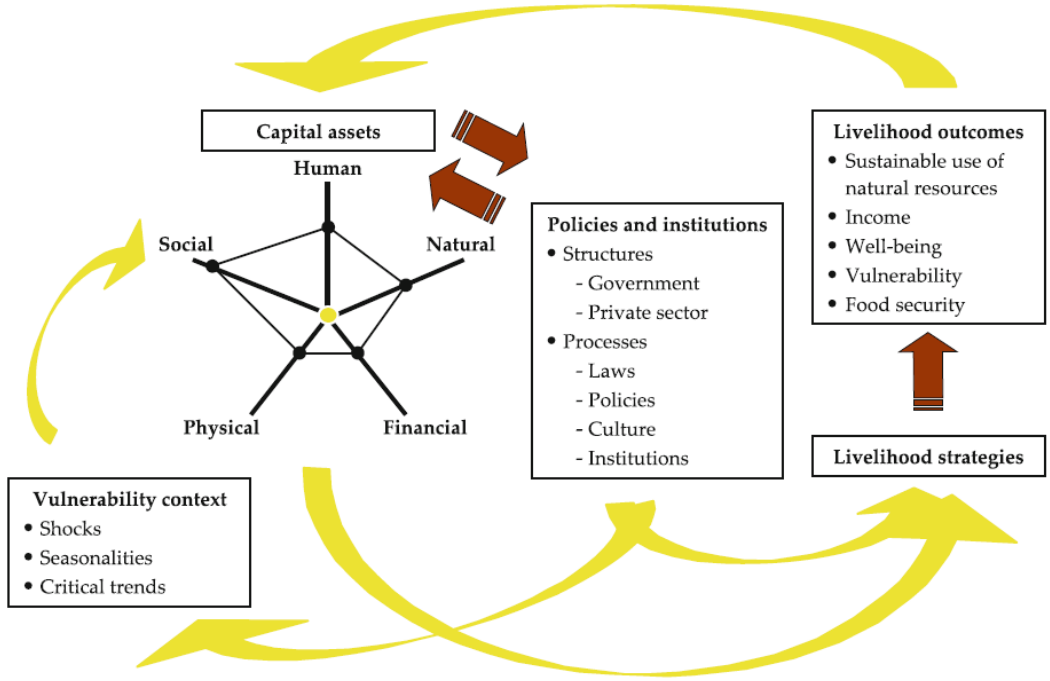


Figure 5.1 The Sustainable Livelihoods Framework
Source: DFID, 2000

Figure 5.1 illustrates a complete Sustainable Livelihood Framework where the Vulnerability context is a major determinant of sustainability of livelihood assets as it directly influences livelihood strategies, institutional process and livelihood outcomes of the community. According to the DFID (2012), adverse effects of climate change such as temperature increment, flood, drought and storms have been categorised under the Vulnerability context of SLF. The level of vulnerability of community determines the impacts of these adverse climatic conditions on people's livelihood assets, strategies and outcomes (DFID, 2012). The researcher will address the indicators of the vulnerability of the land reform beneficiaries to climate change and variability impacts that are listed below and will also extend to add extra indicators.

The components of SLA are *first* categorised under different livelihood assets such as human, physical, social, natural, financial, political, cultural and institutional as defined by SLF. Krantz (2001) indicated that the concept of the Sustainable Livelihood Framework is an attempt to go beyond the narrow conventional approaches which have focused on certain aspects of poverty such as low income, which excludes other aspects such as vulnerability and social exclusion. The framework pays more attention to the various factors and processes which either constrain or enhance poor people's ability to make a living in an economically, ecologically and socially sustainable manner (Krantz, 2001). Furthermore, it takes into

consideration the context in which households and individuals operate (such as macro-economic, social, political, environmental, demographic, historical factors) and livelihood resources available to households (i.e., economic, natural, cultural, physical, human, social and political capital); institutional processes and structures operate within the communities; livelihood strategies are pursued by households and the livelihood outcomes derived from these strategies (i.e., conditions of well-being, access to food, health, education, safety) are also depicted in the framework.

However, the availability of resources is also a crucial factor in sustainability (DFID, 2012). As shown by the SLF for analysis of DFID (2012), in different contexts, sustainable livelihoods are achieved through access to a range of livelihood resources (natural, economic, human and social capitals) which are combined in the pursuit of different livelihood strategies – agricultural intensification/intensification, livelihood diversification and migration (DFID, 2012).

One of the main characteristics of the SL approach is that it puts 'poor' people and the priorities they define firmly at the centre of analysis, offering a systematic analysis of poverty and its causes (Scoones, 2009). This is an important aspect of the approach because the researcher wanted to understand the livelihoods of the selected study areas from the smallholder farmers' perspectives (Scoones, 2009).

The livelihood approach promoted the importance of a solid understanding of the household economy, combined with attention to the policy context in order to achieve development goals (DFID 1999). The Vulnerability context is a vital part of the SA framework as it serves to put livelihood strategies and outcomes into context and identifies different factors and processes that constrain or enhance poor people's ability to make a living (DFID 1999). This includes different economic, environmental, political and social trends that might affect livelihoods, the various shocks that might occur and the seasonality of the local environment and economy (DFID 1999).

The analysis concludes with the processes through which community members interact with each other and the larger society (Carr, 2013). This includes government services, non-governmental services and private agencies. Poor people's livelihood strategies are embedded in structures and governed by institutions and shaped by interactions between the local and the global (De Haan & Zomers in De Haan, 2012). Through these processes, individuals and

communities can access livelihood assets and decide how to utilise them. The livelihood approach has links with other conceptual frameworks and is influenced and inspired by many of them. There are some similarities with the right-based approaches, as they both stress the responsibilities of the global community to eradicate poverty and to promote human rights, in addition to concerns about empowerment and participation (DFID 1999).

Another approach that is reminiscent of SLA is sector-wide approaches (SWA), with which they share a heavy emphasis on understanding the structures and processes that condition people's access to assets and their choice of livelihood strategies (DFID, 1999). The intention is rather to employ a holistic perspective in the analysis of livelihoods to identify those issues or subject areas where an intervention could be strategically important for effective poverty reduction, either at the local level or at the policy level (Scoones, 2009).

The term has a wide span, including quality of life, which is seen in terms of being able to choose valued activities (Chambers and Conway 1991). *"The capability approach to a person's advantage is concerned with evaluating it in terms of his or her actual ability to achieve various valuable functions as a part of living. The corresponding approach to social advantage – for aggregative appraisal, as well as for the choice of institutions and policy – takes the set of individual capabilities as constituting an indispensable and central part of the relevant informational base of such evaluation"* (Sen 1993: 30). The capabilities are not exclusively reactive, but also proactive and dynamic (Chambers & Conway, 1991; Robeyns, 2003).

5.3.1 Sustainable Livelihood Approach: Theoretical Framework

The SL framework is an analytical tool used to understand the set of interconnected factors that connect people to assets. It highlights key points within the SL analysis and how these are connected (Scoones, 1998). According to Scoones (1998), the central question to any sustainable livelihoods analysis is *'given what particular context, what combination of livelihood resources result in the ability to follow what combination of livelihood strategies with what outcome?'* Due to limited amounts of time and resources, the researcher has chosen to analyse the vulnerability context and livelihood portfolios of farmers in the selected study areas to identify which constraints to livelihood outcomes are most dominant (Scoones, 1998).

The latter livelihoods resources and outcomes conform with the researcher outcomes that the institutional and policy variables such as agricultural extension services are important factors in agricultural information dissemination to the farmers (Danso-Abbeam & Baiyegunhi, 2017).

Extension visits which are measured by the number of visits in a production year is hypothesised to positively influence the adoption of climate change adaptation strategies because farmers gain better access to information from extension agents and help link farmer groups to climate information (Muhongayirea *et al.,* 2013; Anang *et al.,* 2015). Access to extension services is statistically significant and positively related to both lacks of climate change information and capital constraint conditions. This implies that the probability of being constrained by a lack of climate change information and capital reduces farmers' contact with extension agents.

This aligns with Olomola and Gyimah-Brempong (2014) who posited that contact with an extension agent and the presence of collateral security positively and significantly affect the likelihood of farmers' access to capital. Information received by farmers from agricultural extension agents facilitates their decision on how and when to use climate change adaptation strategies such as improved seeds, soil and water conservation, conservative agriculture and changing of cropping calendar, for example. This is in line with the findings of Deressa *et al.* (2009), Bryan *et al.,* (2013) and Khanal *et al.* (2019), who indicated a positive and significant relationship between extension access and smallholder farmers' adoption of climate change adaptation strategies.

However, De Silver (2013) argued that the SLA is more concerned with the livelihood barriers and possible climate change adaptation strategies. De Silver (2013) and Saab (2009) agreed that the SLA is guided by its principles, namely people-oriented approach, holistic, multi-level and dynamic, focus more on equity and is rather responsive and participatory. According to Petersen and Pedersen (2010), the SLA framework is more relevant to this study as it addresses the challenges and constraints experienced by the smallholder farmers on the impact of climate change.

Furthermore, it diversifies climate change adaptation strategies made by smallholder farmers to ensure and secure sustainable livelihoods. They further indicated that the SLA is more people-centred; it can thus assist with the empowerment of smallholder farmers to identify

and choose its own adaptation strategies that will enable them to sustain their livelihoods. Rakodi and Lloyed-Jones (2013) agreed that the SLA theory values more participatory processes through which smallholder farmers can further build their own capacity by choosing the correct and relevant climate change adaptation strategies.

Farmers who have access to climate information or have more information have a higher probability of high adaptation (Thi & Chaovanapoonphol 2014). Access to weather information is very vital in helping smallholder farmers to plan against any unexpected outcome on their farms, as well as in reducing shock effects (Oyekale & Oladele 2012).

Access to information and communication technologies (ICT) through the use of radio is negatively signed and statistically significant in constraining smallholder farmers to adopt climate change adaptation strategies in the study area. This is attributed to the fact that the use of ICT tools in general and mobile phones in particular, can help combat the market failures that smallholder farmers face due to a lack of access to market information (Okello *et al.,* 2012; Ndambiri *et al.* 2014). The availability of better climate and agricultural information helps smallholder farmers make comparative decisions among alternative crop management practices and thus choose the ones that enable them to cope better with changes in climate change impact (Baethgen, *et al.,* 2003; Jones 2003).

The adoption of climate change adaptation strategies is constrained with a lack of information about climate change among farmers that are susceptible to climate change impact. This is evident from the positive and statistically significant influence of susceptibility on a lack of information about climate change. The implication of the result shows that smallholder farmers that are constrained as a result of a lack of information are likely to be vulnerable to the impact of drought in the study area.

This aligns with the study of Hann *et al.* (2009) who opined that early warning systems and community preparedness plans might help smallholder farmers prepare for extreme weather events such as drought. Seasonal weather forecasts distributed through local farming associations may help farmers time their plantings and prevent diversion of scarce water resources for irrigation. Mackeller and Smardon (2012) maintain that there are processes at work that determine whether people would have sustainable livelihoods or not. However, understanding livelihoods for poor people has been regarded as providing a basis for a better understanding of rural poverty. According to McNamara and Achlo (2009), SLA has dominated the development agenda since the 1990s. The latter researcher indicated that the

Brundtland Commission first introduced the concept of sustainable livelihoods on the environment and development as a way of linking socio-economic and ecological considerations.

Serrat (2010) highlights the vulnerability contexts that hinder sustainable livelihoods, which results in the insecurity of the individuals, households and rural communities at large. They further state that trends include demographic, environmental, economic, governance and technological. Mackeller and Smardon (2012) argue that institutions and organisations play a crucial role in constructing a sustainable livelihood for rural communities to effectively combine and allocate resources. Benson and Twigg (2007) asserted that policies, institutions and processes have a huge influence on the livelihoods of the poor farming communities.

According to Assan and Beyene (2013), while human beings are highly dependent on the natural environment for their livelihoods, the poor are dependent mostly on the services they receive from the physical environment and if this is not done sustainably it could cause severe harm to the very same people who are fragile and marginalised to the environment. The researcher will analyse the choice of climate change adaptation for smallholder farmers using the SLA framework as a theoretical base.

Therefore, the well-being of communities and smallholder farmers will be examined by utilising the Sustainable Livelihoods Approach (SLA), which measures its livelihood capitals (financial, social, human, natural, physical, political, cultural and institutional) and explore how the sustainable practices of the living link with capital (Flora & Flora 2013). The expansion of abilities, assets and performance focuses on individual and countryside family unit health, education and welfare that is dissimilar from preceding macroeconomic developmental thinking, as indicated by Solesbury (2003).

5.3.3 Vulnerability Context

Discerning the vulnerability context is a central part of the SL framework. The vulnerability context refers to seasonality, trends and shocks that affect people's livelihoods. A main characteristic of these dimensions is that local people themselves cannot control them; not in the short- or medium-term (DFID 2000). Trends comprise of factors that may be susceptible to change and those that most likely will follow their current trajectory. Shocks may be explored by the communities' own sense of past events to predict future events. Vulnerability is a function of how a household's livelihoods would be affected by a certain hazard and how

it can cope with its impact. The DFID (2000) further indicated that when households are exposed to contingencies and stress and have difficulties with coping, there is a condition of vulnerability present. This is also supported by Chambers (2006) that identified the external risks, shocks and stress to which a household is exposed and the internal side of defencelessness that reduces the ability to cope without damaging loss (Chambers 2006).

Second is the integration of vulnerable situations to rural farmers' livelihood strategies, assets and processes that are likely to affect the overall sustainability of the community's development as illustrated by the Sustainable Livelihood Framework in Figure 5.2. The need for support to such vulnerable communities to make their livelihood sustainable through various policies and programmes is the third level of the overall concept of livelihood vulnerability assessment. The integrated concept of vulnerability to climate change impact is accurate and carries large components that are associated with the vulnerability context of the community.

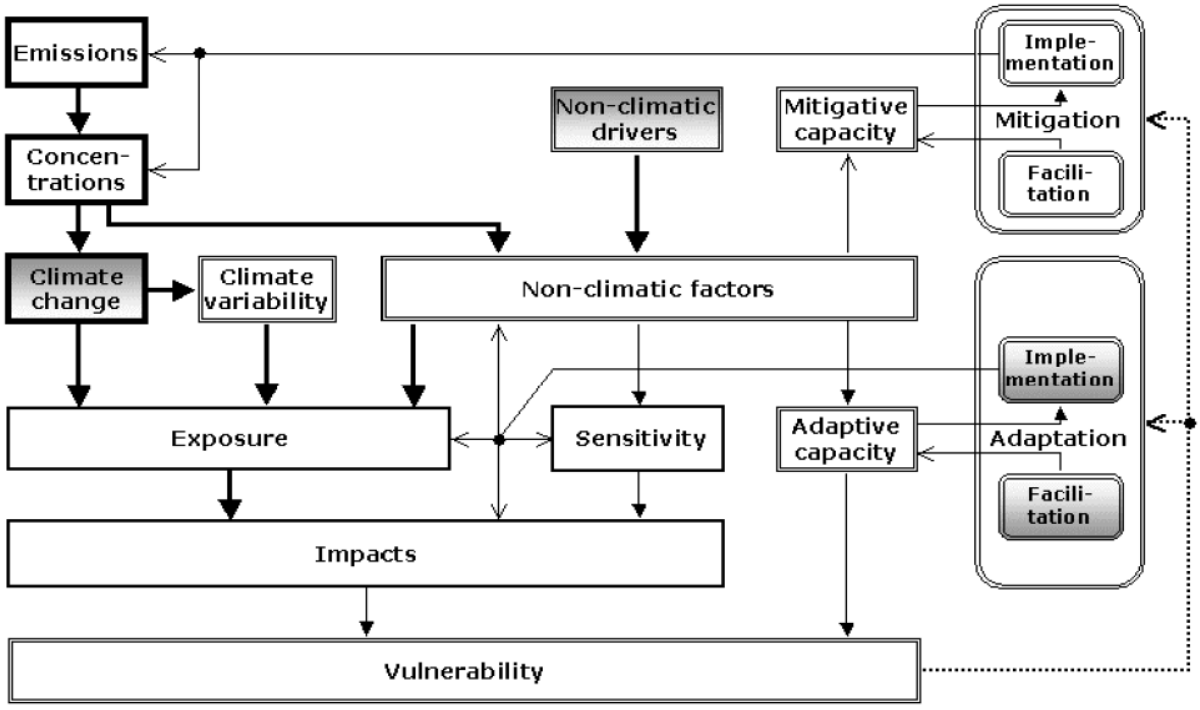


Figure 5.2: Integrated vulnerability context associated with climate change
Source: Fussel, 2010

Figure 5.2 illustrates the wide interrelation of vulnerability with other key aspects of climate change, such as adaptation and mitigation. Very close components of vulnerability contexts are adaptive capacity, exposure and sensitivities which the research will examine in relation to the Sustainable Livelihood Framework (SLF) of DFID. The DFID (2012) report highlighted that the concept of sustainable development emphasises linear and consistency

development where future generations will have an equal ability to purchase their livelihood, similar to what the present generation is purchasing.

The concept of livelihood vulnerability is defined in three different levels. The first is the rise of the vulnerable situation due to a high level of GHG emission, global warming, climatic variability and extremes, the community's capacity to adapt to the change and its sensitivity to those exposures, as illustrated in Figure 5.2. The Sustainable Livelihood Framework demonstrates susceptibility to the exposure of the exterior environment (economy, infrastructure, environment) of the populace. The livelihood assets are expressed as people's significant capitals, including social, human, natural, cultural, financial, physical, political, institutional capitals (Department for International Development 2001); other moulds comprise additional or fewer capital groupings (Flora & Flora 2013; Scoones 1998).

As an effect of its common use in plans and assignments employed by the Department for International Development, this mould was chosen, which demonstrates its effectiveness in a range of circumstances. DFID (2011) reported that livelihood tactics are depicted as the actions, their amalgamation and selections made by persons to attain their individual and family objectives. Lastly, livelihood results are described as a person's aims and main concerns when organising their livelihood stratagems; these results comprise a decrease of shortages, growing income and enhancement of food safety and sustainability (Department for International Development, 2001).

However, Hautala (2010) reported that vulnerability is a forward-looking concept aimed at evaluating community and household exposure and sensitivity to future shocks. The degree of vulnerability is determined by their ability to cope with their exposure to various risks, such as economic fluctuations, droughts and crop blight. Ultimately, the asset base and livelihood strategies pursued by households or communities determine if and to what degree they can cope with shocks and trends (Hautala 2010). The DFID (2000) also argued that there is a good understanding of the indirect means by which the vulnerability context can be reduced, which include building greater resilience and improving overall livelihood security. DFID (2000) state: *"It is important to recognise that vulnerability or livelihood insecurity is a constant reality for many poor people and that insecurity is a core dimension of most poverty. The SL approach seeks to militate against such insecurity through building up resilience."* The issue of vulnerability is multi-faceted and some may rather relate to policies and institutions and a lack of assets, than trends and shocks. Strategies to decrease

vulnerability include, among others, diversification as a means of limiting exposure to risks (DFID, 2000).

5.3.4 Livelihood Resources

A livelihood portfolio comprises strategies to obtain certain livelihoods derived from the assets to which they have access (De Haan, 2010). Vulnerability as such, is a function of the presence or absence of certain assets. According to Bebbington (in De Haan 2010) assets are not simply resources that people use in building livelihoods: they are assets that give them the capability to be and act. They are also the basis of an agent's power to act and reproduce, challenge or change the rules that govern the control, use and transformation of resources (De Haan, 2010). Furthermore, the early work on livelihood perspectives, claims and access is a core dimension of household assets. This section discusses the livelihoods resources or assets which form the basis and key of the research.

Claims refer to demands and appeals regarding material, moral or other practical support and access. Claims are often made when contingencies arise and can include food, work or loans. According to Chambers and Conway (1991), access to livelihood is the opportunity to make use of resources and services, such as transportation health facilities and employment (Chambers and Conway 1991). This is further emphasised by DFID (2000) that livelihood assets are also referred to as resources or capitals, the latter drawing on an economic metaphor, which has received some critique as this implies an economic view of assets that identify with the neo-liberal agenda (DFID, 2000).

As the researcher finds this critique valid, the researcher has chosen to refer to the contents of the livelihood portfolio as 'assets' in this thesis. The livelihood assets are typically displayed using a pentagon, of which there are many variations (DFID, 2000). The researcher's analysis focuses on the five distinguished assets found in the DFID pentagon and each deserves a concise description because the presence or lack of assets determines the level of vulnerability in the livelihoods perspective (DFID, 2000).

5.3.4.1 Human assets

Human capital is probably the most important asset because, in addition to its own intrinsic value, it is necessary in order to make use of the other four assets. Human assets refers to "the skills, knowledge, creativity, ability to labour and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives" (DFID 1999).

Essential assets include the amount of available labour within a household and the quality of labour might be determined by health and education levels (DFID, 2000). Attempts to address these core dimensions of poverty is required to obtain overall improvements in livelihood strategies and outcomes but is not sufficient in its own (DFID, 2000). Initiatives might focus on building schools and hospitals, but for education to be attractive, issues regarding employment opportunities in the community are also vital.

5.3.4.2 Social assets

There has been some ambiguity regarding social assets and their place in the livelihood portfolio. All social relationships are counted as social assets; DFID (1999) describe these assets as "*the social resources upon which people draw in pursuit of their livelihood objectives".* These are developed through networks and connectedness, membership of more formalised groups which often entails adherence to mutually-agreed or commonly accepted rules, norms and sanctions, as well as relationships of trust, reciprocity and exchanges that facilitate co-operation, reduce transaction costs and may provide the basis for informal safety nets amongst the poor.

"These are all inter-related." Social relations ultimately determine the distribution of property, patterns of work and division of labour, the distribution of income and the dynamics of consumption and accumulation (Scoones 2009). Social assets are strongly associated with policies, institutions and processes and are in many ways a product of them or the other way around. Indeed, the relationship can be self-reinforcing; when relationships are cherished, they grow and it is easier to make new relationships (DFID 1999).

Also, a strong civil society can help people in realising their interests in legislation. These relationships build upon trust and respect and can determine whether people gain access to associations and institutions (DFID, 1999). There is also a close relationship between social and human capital when relationships spread knowledge (DFID 1999). In contrast, when a person is excluded from society due to hierarchical structures or other reasons, this may hinder livelihood strategies from being pursued.

5.3.4.3 Natural assets

Natural assets play an essential part in the asset pentagon in rural areas, where most people engage in some agricultural activity. The available natural assets condition the possibility of farming, as well as the level of productivity. It is not only essential for livelihood creation but

to sustain life itself (DFID 1999). The range of natural resources might consist of intangible public goods such as biodiversity and climate, to assets such as land, trees and water, used directly for production. The relationship between natural capital and the vulnerability context is particularly close within the SL framework (DFID 1999).

Many of the shocks that devastate the livelihoods of the poor are themselves natural processes that destroy natural capital (e.g., fires that destroy forests, floods and earthquakes that destroy agricultural land) and seasonality is largely due to changes in the value or productivity of natural capital over the year (DFID 1999). Those who derive all or part of their livelihoods from resource-based activities, such as farming, fishing and gathering in forests, are particularly vulnerable to shocks and trends that damages, destroys or depletes their natural resource base.

5.3.4.4 Financial assets

Financial assets refer to the different financial resources that people use to achieve their livelihood objectives, such as cash flows, savings and credit-providing institutions. Excluding earned income, the most common types of inflows are pensions or other transfers from the state and remittances. Financial capital, according to DFID (1999), is probably the most versatile of the five categories of assets; it can be converted, depending upon transforming structures and processes, into other types of capital.

5.3.4.5 Physical assets

Physical assets include public and private infrastructure, services, goods and equipment needed to sustain livelihoods. Public infrastructure such as roads, water supply and sanitation, energy, schools, hospitals and access to information help people meet their basic needs and to be more productive (DFID 1999). Secure shelter and equipment needed to sustain livelihoods are also vital, and for farmers, this might include livestock and farming tools.

Much research shows that a lack of infrastructure can be a key dimension of poverty and a lack of access to water supplies and energy can inhibit income generation activities due to the time needed to secure these assets (DFID 1999). For farmers, transport infrastructure is necessary to be able to transport produce and fertiliser and to access markets. This, in turn, leaves producers at a comparative disadvantage in the market when the excess effort is used on non-productive activities, such as meeting basic needs, production and gaining access to market (DFID 1999).

5.4 Livelihood Outcomes

The livelihood outcomes are the aspirations that people seek to fulfil through their livelihood strategies. DFID (2000) explains the concept of livelihood outcomes as 'the inverse of poverty'. What one individual is trying to achieve through his or her livelihood strategies is often the opposite of what they will describe as poverty. In order to understand livelihood outcomes, an understanding of local definitions of poverty is central to determining livelihood outcomes (DFID, 2000). A key dimension of livelihood outcomes is that of sustainability. Improvements in one livelihood may be at the expense of environmental degradation.

DFID (2000), therefore, calls for a need to investigate the effects of people's livelihood strategies and outcomes that guide them to social, institutional, environmental and economic factors in order to promote positive directions of change. Another point of interest is that of the dominating economic take on livelihood outcomes. As earlier mentioned, people do not only aim to maximise their income, but also to maximise their well-being (De Haan 2012, Carr 2013).

5.5 United Nations Convention on Climate Change

The earth's climate has constantly changed and evolved. Some of these changes have been due to natural causes but others can be attributed to human activities such as deforestation and atmospheric emissions, from, for example, industry and transport, which have led to gases and aerosols being stored in the atmosphere (IPCC, 2001). These are known as greenhouse gases (GHGs) because they trap heat and raise air temperatures near the ground, acting as a greenhouse on the surface of the planet.

The Intergovernmental Panel on Climate Change (IPCC, 2001) highlighted in its Third Assessment Report on the state of the global climate that an increasing body of observations gave a collective picture of a warming world and other changes in the climate system. The report stated that it was very likely that the 1990s had been the warmest decade worldwide, with 1998 being the warmest year since instrumental records had begun in 1861, although a few areas had not been warmed in recent decades (IPCC, 2001). The report also stated that new analyses of proxy data for the Northern Hemisphere indicated that the twentieth century was likely to have been the warmest century in the last 1 000 years. It added that new and stronger evidence pointed to the likelihood that most of the warming observed over the past 50 years, arising from human activities. According to the report, human influence will

continue to change atmospheric composition throughout the twenty-first century (IPCC, 2001).

5.5.1 Objective and principles of the Convention

This chapter addresses the objective (Article 2) and principles (Article 3) of the Convention. It should be noted that the titles of Convention articles, such as *"Objective", "Principles"* and *"Commitments",* do not form part of the negotiated text of the Convention. They have been included solely to assist the reader.

5.5.1.1 Objective

According to Article 2, the Convention's ultimate objective is *"to achieve, in accordance with the relevant provisions of the Convention, stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (originating in human activity) interference with the climate system".* This objective is qualified in that it should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner (IPCC, 2001). In stating this objective, the Convention reflects concerns that the earth's climate system is threatened by a rise in atmospheric greenhouse gas (GHG) concentrations, which is caused by increased anthropogenic GHG emissions (IPCC, 2001).

Estimates of where these levels lie, evolve continually with scientific advances and are complicated by the political need to take into account the changing ability of societies to adapt to climate change (IPCC, 2001). Another important factor is that stabilising atmospheric concentrations of GHGs near current levels would require a steep reduction of current emissions. This is because once emitted, GHGs remain in the atmosphere for a considerable length of time; carbon dioxide, for instance, stays in the climate system, on average, for a century or more (IPCC, 2001).

5.5.1.2 Principles

The principles of the Convention are stipulated in Article 3, which also states that these principles, among other things, shall guide the actions of parties and thus do not constitute an exhaustive list. Article 3.1 stresses the principles of equity and common but differentiated responsibilities. The latter principle was also formulated in 1992 as Principle 7 of the Rio Declaration.

Principle 7 of the 1992 Rio Declaration on Environment and Development

States shall cooperate in a spirit of global partnership to conserve, protect and restore the health and integrity of the earth's ecosystem. Given the different contributions to global environmental degradation, states have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development because of the pressures their societies place on the global environment and of the technologies and financial resources they command.

Principle 6 of the 1992 Rio Declaration on Environment and Development

This calls for priority to the special situation and needs of developing countries, particularly the least developed and those most environmentally vulnerable.

Principle 15 of the 1992 Rio Declaration on Environment and Development

In order to protect the environment, the precautionary approach shall be widely applied by states according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Principle 3 of the 1992 Rio Declaration on Environment and Development

The right to development must be fulfilled to equitably meet developmental and environmental needs of present and future generations.

Principle 12 of the 1992 Rio Declaration on Environment and Development

States should cooperate to promote a supportive and open international economic system that would lead to economic growth and sustainable development in all countries, to better address the problems of environmental degradation. Trade policy measures for environmental purposes should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade. Unilateral actions to deal with environmental challenges outside the jurisdiction of the importing country should be avoided. Environmental measures addressing transboundary or global environmental problems should, as far as possible, be based on an international consensus.

5.5.2 The Conference of the Parties (COP)

The climate change process revolves around the annual sessions of the COP, which bring together all countries that are parties to the Convention. Article 7.2 defines the COP as the

"supreme body" of the Convention, as it is the highest decision-making authority. Between COP 1 in 1995 and COP 11 in 2005, 221 decisions were adopted under Article 7.2. Besides decisions, the COP can produce other outcomes, such as declarations or resolutions. These are non-binding political statements intended to guide the work of the Convention or express the will of the COP.

Following Article 7.4 and Rule 4 of the draft rules of procedure, the COP meets annually unless the parties decide otherwise. Extraordinary COP sessions may be held if the COP deems it necessary, or if a party submits a written request that is supported by at least one-third of the Parties, within six months (Article 7.5). An extraordinary session is held no later than 90 days after the request has received the required support (draft rules of procedure, Rule 4). No extraordinary session has yet been held (in the case of COP 6, Part II was a resumed session, held 13–27 July 2001 in Bonn).

5.5.3 Intergovernmental Panel on Climate Change (IPCC)

The IPCC17 is not an institution of the Convention, but it contributes important scientific information to the climate change process. It was established in 1988 before the adoption of the Convention by the United Nations Environment Programme (UNEP) and the World Meteorological Organisation (WMO) to provide an authoritative source of up-to-date interdisciplinary knowledge on climate change. It does not carry out its own research but comprehensively assesses the scientific, technical and socio-economic information on climate change that is available around the world in peer-reviewed literature, journals, books and other sources.

5.5.3.1 Adopting protocols

According to Article 17, the Convention may be supplemented with protocols adopted by the COP at any ordinary session. As the Convention does not specify voting rules for the adoption of protocols, the general voting rules of the COP apply. As mentioned in Chapter 2, the COP has not yet been able to adopt rules of procedure as envisaged by Article 4.2(k) of the Convention. Continuing disagreement over voting rules means that the draft rules of procedure are applied except for the draft rule on voting. As a consequence, all decisions of the COP have to be taken by consensus. In order to be adopted "the text of any proposed protocol shall be communicated to all Parties by the secretariat at least six months before a session" (Article 17.2).

According to Article 17.3 of the Convention, "the requirements for the entry into force of any protocol shall be established by that instrument" (i.e., the protocol). Only parties to the Convention may be parties to a protocol; decisions under any protocol shall be taken only by the parties to the Protocol concerned. Thus far, Article 17 of the Convention has been employed only once. By decision 1/CP.3 of 11 December 1997, COP 3 adopted the Kyoto Protocol unanimously. It entered into force on 16 February 2005, under Article 25.1 of the Kyoto Protocol, which set the date for the protocol's entry into force "the ninetieth day after the date on which not less than 55 Parties to the Convention, incorporating Parties included in Annex I which accounted in total for at least 55% of the total carbon dioxide emissions for 1990 of the Parties included in Annex I, have deposited their instruments of ratification, acceptance, approval or accession".

5.6 Summary

This chapter presented the Framework for Action, which was adopted from 2005 to 2015: Building the Resilience of Nations and Communities to Disasters (hereafter referred to as the *"Framework for Action".* The Conference provided a unique opportunity to promote a strategic and systematic approach to reducing vulnerabilities and risks to hazards. It underscored the need for and identified ways of building the resilience of nations and communities to disasters.

The Sendai Framework for Action was adopted for the period 2015 to 2030 to articulate the following: the need for improved understanding of disaster risk in all its dimensions of exposure, vulnerability and hazard characteristics, the strengthening of disaster risk governance, including national platforms, accountability for disaster risk management, preparedness to *"Build Back Better",* recognition of stakeholders and their roles, mobilisation of risk-sensitive investment to avoid the creation of new risk, resilience of health infrastructure, cultural heritage and work-places, strengthening of international cooperation and global partnership and risk-informed donor policies and programmes, including financial support and loans from international financial institutions.

The Sendai Framework is built on elements which ensure continuity with the work done by states and other stakeholders under the HFA and introduces several innovations as called for during the consultations and negotiations. The aim of the researcher to use the Sustainable

Livelihood Approach has been to identify the challenges, constraints and opportunities to secure sustainable livelihoods for smallholder farmers in the selected study areas. Furthermore, to gain an understanding of the complex forces that influence the livelihoods of these smallholder farmers, the use of the Sustainable Livelihood Approach deemed suitable as it is a flexible and dynamic tool that facilitates analysis on all levels (households to international).

Climate change can cause trends in the changing weather patterns or shocks in the unpredictable rainy season or drought. The effects of climate change were, according to the farmers in the selected provinces already evident, challenging their adaptive capacity and contributing to increased risks. Ultimately, limiting their ability to create livelihood opportunities. The researcher concluded this chapter with an overview of the United Nations Framework Convention on Climate Change (the Convention). The researcher also focused on the institutional framework of the Convention and the actions taken by the Conference of the Parties to the Convention (COP) on climate change. The researcher further presented a brief overview of aspects of the Kyoto Protocol with some legislations on climate change.

CHAPTER SIX: RESEARCH METHODOLOGY

6.1 Introduction

This chapter provides a description detailed discussion of the research study areas and research methodology aimed at addressing the context of the research aims and objectives. Consequently, the chapter also explains the investigation area by highlighting the demographic characteristics, physical characteristics and socio-economic factors that relate to the subject of the study.

The second part of the chapter provides a comprehensive description of the philosophy of the study methodology, the basis of research study selection, research design, data collection and data analysis methods used to achieve the stated objectives of the study.

In the last part of this chapter, the researcher employs a combination of descriptive statistics and econometric models to analyse and interpret the data and provide meaningful analysis and discussions. Descriptive statistics such as mean, percentages, frequencies and standard deviations were used to analyse and categorise the information gathered. Descriptive statistics and appropriate econometric models such as Double-Hurdle with count data and Multivariate Probit Models were employed for the analyses.

6.2 Description of the Study Area

South Africa is considered semi-arid due to its mean annual rainfall of about 450 mm (South African Weather Service, 2009). However, there is a broad regional disparity in the yearly precipitation as indicated in Figure 6.1, which shows rainfall from less than 200 mm in the Richtersveld on the border with Namibia to more than 1000 mm in the mountains of the South Western Cape.

As mentioned in Chapter One, the study was conducted in four (4) district municipalities located in four (4) provinces of South Africa. The nine (9) district municipalities included eThekwini, uGu, Mopani and Vhembe, which are found in the upper highlands and lower highlands and in Kwa-Zulu Natal and Limpopo Provinces, respectively within South Africa. The other remaining district municipalities, namely Lejweleputswa, Thabo-Mofutsanyane and Dr Kenneth Kaunda are situated in the mid-highlands (semi-arid) areas. All the study areas have only one major rainy season (September to February). Given this, the yearly

precipitation distribution is imbalanced as there is more below average than over-average precipitation years and the median is more expressive than the mean. Soil and water conservation practices are extensively used in the research areas.

Figure 6.1 illustrates the study areas which shows the selected provinces and district municipalities.

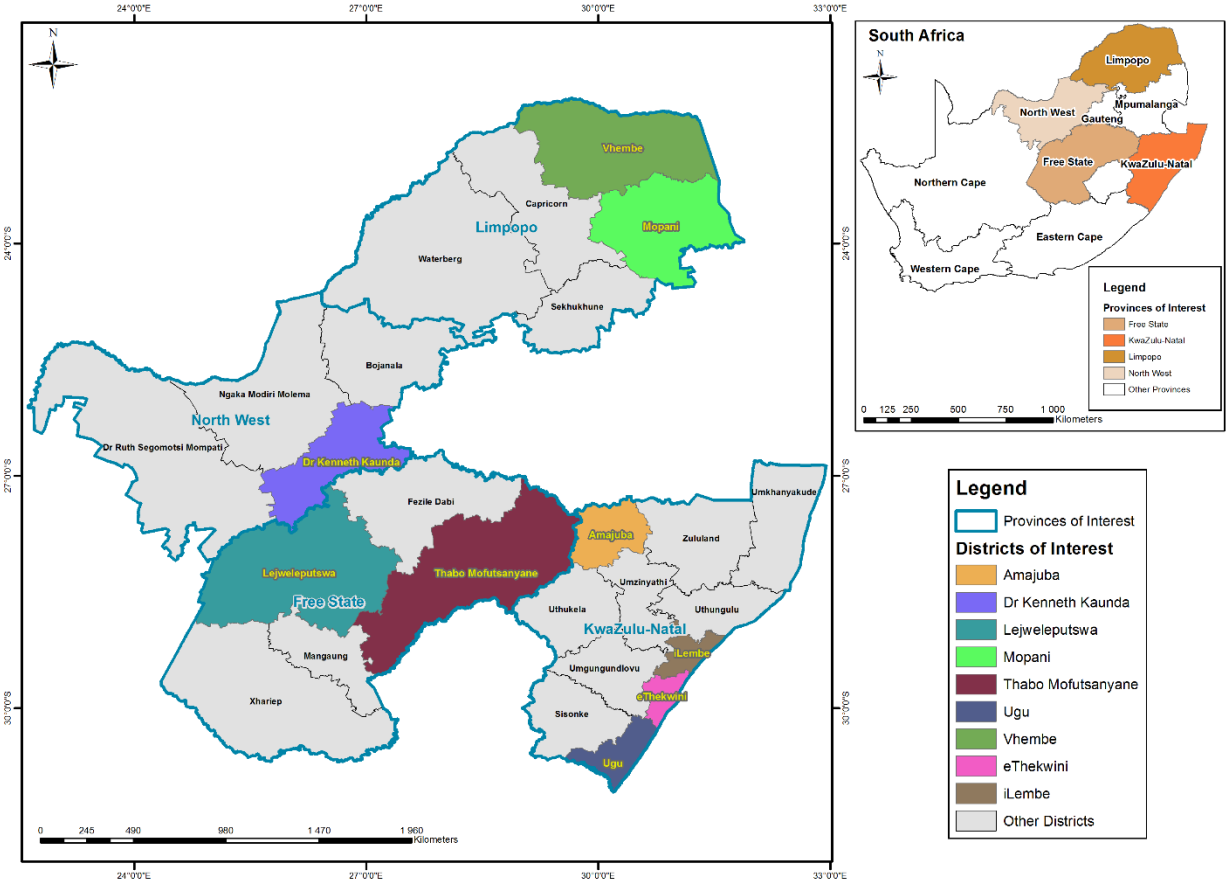


Figure 6.1: Median Rainfall, South Africa

Source: DRDLR, 2017

6.2.1 Demographic description of the study area

6.2.1.1 Free State Demography

According to the National Census of 2011, the Free State jurisdiction houses roughly 6.0% of the nation's populace (SSA, 2011). The Province is flawed by high scarcity rates, disparities in the allocation of income between a range of populace's subgroups and unemployment (SSA, 2011). Poverty and unemployment in South Africa are frequently a rural occurrence and given that a lot of the rural population are related to agricultural conduct, various national departments in South Africa have a significant task to perform in tackling the needs of smallholder farmers in countryside areas (SSA, 2011). The two municipalities chosen in the

Free State Province for the study are Thabo Mofutsanyana and Lejweleputswa District municipalities. Thabo-Mofutsanyane District Municipality is a Category C municipality located east of the Province of the Free State, bordering on Lesotho and the provinces of KwaZulu-Natal and Mpumalanga (SSA, 2011).

Despite all the socio-economic encounters confronting this region, the zone has considerable potential for tourism expansion owing to its picturesque attractiveness and its affluent artistic legacy (SSA, 2011). The SSA (2011) indicates that Thabo Mofutsanyana District Municipality is the biggest district in the Free State Province and is habitat to 27.9% of the populace.

Figure 6.2: Thabo-Mofutsanyana study area in Free State Province
Source: SSA, 2011

The stringent portrayal of 96 555 families (13.8%) are labelled as agrarian families. The disparity is great and is instigated in fraction by the reality that although many homes are occupied in agrarian happenings (frequently personal manufacture), it is not a very important revenue basis to many of these homes (SSA, 2011).

Lejweleputswa District Municipality is a Category C municipality located in the north-western part of the Free State. It is a boundary to the North West Province to the north, Fezile

Dabi and Thabo Mofutsanyane to the north-east and east in that order, Mangaung and Xhariep to the south and the Northern Cape Province to the west (SSA, 2011). The district constitutes approximately one-third of the area and comprise the subsequent five local municipalities, with roughly 18 towns spread all through; Matjhabeng, Tokologo, Masilonyana, Tswelopele and Nala, as indicated in Figure 6.4 (SSA, 2011).

Figure 6.3: Lejweleputswa District Municipality
Source: SSA, 2011

6.2.1.2 Kwa-Zulu Natal demography

KwaZulu-Natal (also known as KZN or *"the garden province'')* is a South African province established in 1994 after the combination of the two provinces, namely Zulu Bantustan of Kwa-Zulu *("Place of the Zulu"* in Zulu) and Natal Province. It is situated in the southeast of the republic, relishing extended seashore along the Indian Ocean and sharing boundaries with three additional provinces, as well as three countries, namely Lesotho, Mozambique and Swaziland (SSA, 2011). The Census (2011) report indicated that KZN is the second utmost inhabited province in South Africa following Gauteng. Kwa-Zulu-Natal has a wide-ranging however, leafy climate due to its varied and complex landscapes (SSA, 2011).

According to the South African Weather Services (SAWS, 2017), temperature decreases near the locality, with Pietermaritzburg being identical in the summer, however cold in the wintertime. Ladysmith in the Tugela River Valley reaches 30 °C (86 °F) in the summer and may decrease below the sub-zero point on winter nights (IDP, 2017). The eThekwini Metropolitan Municipality is a Category A municipality instituted in the republic's province of KZN, as presented in Figure 6.5. eThekwini is the main city in this area and the third major city in the republic. Its land expanse is comparatively greater than that of other South African urbanites and is topographically mountainous, with numerous valleys and gorges and approximately no true seaside plain (IDP, 2017).

Figure 6.4: eThekwini Metro
Source: eThekwini Metro IDP, 2017

The uGu District Municipality is a Category C municipality, situated in the far south of KZN. It lies south of eThekwini, bounded by an oceanfront of 112km. The district encompasses four local municipalities, namely Umdoni, uMzumbe, Ray Nkonyeni and Umuziwabantu, all of which have contributed significantly to the development of the area's budget (uGu IDP, 2017), as illustrated in Figure 6.6. Profitable farming in the region manufactures 1/5 of all bananas consumed in the republic, with numerous corporations fruitfully distributing these and other merchandise to several prominent packers in the United Kingdom (uGu IDP, 2017).

The Ugu District comprises Blue Flag Status beaches, which have put holiday business as a key financial cultivator (uGu IDP, 2017). It also consists of other famous yearly performances, such as the Africa Bike Week, which have increased impetus globally.

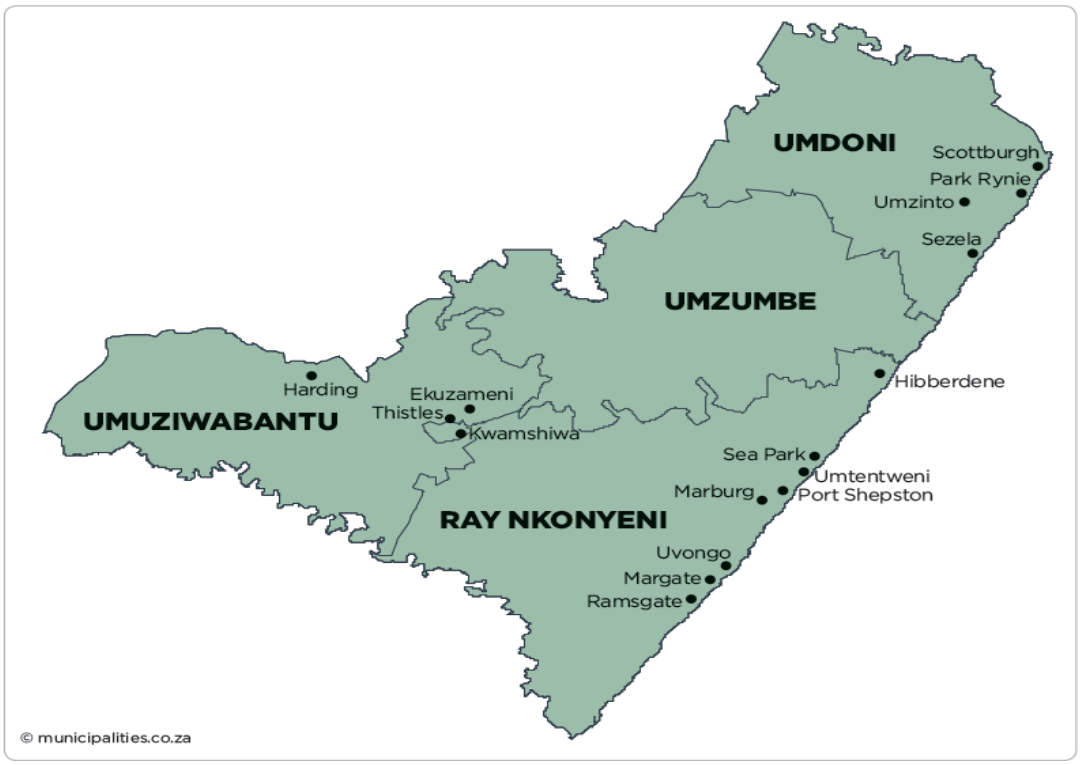


Figure 6.5: uGu District Municipality
Source: uGu IDP, 2017

The iLembe District Municipality is a Category C municipality set on the east coast of KZN, nearby the Indian Ocean (uGu IDP, 2017). It is the least of the area's district municipalities, accounting for a mere 3% of its topographical range. iLembe comprises four local municipalities set between eThekwini and Richards Bay, namely Mandeni, Kwa-Dukuza, Maphumulo and Ndwedwe, as indicated in Figure 6.7 (uGu IDP, 2017). The seat of iLembe is Kwa-Dukuza (formerly Stanger). At the boundary of the region is the Unicity of Durban in the instant south, which is connected by the seaside freeway to Richards Bay in the north, giving it the passage of admission to both harbours for trade motives (uGu IDP, 2017). It is also an important dwelling for the holiday business industry for its rich Zulu Kingdom customs, as it was termed in the generation of King Shaka.

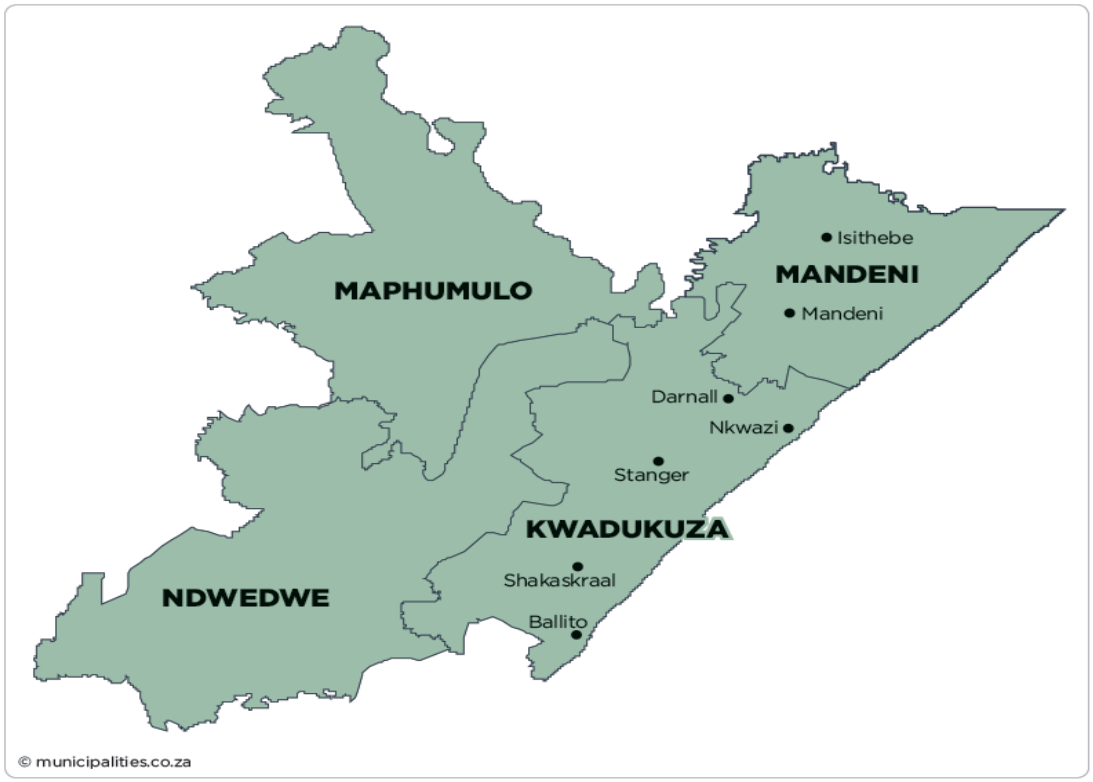


Figure 6.6: iLembe District Municipality
Source: iLembe IDP, 2017

The Amajuba District Municipality is a Category C municipality set in the north-western bend of KZN, adjoining the provinces of Limpopo and the Free State. It is one of the minutest areas in the province, making up only 8% of its topographical part (iLembe IDP, 2017). The municipality encompasses three local municipalities, namely Emalangeni, Dannhauser and Newcastle, as indicated in Figure 6.8. The main conveyance courses connecting the region to its environs are the N11, which is the elective path to Johannesburg from Durban, including the rail line, which is the key line from the Durban port to Gauteng (iLembe IDP, 2017). The R34 also intersects the area in an east-west course and offers a connection from the harbour city of Richards Bay to the inner.

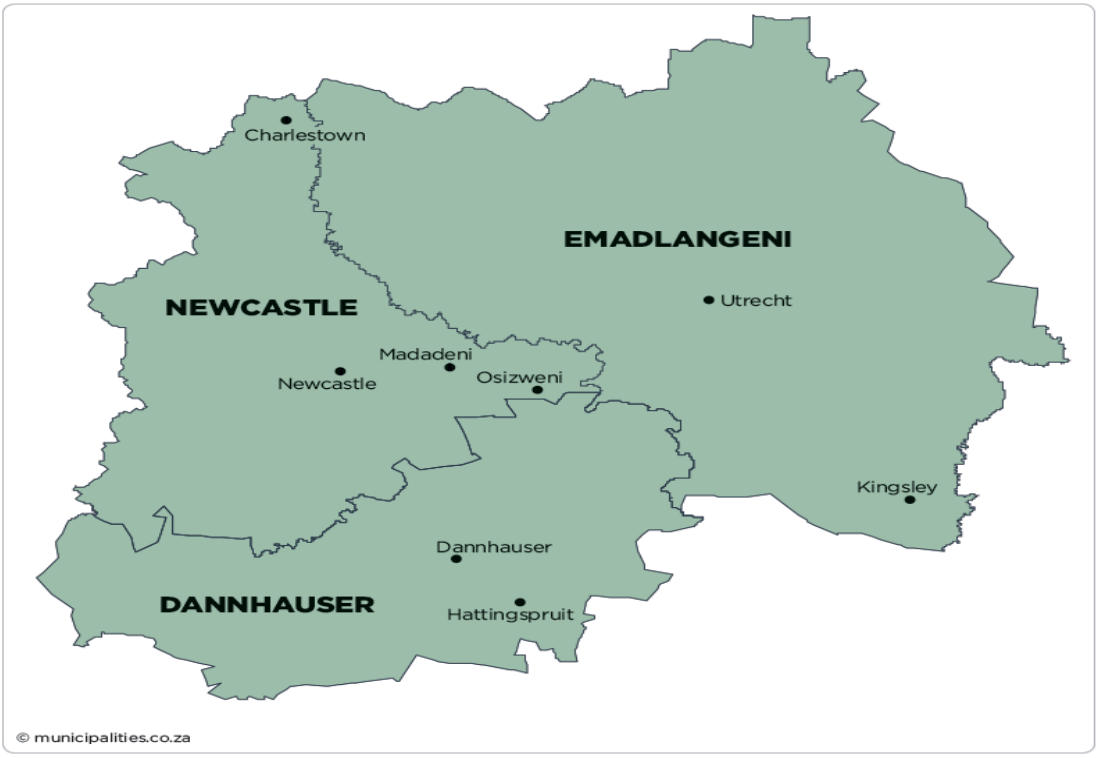


Figure 6.7: Amajuba District Municipality
Source: Amajuba IDP, 2017

6.2.1.3 Limpopo Demography

Limpopo province is the northern province of South Africa, which has a huge unspoiled natural countryside that is referred to as the *"Golden horseshoe"* (Spierenburg *et al.,* 2006). This province comprises five (5) districts, namely: Greater Sekhukhune, Mopani, Capricorn, Waterberg and Vhembe, as reported by the Limpopo Department of Agriculture (LDA, 2012). However, this study focused on the Mopani and Vhembe districts. In order to optimise agricultural production to contribute towards food security, nutrition status and livelihoods for improved well-being of smallholder farmers (LDA, 2012), these districts are regarded as the most affected districts by climate change in Limpopo.

The entire province spans an area of 12.46 million hectares, which is 10.2% of the total area of South Africa (Oni *et al.,* 2012). This province has three distinct climatic regions, which include the Lowveld (arid and semi-arid regions), the middle veld, high-veld (semi-arid region) and the escarpment region, which have a sub-humid climate with a 700mm rainfall per annum (LDA, 2012). The two distinct agricultural production systems are the large-scale commercial farming system and the smallholder farming system. The large-scale commercial farming system in the province is mainly dominated by the White population of South Africa

who has the most advanced production technologies and well-organised farms situated on prime land, which covers about 70% of the total land area (SSA, 2009). Currently, there are about 5000 commercial farming units in the Limpopo province (Statistics South Africa, 2009). Furthermore, smallholder farmers are in remote areas with low levels of production technology, a farm size of about 1.5 hectares per farmer, covering about 30% of the provincial land. In 1995 Statistics South Africa (1998) it was estimated that there were about 519 000 smallholder farmers, with about 80% being women. However, the estimation has decreased to 273 000 in the year 2000 (Oni *et al.,* 2012).

Mopani District Municipality

The Mopani District is situated in the north-eastern part of the Limpopo Province. The District has been named Mopani due to the abundance of nutritional Mopani worms found in the area (Mopani IDP, 2012). This district has five local municipalities, namely Maruleng, Ba-Phalaborwa, Greater Giyani, Greater Letaba and Greater Tzaneen, as indicated in Figure 6.9. However, only two of the five municipalities were researched in this study (i.e., the Greater Tzaneen and the Maruleng local municipality), due to the area large numbers of smallholder farmers who depend on agriculture for their livelihoods and the high-temperature variations experienced. The Mopani District covers an area of about 20 011 km^2 in the Limpopo province with a population size of about 1, 092,507 people and 296,320 households (SSA, 2011).

The district is made up of 14 urban areas (towns and townships), 352 villages (rural settlements) constituting a great proportion of unemployment and poor people (81%) and a total of 118 wards (IDP, 2012). Farming is the second largest employer in the Mopani District; with about 25.9% of the employed people. However, this District is characterised by low rainfall (400mm to 900mm), resulting in limited water resources causing severe water shortages and regular drought conditions, particularly in the lower-lying areas of the district (IDP, 2012).

Figure 6.8: Map indicating study areas in Mopani District
Source: Limpopo local government handbook, 2012

Vhembe District Municipality

According to Mpandeli and Maponya (2013), the Vhembe District municipality is in a semi-arid area; it frequently experiences dry spells, often growing into a severe drought. The district is the most northern district of the Limpopo Province with a rainfall pattern ranging between 246mm to 681mm per annum (Mopani IDP, 2012). Vhembe comprises of variable soil types, for example, sandy in the west and higher loam and clay content toward the east. These soil types are mainly developed on basalt, sandstone and biotite gneiss, with low inherent soil fertility (Odhiambo & Magandini, 2008). This district has four local municipalities, namely Musina, Mutale, Thulamela and Makhado, as indicated in Figure 6.9.

However, only two of the four municipalities were included in this study, namely Musina and Mutale local municipalities. The Vhembe District covers an area of about 25 592 km2 which is predominantly rural, with a population size of about 1, 294,722 people (SSA, 2011). Smallholder farms in this district are located mostly in the former homeland areas and their farming is characterised by low levels of production.

Figure 6.9: Map indicating study areas in Vhembe District
Source: Limpopo local government handbook, 2012

6.2.2.4 North West Demography

North West (NW) is a province of South Africa, with its capital being Mafikeng, although Rustenburg is the biggest city in the area. The province is positioned to the west of the main populace centre of Gauteng. A great deal of the area comprises level parts of dotted trees and grassland. The Magaliesberg mountain range in the northeast and spans roughly 130 km (approximately 80 miles) from Pretoria to Rustenburg.

Temperatures range from 17°C to 31°C (62°F to 88 °F) in the summer and from 3°C to 21°C (37° to 70°F) in winter. Yearly precipitation reaches roughly 360 mm (about 14 in), with approximately all of it precipitating throughout the summer months, amid October and April. Dr. Kenneth Kaunda District Municipality (previously known as the Southern District Municipality) is one of the 4 Districts of the North West Province of South Africa. The seat of the Kaunda District is Klerksdorp (SSA, 2016). The home language of approximately 742 821 of its populace is Setswana (SSA, 2016). The bulk of its population lives in the City of Matlosana Municipality. The area was previously known as the Southern District Municipality (SSA, 2016). It is named after Kenneth Kaunda, the first President of Zambia.

Figure 6.10: Dr Kenneth Kaunda District Municipality
Source: Census, 2016

The Dr. Kenneth Kaunda District Municipality is a Category C municipality in the North West Province. It is positioned 65km south-west of Johannesburg and borders the Gauteng Province on that side (SSA, 2016). It is the smallest district in the province, accounting for 14% of its geographical area. Three municipalities form the area of Dr. Kenneth Kaunda District Municipality, namely JB Marks, City of Matlosana and Maquassi Hills. It is an area with an affluent and varied natural and cultural customs, with the likelihood of continued financial expansion (SSA, 2016). The Municipality is a dwelling to several famous gold mines in the world and one of the oldest meteor impact sites in the world. The District is serviced by several primary roads, with the N12 Treasure Corridor being the main improvement axis in the district and existing as a probable concentration point for upcoming industrial, commercial and tourism growth (SSA, 2016).

6.2 Research methodology

Both qualitative and quantitative methods were used to collect data on smallholder farmers' perceptions of climate change and their choice of adaptation strategies. Qualitative research was used to seek an understanding of the decisions of the smallholder farmer's adaptation strategies towards climate change by looking at first-hand experience to provide data that is

meaningful to the researcher. Qualitative data was collected by conducting one-on-one interview with smallholder farmers to probe farmer's perception and choice of the climate change adaptation strategies using a questionnaire with open-ended questions.

The quantitative research method mainly uses numerical analysis to reduce data into numbers or percentages, unlike the qualitative method (Crossman, 2014). This method uses a close-ended questionnaire. In this study, the quantitative method was used to compare responses from the participants because all participants were asked identical questions in the same order, which allowed for a significant comparison of responses across participants and study areas (Crossman, 2014).

The questionnaires were administered by the field workers to assist each farmer in providing information on their choice of adaptation, decisions towards climate change and its intensity, disaster risk reduction and adaptation strategies, support they receive from the Department to cope with the climate and none-climate challenges, their observations in their areas on the major changes in weather patterns over the last 10 years, adaptation measures they have used to deal with changes in temperatures, rainfall and what influences their decision, as well as their sources for crop irrigation.

6.2.1 Methods of Data Collection

The primary data was collected from the smallholder farmers using a semi-structured questionnaire by conducting one-on-one interviews. The survey questionnaire was prepared in English and then translated into the respective local languages (IsiZulu, Setswana, South Sotho and Tshivenda) in order for the field workers to obtain accurate information from the farmers since these languages are used by all the residents/farming communities in these areas.

6.2.2 Research design

The study is designed in a multi-stage stratified random sampling procedure where a combination of purposive and random sampling procedure was used to identify and select a sample of the districts and smallholder farmers, respectively. At the first stage, nine (9) districts in four (4) provinces were purposively selected since the districts are frequently susceptible to climate-related problems and were recently declared drought disaster areas. The study utilised both a qualitative and descriptive quantitative research approach, which

aims at identifying factors influencing the choice of smallholder farmers' adaptation strategies to climate change.

Also, a sample household was selected using simple random sampling (SRS) with probability proportional to size technique. A simplified formula, as provided by Yamane (Wilma, 2005), was used to determine the required sample size at 95% confidence level, 5% degree of variability and 8% level of precision. Accordingly, 183 samples of households out of 250 were selected for inclusion in the analysis. The primary data used for the study was obtained from a cross-sectional survey of the Land Reform Beneficiaries (LRB) (smallholder farmers) in four (4) provinces, namely: Free State, Kwa-Zulu Natal, Limpopo and North West using a semi-structured interview (open- and closed-ended questionnaires).

Lastly, the data enumerators were carefully selected and trained for one day on the content of the questionnaire and the interview procedures. Four (4) data enumerators were requested for this study to assist in collecting data. The researcher has focused on examining the choices, values, intensity of decisions in adaptation and attitudes of smallholder farmers on climate change and adaptation strategies being exercised by smallholder farmers. A survey or cross-sectional research design was used to capture the relevant data and generate appropriate information. Complementing the research design with the appropriate research methods helps to enhance the acquisition of valid data for analysis (Bryman, 2001).

Thus, a mixed research method that generates quantitative and qualitative data was adopted for the study. Quantitative research is a research strategy that emphasises quantification in the collection and analysis of data and it entails a deductive approach to test theories, while qualitative research predominantly emphasises an inductive approach to generate theories (Bryman, 2001). Considering these issues and the nature of the research, a broad base of information was required to address the stated research objectives.

6.2.3 Sampling selection and sample size

The researcher has collected data in four (4) provinces, namely Free State (44), Kwa-Zulu Natal (35), Limpopo (88) and North West (14), with two agro-ecological zones: semi-arid, Highveld and low veld areas. In this study, a sample of 183 farmers out of 250 was taken from land reform farmers and district managers and the remaining 67 questionnaires came back unanswered. In order to select these participants, a two-stage sampling approach was employed.

First, two district municipalities from the Free State, two from Limpopo and one from North West were purposively selected in the respective district municipalities based on agro-ecological zones and the intensity of the impact of the climate change and variability.

Second, using a systematic sampling method farmers were selected from Kwa-Zulu Natal proportionally, where four (4) district municipalities from KZN were selected. In this case, the lists of the farmers (communal and land reform beneficiaries) were collected first from the field workers. An element of randomness was introduced in the systematic sampling method by using random numbers to pick with which to start. This sampling procedure is useful when a sampling frame is available (i.e., in the form of a list). In such a design, the selection process starts by picking some random points in the list and then every *n*th element is selected until the desired number is secured.

Systematic sampling has certain benefits. It can be taken as an improvement over a simple random sampling as the systematic sampling is spread more evenly over the entire population. It is an easier and less costly method of sampling and can be conveniently used even in large populations.

6.2.4 Data collection tools

The study areas for data collection were selected based on a set of variables differentiating one province from another. Predominantly, variables related to physical attributes, topography, altitude, soil degradation, land-use practices, woody vegetation cover, access to roads, irrigation water use, exposure to erratic rainfall patterns, access to markets and credit services, agricultural extension support and proximity to big urban centres, have served as the basis for selection. In order to enhance the selection of the specific districts in rural areas, the districts were stratified based on similar attributes and representative districts were selected purposely considering the above variables. The STATA 13 was used for the analyses.

6.2.4.1 Household questionnaire

The household questionnaire was designed in line with the stated objectives and research questions in Chapter one and it includes diverse issues that could provide an understanding of the socio-economic attributes of the study of farm households and their choice of climate

change adaptation strategies, the impact of climate change on their livelihoods, strategies adopted to climate change and motivation of households to adopt mitigation measures that reduce climate change impacts. Also, institutional variables influencing development interventions at local level from the perspectives of climate change are included (Appendix I). The questionnaires were selected to capture representative farms across diverse agro-climatic conditions in all other provinces of South Africa.

After setting the questionnaire, a pilot test was carried out on 30 farm households with similar socioeconomic backgrounds in order to check the ease with which respondent households answered the questions and to ensure that the questions are meaningful and to estimate the time needed to complete one questionnaire. The participants were randomly selected according to their availability and to a balanced coverage of the socioeconomic diversity of the farms in the study villages. In each DM, an average of twenty (20) farmers (head of household) was surveyed. In all study areas, a total of 183 participants were interviewed.

The data collected relates to socioeconomic characteristics, farmers' perceptions of climate change and adaptation strategies developed by farmers to address climate change. The individual interview contained 46 questions in total, including check-all and forced-choice questions followed by a comprehensive discussion with the farmers. The questions focused on eight themes: Part I (Social Capital), Part II (Economic/Financial Capital), Part III (Institutional Capital), Part IV (Natural/Environmental Capital), Part V (Infrastructure/Physical Capital), Part VI (Cultural capital), Part VII (Governance Capital) and Part VIII (Political Capital).

The questions related to the general climate change choice of disaster risk reduction adaptation strategies were open-ended, while the specific questions related to climate change effect and temperature and rainfall were organised with sequential options. Responses were coded into different actual values and objectives of the survey were to collect the information needed for in-depth analysis of the research questions.

6.2.4.2 Fieldwork

The fieldwork for this study was carried out from November 2017 to June 2018. The initial field activity was an investigation survey of the study area to establish background information on agro-ecological conditions, livelihood activities, land use systems, natural resource base, development activities being implemented in the context of climate change

and variations. Interactions were carried out with government officials working in the district and selected individuals having knowledge of their localities to enrich the investigation survey. In this exercise, issues related to climate change/ variability incidences, development interventions on agriculture and natural resources management/environmental protection activities designed to avert problems arising due to climatic variability were points of concern.

The overall activity in this regard has helped the researcher to establish a good picture of the study areas and prepare relevant questions in each data collection tool such as a questionnaire. There were challenges experienced during the collection of data in the respective provinces, which resulted in the exclusion of the Eastern Cape Province as they wanted to be paid and had many problems regarding the Department's support. The farmers' resistance to participate in the study was the result of the researcher requesting the Land Reform officials to assist in the Eastern Cape.

6.3 Method of Data Analysis

After the data was collected from the sample participants, the researcher employed both descriptive statistics and an econometrics model to analyse and interpret the data, which provided meaningful analysis and discussions. Descriptive statistics such as mean, percentages, frequencies and standard deviations were used to analyse and categorise the information gathered. Descriptive statistics and an appropriate econometric model such as the Double-Hurdle Model with count data and Multivariate Probit Model were employed for the analyses. These models are discussed in detail in the next section.

6.3.1 Descriptive statistics and Econometrics Model

6.3.1.1 Double-Hurdle (DH) Model

The most popular sample selection models used to correct the presence of zeros in the empirical literature are the Double-Hurdle (DH) Model, as well as the Tobit and Heckman sample selectivity models (Wodjao, 2007). Empirical studies have commonly vindicated the superiority of the DH approach over the Tobit and Heckman sample selectivity models (Wodjao, 2007). The Double-Hurdle Model, originally proposed by Cragg (1971), has been extensively applied in several studies, for example, Burton *et al.* (1996) and Newman *et al.* (2001).

However, this model has been rarely used in the adoption of climate change adaptation strategies, with the exception of Hitayezu *et al*. (2017). Baiyegunhi and Oppong (2015) used the Double-Hurdle Model to estimate the commercialisation of Mopani worms (*Imbrasia belina*) in rural households in the Limpopo Province, South Africa. The result of the Double-Hurdle Model showed that gender, education, household size, quantity harvested, social capital, distance, transportation and information impact households' decision-making to commercialise Mopani worms.

Furthermore, household age, gender, education, exogenous income, price, the quantity of marketable surplus, the absence of institution/law and transportation are statistically significant factors influencing the intensity of Mopani worm commercialisation in the study area. Hitayezu *et al.* (2017) used a Double-Hurdle Model in the assessment of farmers' perceptions about climate change among farmers in KwaZulu-Natal, South Africa.

The results point to higher probabilities of perceiving climate risk among farmers who experience more emotive mental imagery and those with stronger egalitarian values. The results further suggest that farmers who perceived climate change based on effective impression and direct personal experience are more likely to suffer cognitive bias in their perceptions compared to farmers who perceive climate risk based on knowledge and analytic processing of climate information. In estimating the determinants of adoption of poultry technology in East Shewa and Welayeta zones of Ethiopia, Teklewold *et al.* (2016) employed a Double-Hurdle approach.

Results of the study indicated that farmers' decision on adoption of poultry technology was positively affected by the sex of the household head, family size, availability of supplementary feed, credit and extension service and the extent of the expected benefit from poultry, while negatively affecting the market problem. However, farmers' decision on the extent of adoption of exotic poultry breed was positively influenced by the age of the household head, experience in the adoption of poultry technology, expected benefit from poultry and negatively influenced by the market problem. Dong *et al.* (2004) utilised the DH to model milk-purchasing behaviour with panel data. Newman *et al.* (2003) applied the Double-Hurdle Model to study Irish household expenditures on prepared meals for home consumption.

Ghimire and Huang (2015) employed a Double-Hurdle approach to estimate the household wealth and adoption of improved maize varieties in Nepal. The study found the presence of heterogeneous factors influencing adoption and intensity of adoption between poorly and well-endowed households, suggesting a need for wealth-group-specific policy interventions to increase adoption of IMVs and their subsequent impacts on food security. The results also indicated that the availability of seed in local retail outlets would benefit the poorly endowed farmers, because the distance to market showed a negative impact on the adoption and intensity of adoption of IMVs.

In a study conducted by Aryal *et al.* (2018), they applied a Double-Hurdle Model for assessing the factors that determine the adoption and intensity of laser-levelling technology among farm households in Haryana. The results show that large landholders are more likely to laser-level their farmland; however, a negative association between land holdings and the proportion of laser-levelled land was found. Information about technology through farmer-to-farmer communication and private traders, participation in agricultural training and membership in local agricultural institutions increased both the likelihood and the intensity of adoption.

6.3.1.2 Multivariate Probit Model (MVP)

Mulwa *et al.* (2017) used a Multivariate Probit Model in assessing the role of information, household demographics and farm characteristics as a response to climate risks among smallholder farmers in Malawi. Plot characteristics, credit constraints and availability of climate-related information explain the adoption of several climate change adaptation strategies. In relative terms, the result also indicate that even when financial limitations are binding, making climate-related information available can still motivate farmers to adapt. The study recommended that the deepening of extension access with information on the appropriate adaptation strategies is crucial to help farmers make adaptation choices.

However, Asfaw *et al*. (2014) explored adaptation to climate change and food security in Malawi and employed a Multivariate Probit (MVP) technique to model simultaneous and interdependent adoption decisions by farm households. They used multiple maize plot observations to jointly analyse the factors that facilitate or impede the probability of adopting these practices in a smallholder maize system. The approach recognised the likely correlations between the adoption decisions across the different practices for the same farm

household through unobserved characteristics. It simultaneously modelled the influence of the set of explanatory variables on each of the different practices, while allowing the unobserved and unmeasured factors (error terms) to be freely correlated.

The study found that access to extension advice, social capital and collective action also positively affect the adoption decisions suggesting the importance of information and networks. The impact estimate shows that adoption of farm management practices has a positive and statistically significant impact on maize productivity signifying the positive synergies between adaptation strategies and food security.

The result of the MVP from the study of Danso-Abbeam and Baiyegunhi (2017) on the adoption of agrochemical management practices among smallholder cocoa farmers in Ghana showed that agrochemical management practices are complementary and thus the adoption of an agrochemical input is conditional on the adoption of others. The result further showed that different household characteristics, household assets, institutional variables and the perception of soil fertility status and the incidence of pests and diseases influence the adoption of individual agrochemical inputs.

Kassie *et al.* (2013) examined the adoption decisions for SAPs, using recent primary data of multiple plot-level observations collected in four districts and 60 villages of rural Tanzania. The study employed a Multivariate Probit technique to model simultaneous interdependent adoption decisions by farm households. The analysis revealed that rainfall, insects and disease shocks, government effectiveness in the provision of extension services, tenure status of the plot, social capital, plot location and size and household assets, all influence farmer investment in SAPs.

The study recommended that policies that target SAPs, aimed at organising farmers into associations, improving land tenure security and enhancing skills of civil servants can increase uptake of SAPs in smallholder systems. In estimating the determinants of the farmers' adaptation to CC in agricultural production in the central region of Vietnam, Liu and Huang (2013) used a Multivariate Probit Model to explore the different factors influencing the farmers' decisions on adaptation to climate change in their agricultural production.

Training attendance, farm size, damage level, educational level, farming experience, access to credit and gender were the factors that significantly influenced the probability that farmers would adapt to climate change. Of these factors, attendance in climate change training and farm size were the most important factors affecting the farmers' decisions on adaptation to climate change, while labour availability and membership in local organisations were not.

Based on 505 consumers' sampling data from the Shandong Province of China, Han and Mu (2018) used a Multivariate Probit Model to analyse the factors influencing consumer multilevel cognitive behaviour. The results indicated that consumer cognitive behaviour to purchase fresh agricultural products online presents a significant heterogeneity; there are different cognitive effects of gender and income at all levels, while age and education have significant effects at all levels of cognition in individual characteristics; there are different cognitive effects in network security awareness and computer operation skills, as well as information channels of fresh agricultural products and consumer involvement at all levels; the popularity of shopping websites has a significant effect on cognitive performance at all levels.

6.3.2 Empirical models used for the study

6.3.2.1 Intensity and adoption of climate change adaptation strategies among smallholder farmers

Farmers usually make rational decisions when it comes to the adoption of any particular technology. Since the objective of the farmer is to maximise expected (discounted) profits over time, although subject to input, commodity prices and technology constraint, farmers will usually weigh the benefits associated with a particular technology before they decide to adopt it. Rationally, a farmer will adopt new technology if the expected (discounted) utility of profits of using that technology is greater than the utility from the old technology (Adesina & Forson, 1995). Count data are non-normal and thus are not well estimated by Ordinary Least Squares (OLS) regression (Maddala, 2001).

According to Cameron and Trivedi (1998), the most common regression models used to analyse count data models include the Poisson Regression Model (PRM), the Negative Binomial Regression Model (NBRM), the Zero Inflated Poisson (ZIP) and the Zero Inflated Negative Binomial (ZINB). The PRM and NBRM regression models have become the standard models for the analysis of response variables with non-negative integer (Greene, 2008; Kirui *et al.,* 2010). The ZIP and ZINB regression models are specifically used to

account for cases with frequent zero counts (i.e., when there are more zeros than would be expected), as in the case of this study. Only the ZIP will, therefore, be discussed since the response variables were non-negative integers with a few zero counts.

The Zero-Inflated Regression Model was employed in this study because diagnostic tests from the Poisson Regression Model revealed the presence of overdispersion and under dispersion in the Poisson Regression Model. In order to handle data sets that contain excess zero, two-part models have been used in the study, with the hurdle Poisson and Zero Inflated Poisson (ZIP) models being the common ones. Each of these two models consists of an equation for participation and a model for the event count that is conditioned on the outcome of the first decision (Cameron & Trivedi, 2005). The Hurdle Probit Model combines a Binary Model (adoption of climate change adaptation strategies) to predict zeros and a Zero-Inflated Regression Model (count part) to predict non-zero counts (Cameron & Trivedi, 1998).

Thus, the hurdle probit relaxes the implicit assumption in the Poisson and the negative binomial models that the zeros and the positives come from the same data generating process. The advantages of using a hurdle Poisson are two-fold; firstly, the hurdle Poisson model is suitable for taking into account the over-dispersion or under-dispersion of the data (Cameron & Trivedi, 1998).

Secondly, the hurdle Poisson model controls data selection. The starting point of the hurdle Poisson model is a binary process, which determines whether the variable takes on the value zero or a positive value (Cragg, 1971).

The Zero-Inflated Poisson Model provides another way to model excess zeros. In ZIP regression, the counts Q_i equal 0 with probability Φ_i and follow a Poisson distribution with mean $\gamma_i = \gamma(X, \beta)$ and probability $1-\Phi$. The probability mass function for the Zero-Inflated Poisson is given as:

$$\ln Y(\Psi_i, \alpha_i, q_i) \equiv \Pr(Q = q) = \begin{cases} \Phi_i + (1-\Phi_i)\exp(-\gamma_i), & q = 0 \\ (1-\Phi_i)\dfrac{\exp(-\gamma_i)\gamma_i^q}{q^!} & q = 1, 2, 3... \end{cases} \quad (3)$$

The probability Φ_i is parameterised as a ZIP function of the observable vector of covariates σ_i , thereby ensuring non-negativity of Φ_i , that is

$$\gamma = \frac{\exp(\sigma_i \partial)}{1 - \exp(\sigma_i \partial)} \tag{4}$$

where σ_i is a vector of covariates while ∂ is a vector of coefficients. Let $1(q_i = 0)$ denote an indicator variable that takes value 1 if $q_i = 0$ and zero otherwise. The log-likelihood function for the double hurdle model is presented in equation 5:

$$\log L = \sum\nolimits_0 \ln\left[1 - \Upsilon(\sigma_i^{!}\partial)\Upsilon(\frac{X_i^{!}\beta}{\delta})\right] + \sum \ln\left[\Upsilon(\sigma_i^{!}\partial)\frac{1}{\delta}\Upsilon(\frac{q_i - X_i^{!}\partial}{\quad})\right] \tag{5}$$

After the adoption of climate change adaptation strategies, the producer decides how the smallholder farmers adopt many of these climate change adaptation strategies. Because the choice set is observed as a number of varieties (a discrete, countable decision), the decision is appropriately modelled using a count regression model such as the Poisson or ZIP. The model was estimated using full information maximum likelihood estimation (FIML). The maximum likelihood estimation of the hurdle model involves separate maximisation of the two terms in the likelihood, one corresponding to the zeros and the other to the positives.

6.3.2.2 Determinants of constraints to adoption of climate change adaptation strategies

The Multivariate Probit Model is used to analyse the determinants of climate change adaptation strategies constraints among smallholder farmers in the study area. This approach had been used in similar studies (Mulwa *et al.*, 2017; Ojo & Baiyegunhi, 2019). When the covariance matrix of disturbance is unknown, the feasible generalised least square (FGLS) method can be applied to estimate the parameters and correlation coefficients simultaneously (Zellner & Huang, 1962), while the least square residuals may be used to consistently estimate the elements of the covariance matrix of disturbance (Greene, 2000).

The MVP model was formulated in line with Lin *et al.* (2005), using three dummy dependent variables representing the constraints to the adoption adaptation strategies used by farmers in the study area to mitigate the effect of climate change on their farms.

Climate change adaptation strategies constraints are described by a series of dichotomous variables defining the possible categories of constraint viz. lack of knowledge of CC constraint, lack of climate change information constraint and lack of capital constraint. MVP recognises the correlation in the error terms by simultaneously modelling the effects of a set

of covariates on each of the constraints to the adoption of climate change adaptation strategies and estimating a set of binary probit models. In terms of econometric modelling, separate estimations would not capture this correlation and would not exploit the information deriving from the entire set of common regressors (Green, 1997; Asfaw *et al*. 2016).

A correlation coefficient with a positive sign is consistent with the unobserved heterogeneity in the discriminatory tendency against the farmers (complementarity). However, a coefficient with a negative value is consistent with the interpretation that factors causing farmers to be placed in the constrained category may make them less likely (substitutability) to be placed in another category. MVP also establishes the relationship between the constraints of adaptation strategies and accounting for potential correlations between unobserved disturbances (Danso-Abbeam & Baiyegunhi, 2017).

Since the utility could not be observed, it was depicted as a function of observable components, as expressed in equation (1):

$$Y_{ik}^{*} = \beta_k X_{ik} + \alpha_k A_{ik} + \varepsilon_k \qquad \text{where } (k = 1,\ldots, m) \qquad (1)$$

$$Y_{ik} = 1 \;\; if \;\; Y_{ik}^{*} > 0 \text{ and 0 if otherwise}$$

where Y_{ik}^{*} is the latent variable that represents the unobserved characteristics and is associated with k^{th} representing climate change adaptation strategies, while Y_{ik} denotes the binary dependent variables, and $(k = 1,\ldots, m)$ represents the various practices used by smallholder farmers in the study area. A smallholder farmer was given a value of 1 if he is constrained by adopting any of the adaptation strategies and 0 otherwise X_{ik} is a vector of the explanatory variables used in the model.

According to Wooldridge (2003), A_{ik} denotes climate change variables, such as the experience of drought and flood that account for unobserved heterogeneity. β_k and α_k are conformable vectors that are also estimated. The error term, ε_k, has multivariate normal distributions, with zero means, unitary variance and an n × n correlation matrix (Mulwa et al., 2017), where $\varepsilon_k \approx MVN(0, \Pi)$. The covariance matrix, Π, is illustrated in equation 5:

$$\Pi = \begin{vmatrix} 1 & \rho_{12} & \rho_{13} & \cdots & \rho_{1m} \\ \rho_{21} & 1 & \rho_{23} & \cdots & \rho_{2m} \\ \rho_{31} & \rho_{32} & 1 & \cdots & \rho_{3m} \\ \vdots & \vdots & \vdots & 1 & \vdots \\ \rho_{m1} & \rho_{m2} & \rho_{m3} & \cdots & 1 \end{vmatrix} \quad (2)$$

where ρ represents the unobserved correlation between the stochastic components of the error terms in the model. As shown in equation (2), the elements at the off-diagonal represent the correlation between the stochastic error terms of the different adaptation strategies adopted (ρ_{21}, ρ_{12}, ρ_{31} and ρ_{13}) in the variance-covariance matrix (Teklewold *et al.*, 2013). The assumption of the unobserved correlation between the stochastic component of the k^{th} and m^{th} choice of adaptation strategies indicates that equation (1) provides an MVP model that represents the joint constraints of adopting an adaptation strategy.

6.3.3.3 The determinants of climate change adaptation strategies among the smallholder farmers

The decision to adopt a climate change adaptation strategies is a discrete outcome: either a farmer adopts a strategy or not. Households make decisions to maximise their expected satisfaction and their utility is a function of expected costs and benefits in adopting a technology, while their preferences are influenced by various factors. This study used the theory of utility satisfaction to conceptualise climate change adaptation strategies. A benefit derived from choosing a strategy might be the stability of productivity, with an implicit reduction in the impact of climate change.

A utility is maximised by risk-averse farmers when they select a strategy in which the benefits of adaptation minus the cost of adoption are more than the benefits realised without adoption. The farmer adopts a strategy if the utility derived exceeds that from not adopting. That is, $\Pi_a > \Pi_b$; where *a* denotes adoption and *b* denotes non-adoption. Π_a and Π_b are modelled as: $\Pi^a = X^i\beta_a + \varepsilon_a$ and $\Pi^b = X^i\beta_b + \varepsilon_b$. Since Π_a and Π_b are latent, it is the probability of the observed decision (adoption or non-adoption) that are modelled. This decision to adoption or non-adoption is dependent on socioeconomic, locational and technical factors surrounding a farmer, captured by the contextual identity framework. Since the utility

could not be observed, it was depicted as a function of observable components, as expressed in equation (2):

$$Y_{ik}^{*} = \beta_k X_{ik} + \alpha_k A_{ik} + \varepsilon_k \qquad \text{where } (k = 1,\ldots, m) \qquad (1)$$

$$Y_{ik} = 1 \ \ if \ \ Y_{ik}^{*} > 0 \text{ and 0 if otherwise} \qquad (2)$$

where Y_{ik}^{*} is the latent variable that represents the unobserved characteristics, while Y_{ik} denotes the binary dependent variables and $(k = 1,\ldots, m)$ represents the various climate change adaptation strategies used by smallholder farmers in the study area. A smallholder farmer was given a value of 1, if they adopt any of the climate change adaptation strategies and 0 otherwise X_{ik} is a vector of the explanatory variables used in the model. β_k and α_k are conformable vectors that are estimated.

6.4 Chapter Summary

This chapter encompassed a description of the study area in terms of physical and socioeconomic attributes. The study was carried out in four provinces with nine district municipalities of South Africa, all located in different topographical areas. The research design used for the study entailed a multi-stage stratified random sampling procedure where a combination of purposive and random sampling procedures was used to identify and select samples of the districts and smallholder farmers, respectively.

The research design adopted for this study is a survey design, more specifically known as a cross-sectional design which provides an opportunity to gather data from different sources at one point in time. Accordingly, data was generated from 250 sample farm households using survey questionnaires and only 183 questionnaires were responded to whilst 67 came back unanswered. In this research study, a mixture of qualitative and quantitative data was collected which aims at identifying factors influencing the choice of smallholder farmers' adaptation strategies to climate change.

The researcher employed a combination of descriptive statistics and econometrics models to analyse and interpret the data and provide meaningful analysis and discussions. Descriptive statistics such as mean, percentages, frequencies and standard deviations were used to analyse and categorise the information gathered. Descriptive statistics and appropriate econometric

models such as Double-Hurdle with count data and Multivariate Probit Models were employed for the analyses.

In the overall data analysis of the smallholder farmers' choice of adaptation strategies and the intensity on climate change, the Double-Hurdle (DH) with count data and Multivariate Probit Models (MVP) were used for the analysis and where applicable, the Zero-inflated regression model was employed because diagnostic tests from the Poisson Regression Model revealed a presence of over-dispersion and under-dispersion in the Poisson Regression Model. In order to handle data sets that contain excess zero, two-part models have been used, with the hurdle Poisson and Zero-Inflated Poisson (ZIP) models being the common ones.

The advantages of using a hurdle Poisson are two-fold. Firstly, the hurdle Poisson model is suitable for considering the over-dispersion or under-dispersion of the data. Secondly, the hurdle Poisson model controls data selection. The analytical tests in many places were supported by descriptive statistics and this involved computation of percentages of single variables, the median and average outcomes. SPSS version 13 statistical software was used for analysing the data.

The next chapter focuses on descriptive statistics and the analysis and discussions of the empirical results.

CHAPTER SEVEN: RESULTS AND DISCUSSIONS

7.1 Introduction

In this chapter, the researcher will analyse, interpret and discuss the outcome of the results. The researcher will employ both descriptive statistics and econometrics model to analyse and interpret the data and provide meaningful analysis and discussions. The chapter will thus address the major objectives stated in relation to the determinants of farmers' choices of adaptation options to climate change in the study area.

Descriptive statistics such as mean, percentages, frequencies and standard deviations were used to analyse and categorise the information gathered. Descriptive statistics and appropriate econometric models such as the Double-Hurdle with count data and the Multivariate Probit Model were utilised for the analyses and discussions on descriptive and empirical analysis will be presented and it will be addressed according to each objective. Different variables, constraints and factors affecting the choice of adaptations will also be discussed.

7.2 Descriptive analysis of the results

Under this section, the responses of the farm households (smallholder farmers) were analysed using descriptive statistics. This provided background information on the farmers and the agriculture activities they are engaged in. The data analysed include the demography of the farmers and information on their farming systems.

Figure 7.1 shows the number of participants per province, with the Limpopo Province having the highest number of participants, followed by the Free State. The Northwest province has the least number of participants.

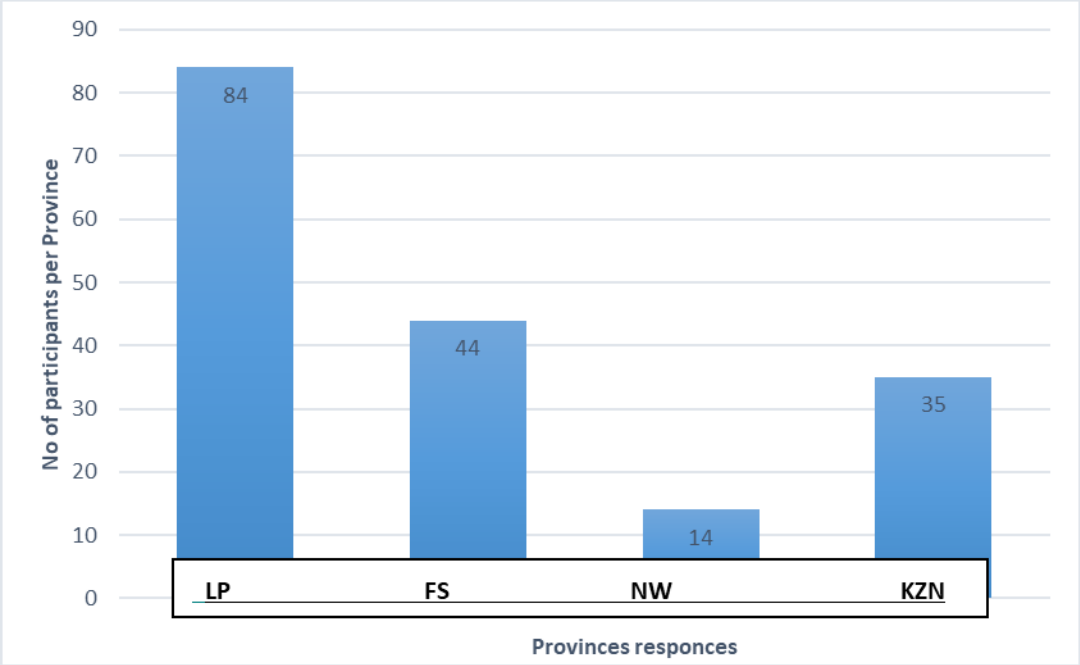


Figure 7.1: Frequency of respondents by Provinces

The participants of farmers in the Limpopo Province can be attributed to the highest level of support and participation from the Department of Rural Development and Land Reform.

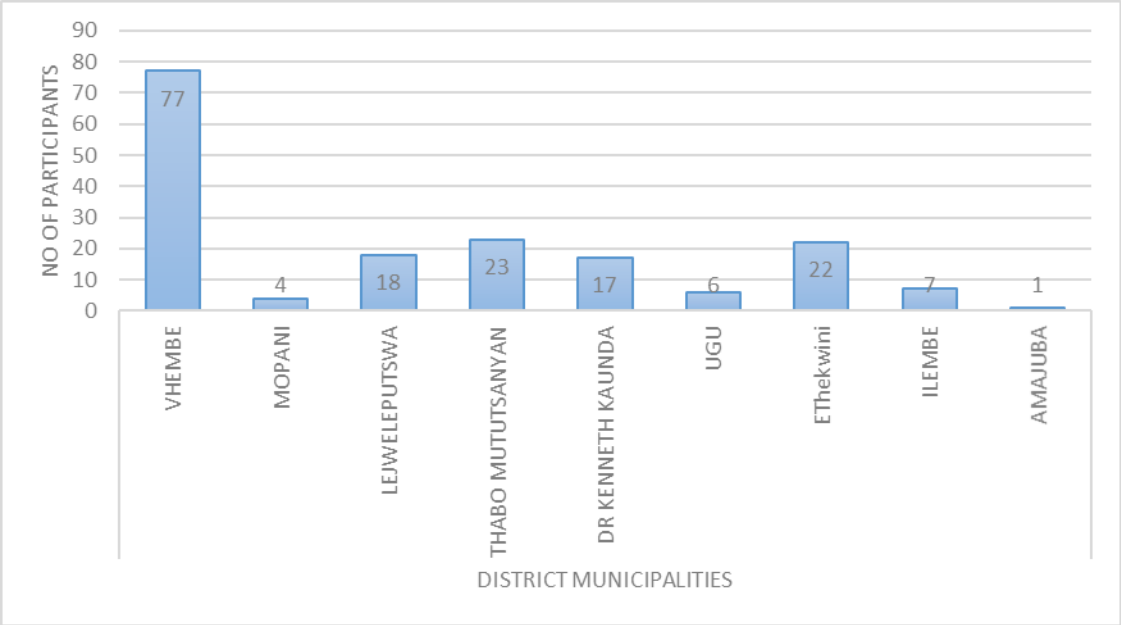


Figure 7.2: Number of participants per District Municipalities

Figure 7.2 indicated that the Vhembe District Municipality has a high number of participants, followed by Thabo Mofutsanyana and the least being the Amajuba District Municipality. As indicated in Figure 7.2, the disparity of responses from different district municipalities is

revealed. The Vhembe District Municipality appears to be the highest district that responded on the study questionnaires.

This also indicates their willingness to participate in the study and because the field workers visit the officials, it indicates that they are also embracing what the Department is doing to support them.

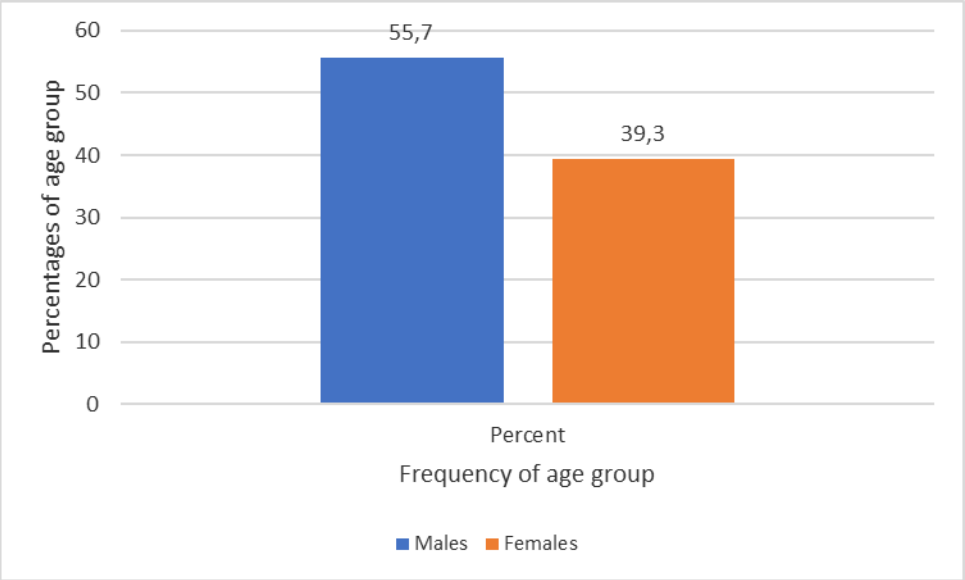


Figure 7.3 Percentages of gender of household head respondents

From the descriptive results in Figure 7.3, the percentage of males is higher than those of females. The percentage regarding females indicates that there are fewer female-headed households compared to male farmers. This is mostly because farming is dominant amongst male-headed households compared to female-headed households (Aguiler *et al.*, 2015).

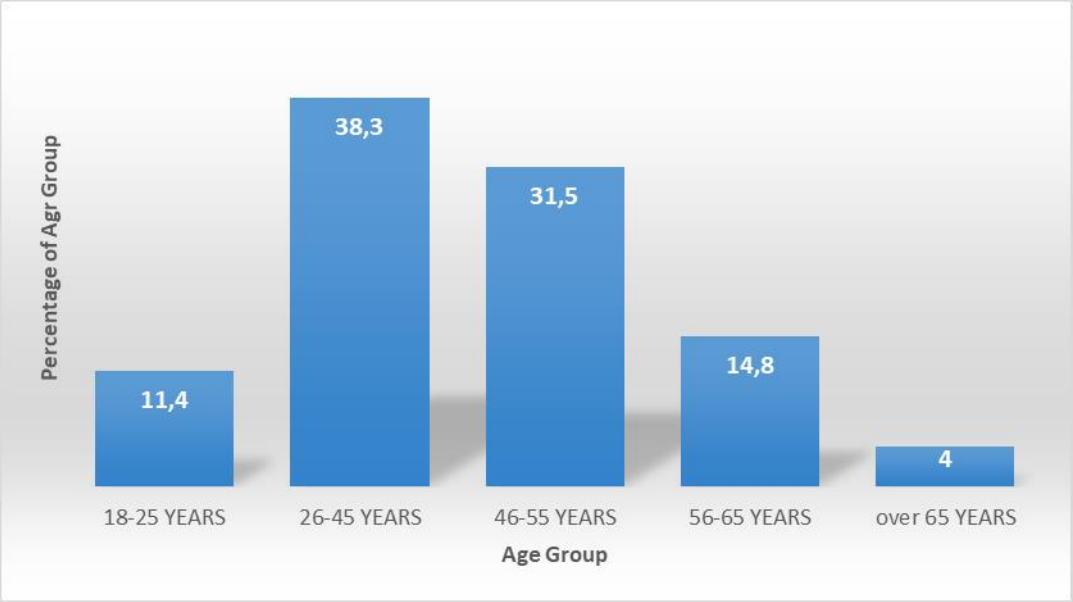


Figure 7.4 Age group of the respondents

Figure 7.4 shows that the most popular age group of the household heads of the smallholder farmers in the study areas range between 26 and 45 years of age. It constitutes 38.3% of the farmers, followed by the age group of 46 to 55 years, which constitutes 31.5%.

These two age groups constitute over 60% of the farmers. This simply implies that most young people have shown an interest in farming as they have benefitted in the land reform programme; the farmers in this study are land reform beneficiaries.

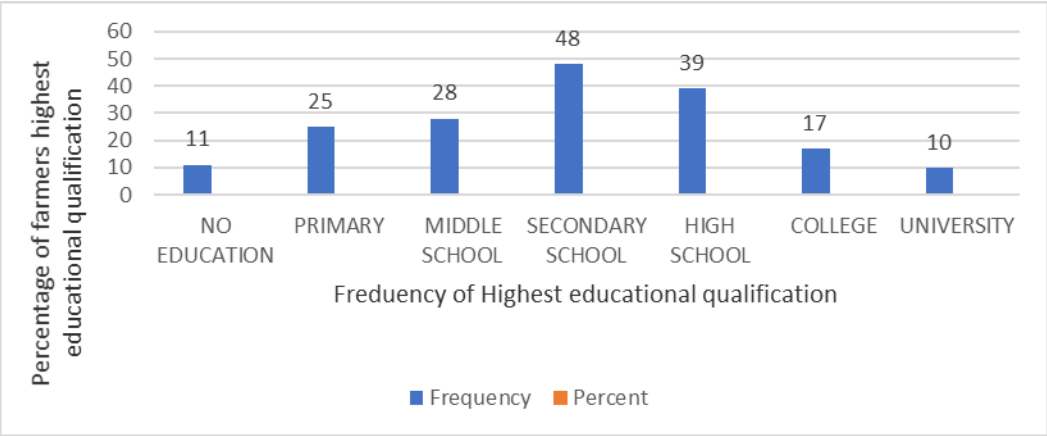


Figure 7.5 Highest Education Qualification of the respondents

Results of the survey, as shown in Figure 7.5, indicated that most farmers completed school at secondary level. However, they were able to use their indigenous knowledge to adapt to climate change because they have been using this knowledge to cope with climate change impact. Education plays an important role in the running and managing of a farm and more

educated farmers are expected to adapt to climate change, as stated Deressa *et al.* (2009) and Akponikpe *et al.* (2010).

Since the results show that a high percentage of the farmers in this study reached the level of secondary school and can read and understand the changes in temperature and weather patterns, they are expected to adapt to climate change.

The study also discovered that crop production is more prevalent in the Limpopo and Kwa-Zulu Natal provinces. This is also supported by the observed rainfall patterns from the SAWS data. Literature states that these areas are more suitable for crop production and that if farmers plant different crops per season, they can improve their productivity (Deressa *et al.*, 2009; Akponikpe *et al.*, 2010).

The results in Figure 7.6 shows that crop production is the highest farming system, especially in Limpopo and Kwa-Zulu Natal. This is followed by mixed farming and thus indicates that smallholder farmers in some study areas do know about different farming systems.

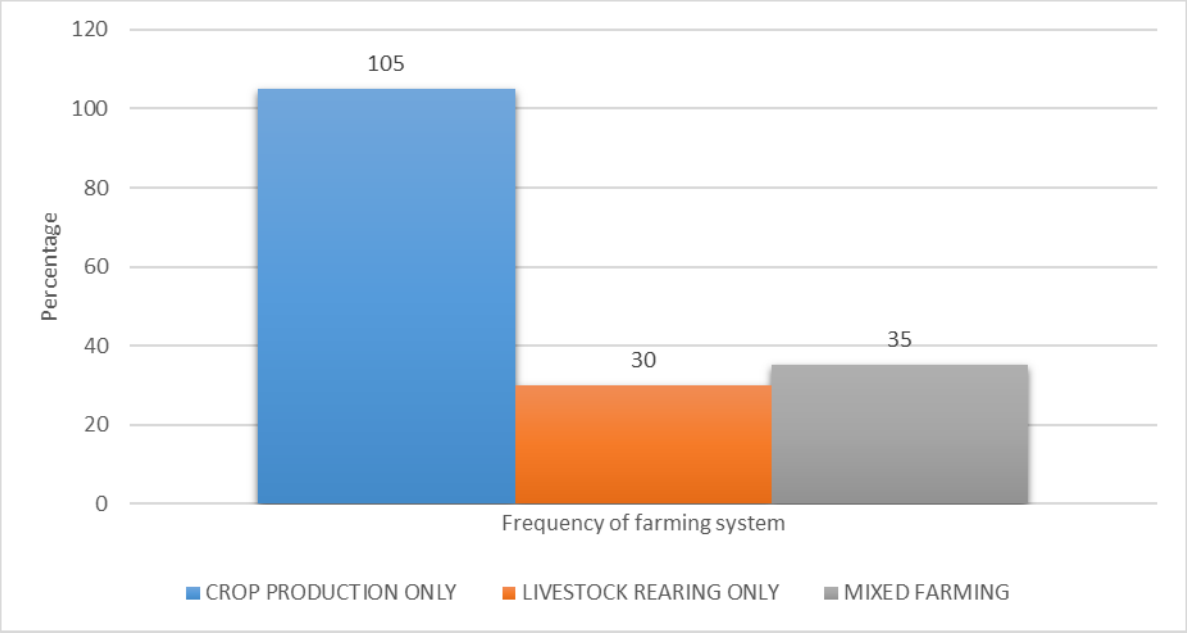


Figure 7.6 Frequency of farming systems

7.2.1 The descriptive statistics of the smallholder farmers in the study area

This section includes discussions about the description of both dependent and explanatory variables included in the model estimations. The dependent variables refer to the adoption and intensity of adaptation strategies employed by land reform beneficiaries. This study obtained its empirical specifications from the studies on the determinants of adoption of

climate change adaptation strategies (Abdulai & Huffman 2014; Kibue *et al.* 2016; Mulwa *et al.*, 2017; Ojo & Baiyegunhi 2019). The description of the explanatory variables and their respective means are presented in Table 7.1.

The socioeconomic characteristics such as gender, age, educational attainment, household size and the number of years in crop farming were included in the model in order to control household heterogeneity. These variables have been hypothesised to potentially influence the adoption and intensity of adaptation strategies. From the 183 responses, about 61% were males and 39% were females.

The average age of the sampled farmers was 43 years, suggesting that the majority of the farmers in the sample were in the productive age bracket. The majority (about 60%) of the respondents had attained at least a primary level of education.

Table 7.1: Definitions and summary statistics of variables used in the model

Variables	Description of Variables	Mean	Std. Dev.
Dependent variables			
Adoption of CC AS	1 = adopter, 0 = non-adopter of CC AS	90	85.13
Number of CCAS	Numbers of CC AS adopted by farmers	5.95	4.20
Lack of Knowledge	1 = constrained by knowledge of CC, 0 = otherwise	89.20	85.13
Lack of CC information	1 = constrained by CC information, 0 = otherwise	77.30	74.20
Lack of capital	1 = constrained by lack of capital, 0 = otherwise	72.34	69.45
Explanatory variables			
Age	Age of HH head (years)	43.83	12.68
Gender	1 if HH head is male, 0 if female	0.61	0.49
Educational level	Years of education of HH head	59.96	52.55
Farming experience	Years of household experience in farming	10.54	4.71
Access to extension	1 if HH has access to extension, 0 if otherwise	0.33	0.47
Non-farm income	1 = if HH engages in any off-farm activity	0.38	0.49
Credit	1 if HH has access to credit, 0 if otherwise	0.45	0.50
Land reform	1 = beneficiary, 0 = non- beneficiary of Land reform	0.32	0.47
Access to training	1 if HH has access to agricultural training, 0 if otherwise	0.48	0.50
ICT_Radio	1 if HH has access to information through Radio, 0 if otherwise	0.48	0.50
ICT_Mobile phone	1 if HH has access to information through mobile phone, 0 if otherwise	0.36	0.48
ICT_Television	1 if HH has access to information through Television, 0 if otherwise	0.25	0.43
ICT_Neighbour	1 if HH has access to information through Neighbour, 0 if otherwise	0.50	0.50
ICT_Family members	1 if HH has access to information from family members, 0 if otherwise	0.36	0.48
Access to irrigation	1 if HH has access to irrigation, 0 if otherwise	0.57	0.50

7.2.2 Discussions in responding to each of the study objectives: response from study questions

A 1: Profiling the smallholder farmers' perceptions of climate change

In this section, smallholder farmers' perceptions of climate change are investigated and checked against the actual climate, as stated by the meteorological services in the respective areas of study. This is the first stage towards the fulfilment of the main aim of this study.

The study explored the farmers' perceptions of climate change by asking questions on drought, floods, temperature and rainfall. The results are in line with the findings of Deressa *et al.* (2009) and Akponikpe *et al.* (2010).

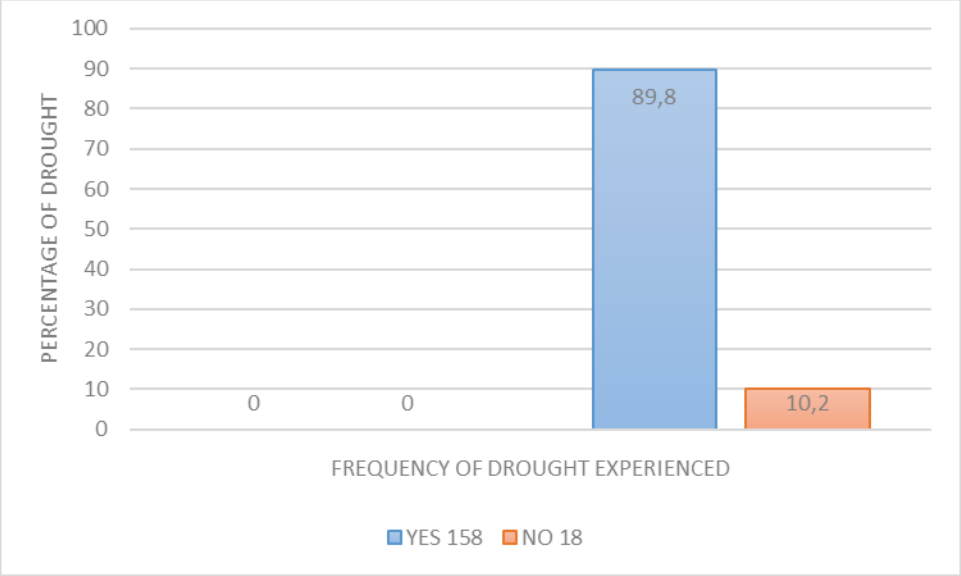


Figure 7.7 Drought experienced

There is a high percentage of farmers that experienced more drought than in the past 10 years. This is confirmed in Figure 7.8, which shows the rainfall patterns. This drought perception is expected to positively influence the adaptation to climate change by farmers as posited by Krishna (2011). These results are also confirmed in Figure 7.10 from the South Africa Weather Services, indicating the rainfall patterns in the four provinces of the study area in the past 10 years.

Figure 7.8 shows that there was a very low mean annual rainfall in the last 10 years. These results agree with the results from the studies by Bhushal *et al.* (2009), Akponikpe *et al.* (2010), McSweeney *et al.* (2010), Johnsen and Aune (2011), as well as Krishna *et al.* (2011),

which indicate that a clear majority of smallholder farmers experienced the effect of drought because of climate change.

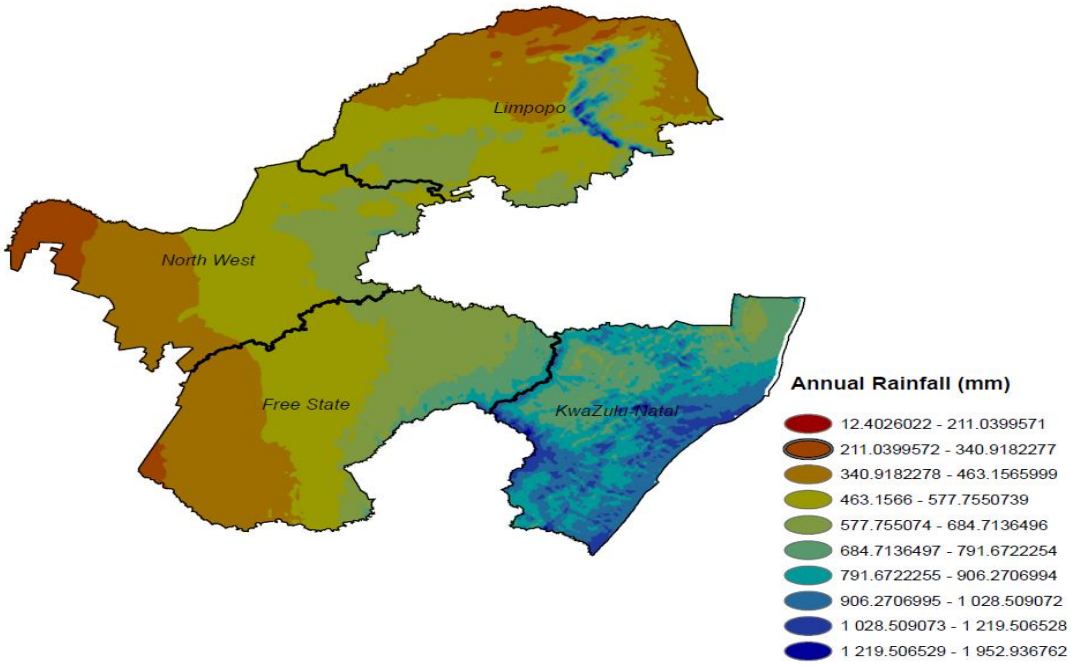


Figure 7.8 Mean Annual Rainfalls

Approximately 66% of the farmers, in response to the question of their experience regarding high temperatures, as presented in Figure 7.9, indicated that they have experienced high temperatures in the last 10 years.

These results show that most of the farmers in the study area experienced climate changes in terms of temperature. This could mean that the farmers are more likely to adapt to climate change as they experienced its effect on their agricultural activities (Krishna, 2010).

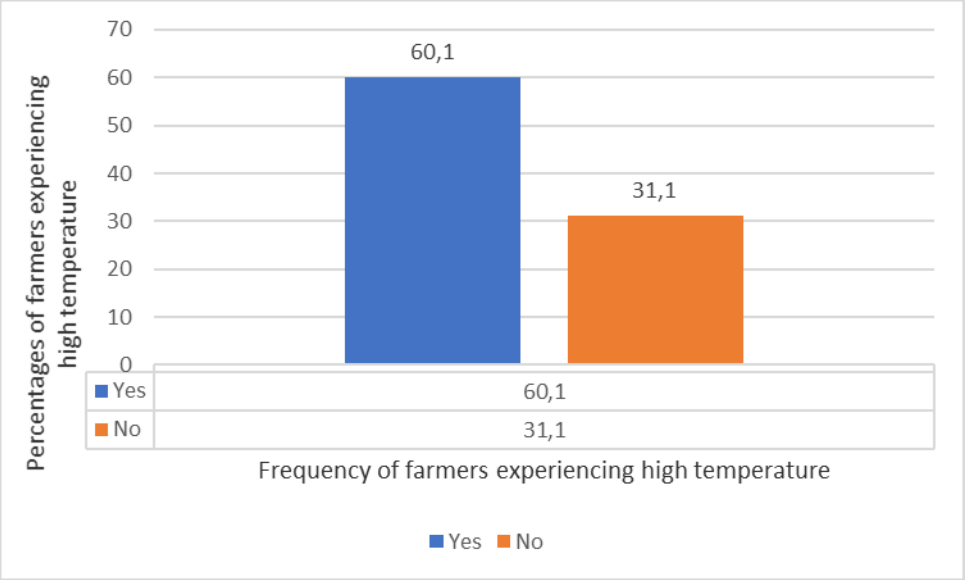


Figure 7.9 Farmers experiencing high temperatures

Figure 7.10 illustrates that most of the smallholder farmers in the study (63.3%) have experienced too much flooding in the past 10 years while less than 34% disagree and stated that they have not been aware of the increased floods. This was supported by the results from SAWS, which are presented in the SAWS report (2015) illustrating the mean annual rainfall. SAWS data shows that most parts of KZN, North West and the Free State experienced high volumes of precipitation in the past 10 years. The farmers experienced the effect of floods and rainfall in the study area.

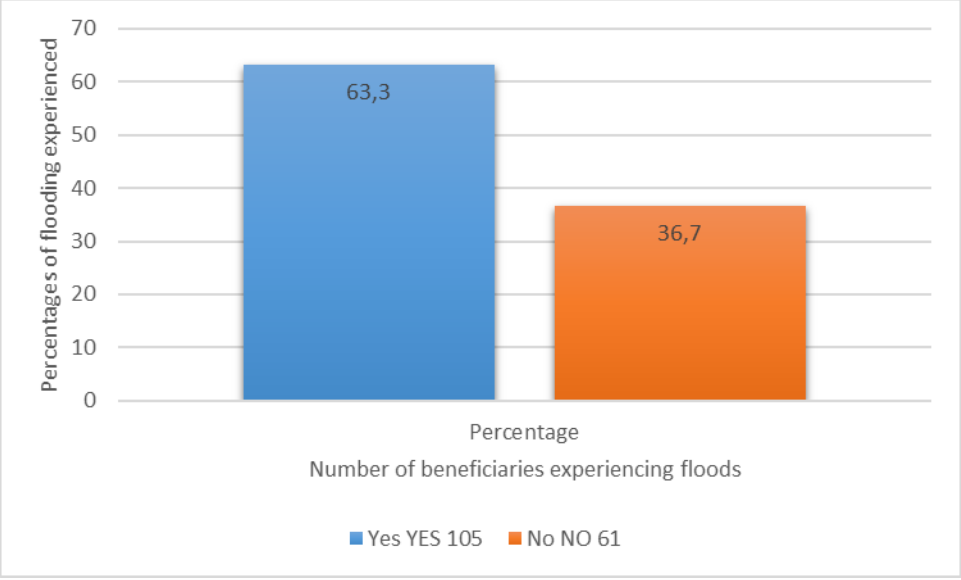


Figure 7. 10 Number of beneficiaries experiencing flooding

Figure 7.10 illustrates that for all the examined four aspects (droughts, floods, temperatures and rainfall), most farmers, on average over 60% observed climate change correctly. This was verified by the information from SAWS, which was presented by means of maps. Perception either has a positive or negative impact on adaptation, where research states that a correct perception has a positive effect and a wrong perception a negative effect (Krishna, 2011). From these results, most farmers are, therefore, expected to adopt adaptation strategies to deal with climate change impacts.

A 2: Profiling adaptation strategies currently used by smallholder farmers and constraints to adaptation

This section presents the results for the second objective. The first step in this objective was to profile the number of climate change adaptation strategies employed by smallholder farmers in the study area. According to Figure 7.11, almost 90% of the beneficiaries adopted climate change adaptation strategies to reduce the advert effect of climate change. Also, 11 adaptation strategies were listed that the farmers in the study area adopted. These are listed in Table 7.2.

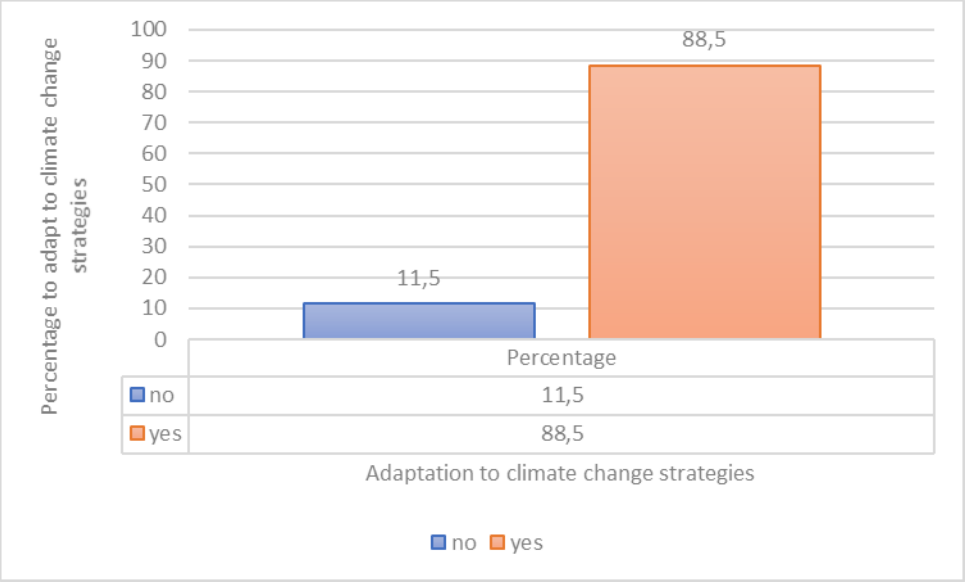


Figure 7.11 Adapt to climate change strategies

Table 7.2 presented the list of adaptation strategies that were employed by smallholder farmers.

Table 7.2 List of adaptation strategies that were employed by farmers in this study

No	Adaptation strategies
1	Buying Insurance
2	Change of Crop Variety
3	Mixed Farming
4	Temporary Migration
5	Planting Early Maturing Crops
6	Soil and Water Management
7	Planting Trees
8	Irrigation
9	Changing Planting dates
10	Off-Farm Employment
11	Reduced Number of livestock

Table 7.3 shows an analysis and the responses from the beneficiaries on the number of climate change adaptation strategies that were adopted. The study also shows that 88.5% of the farmers adopted at least one adaptation strategy. This agrees with the results from Objective 1, as presented in Table 7.3, which showed that most of the farmers in the study correctly perceived climate change and thus were expected to adapt in numbers.

Table 7.3 Number of climate adaptation strategies analysis

NUMBER OF CLIMATE ADAPTATION STRATEGIES					
No of CC adapt Strat		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	21	11.5	11.5	11.5
	1.00	28	15.3	15.3	26.8
	2.00	8	4.4	4.4	31.1
	3.00	5	2.7	2.7	33.9
	4.00	10	5.5	5.5	39.3
	5.00	17	9.3	9.3	48.6
	6.00	7	3.8	3.8	52.5
	7.00	13	7.1	7.1	59.6
	8.00	5	2.7	2.7	62.3
	9.00	9	4.9	4.9	67.2
	10.00	9	4.9	4.9	72.1
	11.00	51	27.9	27.9	100.0

NUMBER OF CLIMATE ADAPTATION STRATEGIES					
No of CC adapt Strat		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	21	11.5	11.5	11.5
	1.00	28	15.3	15.3	26.8
	2.00	8	4.4	4.4	31.1
	3.00	5	2.7	2.7	33.9
	4.00	10	5.5	5.5	39.3
	5.00	17	9.3	9.3	48.6
	6.00	7	3.8	3.8	52.5
	7.00	13	7.1	7.1	59.6
	8.00	5	2.7	2.7	62.3
	9.00	9	4.9	4.9	67.2
	10.00	9	4.9	4.9	72.1
	11.00	51	27.9	27.9	100.0
	Total	**183**	**100.0**	**100.0**	

Table 7.3 illustrates that only 27.9% of the farmers have adopted 11 adaptation strategies each. More than half of the farmers (51.4%) have adopted six or more adaptation strategies to deal with climate change. Literature also shows that farmers tend to employ more than one adaptation strategy to deal with climate change. Comparable discoveries were also testified by Rischkowsky *et al*. (2004), Arya (2010), Bhushal *et al.* (2009), Pettengell (2010) and Owusu-Sekyere *et al.* (2011).

The most common adaptation strategies were mixed farming, as shown in Figure 7.12. This is followed by soil and water management and reducing the number of livestock, with the least being buying insurance (46%) due to the cost thereof. It should be noted that this is also due to the dependency on Government to provide support and paying everything inclusive of insurance, thus there is a need for training and awareness for the smallholder farmers. Therefore, many smallholder farmers are disgruntled and failing to sustain their farm production due to a lack of support, lack of access to information and a lack of access to credit/finance (Cherotich *et al.*, 2012).

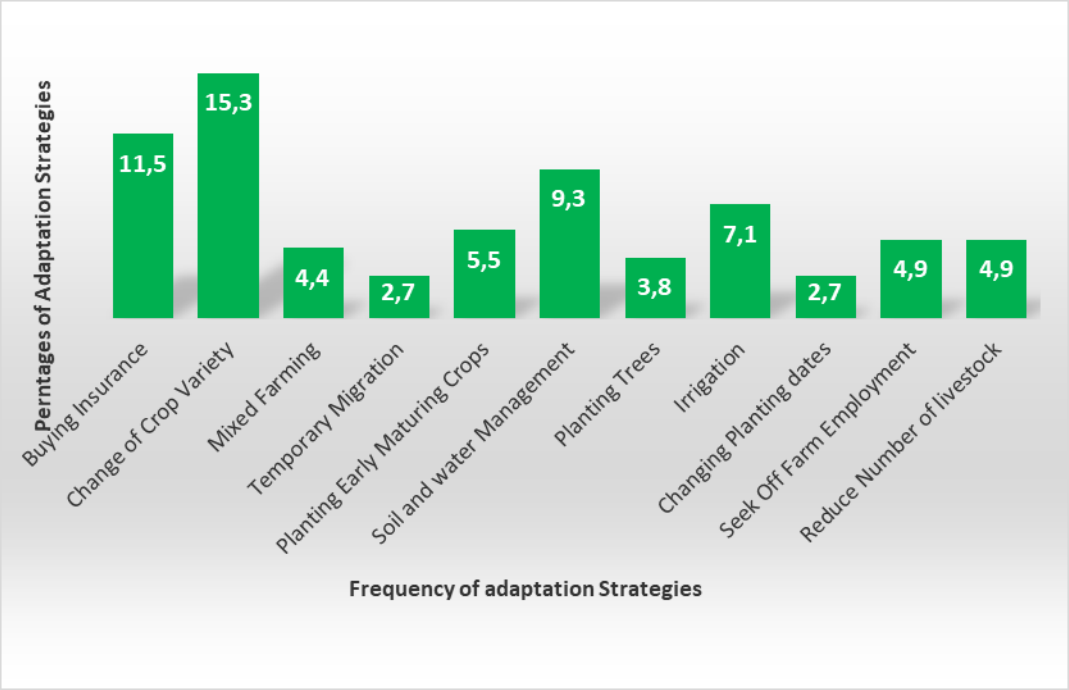


Figure 7.12 Adaptation strategies

The second step of this study included an exploration of the challenges of farmers' adaptation. The farmers were asked to state the reasons for not embracing adaptation. The results are summarised in Table 7.4. The top three constraints included a lack of information, lack of capital and lack of knowledge, which are crucial for adaptation.

Even though earlier in this study, the farmers showed correct perceptions and understandings of climate change, they did state that they lack knowledge and information on it, which has hindered their adaptation. Research has also shown that smallholder farmers' adaptation is mostly constrained by their lack of knowledge, information and financial constraints (Deressa, 2010).

The three dominant constraints to the adoption of climate change adaptation strategies were used as the outcome variables in the Multivariate Probit Model to ascertain the determinants of constraints to the adoption of climate change adaptation strategies among the smallholder farmers in the study area, as shown in Table 7.4.

Table 7.4 Constraints to adaptation by smallholder farmers

S/no	Reasons for not embracing adaptation	Yes (%)	No (%)
1	Lack of information	89.20	10.80
2	Lack of capital	73.90	26.10
3	Lack of knowledge	77.30	22.70

4	Shortage of farming land	60.80	39.20
5	Not observing climate-related problems	63.10	36.90
6	Giving less emphasis on climate change problems	68.80	31.30

Figure 7.13 shows the respondent's access to extension services. The results show that there is a high number of respondents that do not have access to extension services as compared to those who have access to the services.

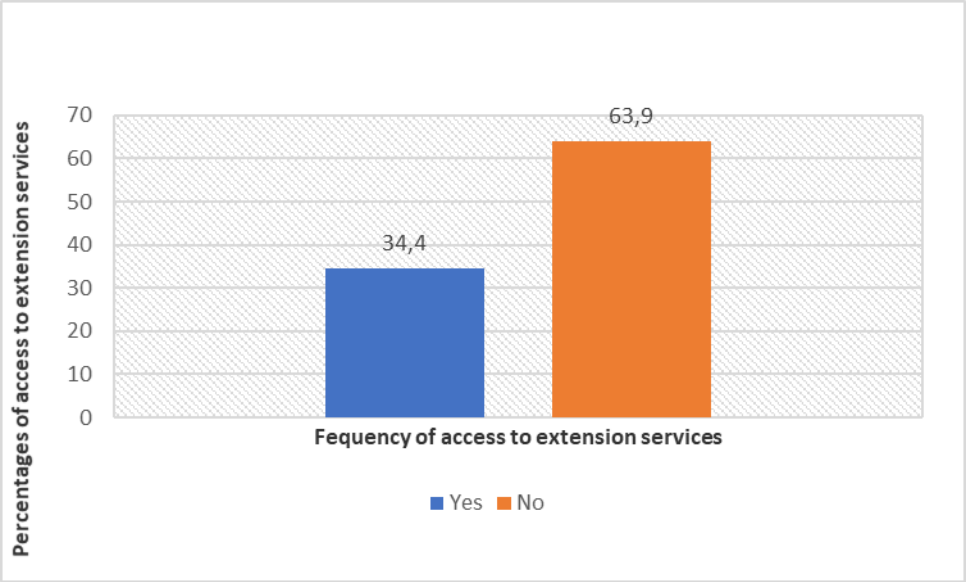


Figure 7. 13 Access to extension services

7.3 Empirical results and Discussions

This section presents results and discussions of the determinants of smallholder farmers' decision to adopt and their intensity of adoption of climate change adaptation strategies, as well as the estimated factors that constrain smallholder farmers' adaptation to climate change. This was achieved through fulfilling objectives 2 and 3 of the study.

7.3.1 The distributions of climate change adaptation strategies used by the farmers

Following Asfaw *et al.* (2019), it is imperative to understand and identify climate change adaptation strategies employed by the smallholder farmers in order to implement feasible adaptation strategies at farm level. Smallholder farmers mitigated climate risks through several adaptation practices.

Some of the adaptation strategies included mulching, varying planting date, soil and water conservation, use of improved planting materials, tree planting and planting early maturing variety. Others included the reduction of livestock numbers, migration and insurance. Some of these strategies were also identified in the studies of Hassan and Nhemachena (2008),

Deressa *et al.* (2015), Mulwa *et al.* (2017), Asfaw *et al.* (2019) and Ojo and Baiyegunhi (2019).

This aligns with the study of Fernandez-Cornejo and Mishra (2007) who indicate that participation in non-farm income activities increases technology adoption. Conversely, Diiro (2009) established that farmers without off-farm activities use all the available labour more intensively on the farm and thus adopt yield-increasing technologies. Lack of and/or limitations in information (on seasonal and long-term climate and agricultural production) increases downside risks due to the failure to adopt new technologies and adaptation measures (Kandli & Risbey, 2000).

A3: Determinants of smallholder farmers' decision on adoption of climate change adaptation strategies

The results of the Double-Hurdle Zero-Inflated Regression Model, which include the first hurdle (Probit) are presented in Table 7.5.

Table 7.5 Determinants of adoption climate change adaptation strategies: Probit model

Adoption of adaptation strategies	Coef.	Std. Err.	P-value
Age	-0.025	0.012	**0.033****
Gender	-0.542	0.260	**0.037****
Non-farm income	1.152	0.325	**0.000*****
Education	0.049	0.081	0.548
ICT_Television	-0.227	0.449	0.613
ICT_Radio	0.166	0.305	0.585
ICT_Mobile phone	1.137	0.257	**0.000*****
Access to extension	0.240	0.206	0.244
Agricultural trainings	0.824	0.416	**0.048****
Experienced flood	-0.014	0.275	0.959
Experienced drought	-0.478	0.485	0.324
Land tenure	0.768	1.071	0.473
Access to irrigation	-0.536	0.647	0.407
Access to credit	0.861	0.436	**0.048****
Access to information_Neighbour	-0.403	0.999	0.687
Access to information _Family member	-2.873	0.946	**0.002*****
Land reform	0.816	0.755	0.280
Constant	0.526	0.786	0.504

*,** &*** represent significant level at 10%, 5% & 1%, respectively*

The age of the respondent is negatively signed and statistically significant with the adoption of climate change adaptation strategies. This suggests that younger farmers are more likely to adopt compared to their older counterparts; possibly for being innovative and keen to try new technology and methods to improve agriculture. Older farmers could also be unaware of recent innovations in agriculture and/or are reluctant to try new methods. This is in line with the study of Ali and Erenstein (2017) that found that the age of the household head is negatively associated with the adoption of the adaptation strategies.

The gender of the respondent is negatively signed and statistically significant with the adoption of climate change adaptation strategies. The implication of the result shows that female-headed households are more likely to adopt climate change adaptation strategies as compared to the male-headed household.

In a study comparing gender differences in the adoption of sustainable agricultural intensification practices in Kenya, Ndiritu *et al.* (2014) concluded that female plot managers were more likely to adopt minimum tillage and animal manure compared to their male counterparts. Participation in non-farm income activities is positively signed with the adoption of climate change adaptation strategies among smallholder farmers.

The results show that as household income increases, adoption/utilisation of climate change adaptation strategies also increases. Lack of and/or limitations in information (on seasonal and long-term climate changes and agricultural production) increases downside risks due to not adopting new technologies and adaptation measures (Kandli & Risbey, 2000). The variable ICT_mobile is positive and statistically significant in influencing the adoption of climate change adaptation strategies.

Better climate and agricultural information using mobile phone help farmers choose strategies that enable them to adapt well with changes in climatic conditions (Baethgen *et al.*, 2003). As there is agricultural training, the more the respondents will utilise climate change adaptation strategies.

Access to land titles will likely induce the utilisation of climate change adaptation strategies. Access to radio, neighbour information and climate change will result in the utilisation of

climate change adaptation strategies. However, the adoption of adaptation strategies will be less if the source of such strategy information is from a family member.

A4: Determinants of the intensity of adoption of climate change adaptation strategies

In order to analyse the determinants of intensity of climate change adaptation used by smallholder farmers in the study area, some diagnostic tests were performed on the suitability of the model to use, as presented in Table 7.6.

Table 7.6: Estimation of AIC and BIC scores

Count Models	Degree of freedom	AIC	BIC
ZIP	17.000	931.780	985.088
NBREG	16.000	942.317	992.490
POISSON	15.000	999.248	1046.285

As shown in Table 7.6, estimation of Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) are important to indicate the better model in analysing count data of the intensity of adoption climate change adaptation strategies among smallholder farmers. In this study, the focus is on three count models, namely the Poisson Regression Model, the Negative Binomial Model and the ZIP Regression Model, starting from the AIC values, the Poisson Regression Model, NBREG and ZIP shows 999.248, 942.317 and 931.780, respectively. However, for BIC values, the Poisson Regression Model, NBREG and ZIP shows 1046.285, 992.490 and 985.088, respectively.

Comprising both observations, from AIC and BIC values, the Zero-Inflated Regression Model fits better in analysing count data of intensity of adoption of climate change adaptation strategies among smallholder farmers in the study area.

From the results in Table 7.6, it clearly shows that AIC values are much smaller in the ZIP Regression Model as compared to both Poisson and negative Binomial models. Furthermore, the BIC value also corroborates the results of AIC justifying the use of ZIP over the other two models with a smaller value.

Thus, the ZIP regression model is suitable for measuring the intensity of adoption of climate change adaptation strategies among smallholder farmers in the study area. The results of the ZIP Regression Model are discussed in this study. The ZIP Regression Model was estimated to examine the factors determining the intensity of climate change adaptation used by

smallholder farmers. The significance levels for the parameters of the ZIP Regression Model are presented in Table 7.7.

Table 7.7 ***Zero-inflated regression model of the determinants of intensity of adoption of climate change adaptation strategies***

	POISSON MODEL			**NEGATIVE BINOMIAL MODEL**			**ZERO-INFLATED MODEL**		
	Coef.	**Std. Err.**	**P-value**	**Coef.**	**Std. Err.**	**P-value**	**Coef.**	**Std. Err.**	**P-value**
Age	-0.020	0.003	**0.000*** **	-0.022	0.005	**0.000*** **	-0.020	0.003	**0.000*** **
Gender	0.061	0.068	0.370	0.110	0.113	0.331	0.067	0.069	0.336
Education	0.066	0.022	**0.003*** **	0.092	0.037	**0.012** **	0.104	0.023	**0.000*** **
Framing experience	0.008	0.007	0.286	0.009	0.012	0.488	0.015	0.008	**0.059***
ICT_Television	0.099	0.093	0.288	0.110	0.155	0.480	0.063	0.094	0.500
ICT_Radio	0.211	0.078	**0.007*** **	0.203	0.129	0.117	0.159	0.077	**0.040** **
ICT_Mobile phone	0.122	0.072	**0.093***	0.103	0.117	0.378	0.053	0.072	0.460
Non-farm income	0.249	0.084	**0.003*** **	0.230	0.134	**0.087***	0.302	0.083	**0.000*** **
Access to extension	0.025	0.026	0.349	0.039	0.060	0.515	0.019	0.027	0.469
Access to credit	-0.132	0.088	0.135	-0.174	0.149	0.243	-0.161	0.091	**0.077***
On-farm demonstration	-0.265	0.099	**0.007*** **	-0.304	0.165	**0.066***	-0.298	0.099	**0.003*** **
Experience flood	-0.171	0.081	**0.034** **	-0.152	0.126	0.229	-0.070	0.082	0.389
Experience drought	-0.327	0.150	**0.029** **	-0.284	0.219	0.195	-0.041	0.152	0.787
LANDREFOFF	-0.116	0.121	0.338	-0.109	0.197	0.581	-0.059	0.121	0.626
Constant	3.407	0.227	**0.000*** **	3.501	0.365	**0.000*** **	3.228	0.232	**0.000*** **
Inflate									
Gender							-0.277	0.598	0.643
Constant							-2.286	0.447	**0.000*** **
Lnalpha				-1.317	0.220				
Alpha				0.268	**0.059***				
Deviance goodness-of-fit		423.591							
Prob > chi2(155)		**0.000*** **							
Pearson goodness-of-fit		360.913							
Prob > chi2(155)		**0.000*** **							

, and *** represent significance level at 10%, 5%, & 1%, respectively*

Discussions of empirical results

A2: Determinants of the intensity of adoption of climate change adaptation strategies

From the results of the determinants of the intensity of climate change adaptation, three variables under the category of socioeconomic characteristics are significantly influencing the intensity of adoption of climate change strategies. The age of the household head, which equally represents farming experience, thus affecting the intensity of climate change adaptation strategies positively and significantly. The implication of the result shows that as the age of the household head increases, the person is expected to acquire more experience in weather forecasting, which subsequently increases the likelihood of practicing different adaptation strategies to climate change.

This aligns with Tazeze *et al.* (2012) who also found a positive influence regarding age on the adoption of climate change adaptation strategies among smallholder farmers in Ethiopia. The coefficient of education is positively signed and statistically significant, suggesting that education enhances the probability of adopting more climate change adaptation strategies than farmers with no formal education. Educated farmers usually have a better understanding of climate change and related issues.

Farmers' abilities are enhanced through education in order to assimilate information better, take up innovations and technologies and better anticipate changes that would improve their probability of adopting different adaptation strategies. Earlier works such as studies conducted by Abid *et al.* (2015), Asfaw *et al.* (2018) and Ojo and Baiyegunhi (2019) corroborate the results of this study.

The sign for farm size is positive and significant, indicating that households with larger farm sizes allocated to rice cultivation, for example, are more likely to adopt adaptation techniques. This could be because farmers with large plots of land have the flexibility of experimenting a portion of their plots for new agrarian technologies. Similarly, participation in non-farm work positively and significantly affects the adoption of climate change strategies. The current study's findings are similar to the works of Deressa *et al*. (2011) and Derresa *et al.* (2009).

Better access to services, apart from influencing the availability of technology, has an effect on farmers' decisions on the use of input and output markets and the availability of

information and support organisations, as well as the opportunity costs of labour. Many empirical studies (Fosu-Mensah *et al.* 2012, Below *et al.* 2012, Kibue *et al.* 2016, Asfaw *et al.* 2018) have documented that institutional variables such as participation in non-farm activities, training through extension services, on-farm demonstration plots and access to credit, among others, have significant positive effects on farmers' likelihood to adopt several adaptation strategies.

Interestingly, access to credit and non-farm income are all positive and statistically significant. Access to credit is a major determinant of the decisions to adapt to climate change. With resource limitations, farmers may fail to meet the costs of adaptation and at times, cannot make beneficial use of available information (Kandli & Risbey, 2000). The result of the study shows a positively signed and statistically significant influence of credit access on the intensity of climate change adaptation strategies.

The adoption of adaptation strategies could be capital-intensive, with some crops requiring investment in new or improved planting materials and other technologies. Therefore, it might be difficult for farmers to adopt any adaptation strategy if they have no access to credit, even when informed on climate change, as they might not be able to purchase the required inputs (Ojo & Baiyegunhi 2019).

Information received by farmers from agricultural extension agents through on-farm demonstration plots facilitates their decision on how and when to use climate change adaptation strategies such as improved seeds and changing of cropping calendar. Deressa *et al.* (2009) and Khanal *et al.* (2018) indicated a positive and significant relationship between extension access and farmers' adoption of climate change adaptation strategies. According to Fernandez-Cornejo and Mishra (2007), participation in non-farm income activities has been hypothesised to increase technology adoption.

The results indicate that non-farm work significantly increases the number of strategies farmers employ to reduce the adverse effects of climate change. The positive impact of non-farm work on climate change adaptation strategies agrees with the studies of Sallawu *et al.* (2016) and Derresa *et al.* (2009, 2011) in Nigeria and Ethiopia, respectively. The current study’s results suggest that the involvement of farm households in non-farm economic activities may free them from financial burdens and credit constraint conditions, inducing to invest in productivity-enhancing farm inputs and other adaptation strategies to minimise

production risk. Derressa *et al.* (2009) and Tazeze *et al.* (2012) reported that engagement in non-farm income-generation activities enhances the chance of changing planting and harvesting dates, planting trees and using irrigation systems as mitigation strategies.

The positive and significant effect of access to information on climate change through ICT suggests that farmers who receive information on climate change probably through radio, television and mobile phones, for example, are more likely to adopt adaptation strategies compared to those farmers that are information constrained. Thus, by making farmers aware of the adverse effect of climate change enhances their adaptive capacity. Similar findings were reported by Derresa *et al.* (2014), Shongwe *et al.* (2014), Opiyo *et al.* (2015) and Asfaw *et a*l. (2015) in Eastern Ethiopia, Swaziland (now Eswathini), North-western Kenya and North-central Ethiopia, respectively.

A3: Factors constraining smallholder farmers' adoption of climate change adaptation strategies

In order to estimate factors constraining smallholder farmers' adaptation to climate change, a Multivariate Probit Model was employed. The results of the correlation matrix from the MVP regression are reported in Table 7.8.

Table 7.8: Correlation matrix of the constraints to adoption of adaptation strategies from the MVP model

	Lack of Knowledge	**Lack of CC information**	**Lack of Capital**
Lack of Knowledge		0.4325 (0.189)**	0.154 (0.091)**
Lack of Climate change information			0.256 (0.229)
Likelihood ratio test	Chi^2 (3) =	(Chi^2) 162.57	
P-value	**0.0293****		
Joint probability (success)	49.047		
Joint probability (failure)	18.760		
Linear predictions			
Lack of Knowledge	0.457		
Lack of Climate change information	0.337		
Lack of Capital	0.540		

*** represents significance level at 5%, CC means climate change*

The results support the use of the MVP to study the relationship among the dominant constraints of adopting climate change adaptation strategies (lack of climate change knowledge, lack of climate change information and lack of capital). The likelihood ratio test (Chi^2 (3) = 162.570; P > 0.0293) of the independence of the error terms in the different constraint equations was rejected in Table 7.8. Therefore, the study accepted an alternative hypothesis of interdependence among the different constraints to the adoption of climate change adaptation strategies.

The results, therefore, justified the use of the MVP model. All the pair-wise coefficients were positively correlated, demonstrating complementarity among the constraints. The results show that the joint probability of being constrained with the adoption of climate change adaptation strategies was 49% while 18% was not constrained. The linear predictions of the results show that the likelihood of being constrained by a lack of climate change knowledge, lack of climate change information and lack of capital are 46%, 34% and 54%, respectively.

The age of households is statistically significant and inversely related only to a lack of knowledge of farmers about climate change. This implies that as the age of the farmer increases, the probability of being constrained with the knowledge of climate change reduces. This could be attributed to the fact that the farming experience of older farmers might possibly increase the propensity to easily perceive the impact of climate change as compared to their young counterparts.

Similarly, the results revealed that female headed-households has a higher likelihood of being constrained to adopt climate change adaptation strategies due to the lack of knowledge of CC as compared to male-headed households. This could be ascribed to the general situation in South African communities where women lack access to productive resources, especially land for farming. Women that have access to land, receive it through their husbands, thus, they are most likely to be constrained with the adoption of climate change adaptation strategies. The results of this study conform to the findings by Awotide *et al.* (2012).

Extension visits, which are measured by the number of visits in a production year, are hypothesised to positively influence the adoption of climate change adaptation strategies because farmers gain better access to information from extension agents and help link farmer groups to climate information (Muhongayirea *et al.,* 2013; Anang *et al.,* 2015). Access to

extension services is statistically significant and positively related to both lacks of climate change information and capital constraint conditions.

This implies that the probability of being constrained by a lack of climate change information and capital reduces farmers' contact with extension agents. Information received by farmers from agricultural extension agents facilitates their decision on how and when to use climate change adaptation strategies such as improved seeds, soil and water conservation and conservative agriculture changing of cropping calendar. This is in line with the studies of Deressa *et al.* (2009), Bryan *et al.*, (2013) and Khanal *et al.* (2018), which indicated a positive and significant relationship between extension access and farmers' adoption of climate change adaptation strategies.

Table 7.9 ***Estimates of the determinants of constraints to adoption of climate change adaptation strategies: MVP model***

	Lack of Knowledge about CC			Lack of CC information			Lack of Capital		
	Coef.	**Std. Err.**	**P-value**	**Coef.**	**Std. Err.**	**P-value**	**Coef.**	**Std. Err.**	**P-value**
Age	-0.023	0.011	**0.036****	0.012	0.017	0.495	-0.017	0.012	0.152
Sex of the household head	-0.447	0.244	**0.067*****	-0.134	0.416	0.748	0.278	0.274	0.311
Access to extension service	-0.037	0.384	0.922	-2.138	0.557	**0.000*****	-1.677	0.467	**0.000*****
Non-farm activity	-0.596	0.303	**0.049****	-1.529	0.508	**0.003*****	0.253	0.337	0.454
Education status	0.007	0.080	0.928	0.187	0.133	0.159	0.136	0.087	0.119
Farming experience	-0.017	0.026	0.516	-0.045	0.043	0.298	-0.025	0.030	0.400
Susceptibility	1.130	0.265	**0.000***	-0.117	0.422	0.782	-0.266	0.281	0.344
Owned TV_Comm	-0.495	0.338	0.144	0.949	0.583	0.104	-0.564	0.360	0.117
Owned Radio_Comm	0.183	0.279	0.512	-1.217	0.477	**0.011****	0.789	0.286	**0.006*****
Membership in FBO	-0.845	0.277	**0.002***	-0.397	0.474	0.403	0.140	0.299	0.639
Access to credit	0.312	0.321	0.331	-0.861	0.586	0.142	-0.548	0.355	0.123
Training	-0.123	0.287	0.669	-1.438	0.403	**0.000*****	0.980	-0.283	**0.001*****
Constant	0.381	0.636	0.549	-3.560	1.119	**0.001*****	-0.083	0.656	0.899

, and *** represent significance level at 5%, FBO means Farmers' based Organization, Owned TV_Comm and Owned Radio_Comm depict Owned Television and Radio for communication, respectively and CC represents Climate change.*

Many empirical studies (Fosu-Mensah *et al.* 2012, Below *et al.* 2012, Kibue *et al.* 2016, Asfaw *et al*. 2018) have documented that supply-side policy variables such as membership of FBOs, among others, have significant positive effects on farmers' propensity to adopt several adaptation strategies. The coefficient of membership of FBOs is negatively signed and statistically significant in influencing the constraint condition of a lack of knowledge on climate change.

This implies that the involvement of farmers in FBOs reduces the probability of being constrained with a lack of climate change knowledge. This could be attributed to the fact that farmers share information on farming practices, markets and other production-related issues in groups that enhance their skill and knowledge in farming (Ahmed & Melesse, 2018). This is also consistent with the studies of Ghimire and Huang (2015), Baiyegunhi and Hassan (2018), as well as Ojo *et al.* (2019) suggesting that information dissemination about new technologies is better shared among farmers in associations.

The estimates related to policy and institutional variables indicate that farmers who had training perhaps through demonstration farms are more likely not to lack information about the effect of climate change on agricultural production. This is evident from the result of the study that shows that training is negatively signed and statistically significant with being constrained with both a lack of climate change information and capital. Demonstration farms increase farmers' awareness and knowledge of climate change and how to mitigate its impact as they are offered the opportunity to engage in on-farm trials which improve their farm management skills.

This is in line with Danso-Abbeam and Baiyegunhi (2017), who found that farmers who received other agricultural-related training such as farm financial management, had a higher propensity to adopt fertiliser and insecticides than farmers who did not receive such training.

According to Deressa *et al.* (2009), farm and non-farm income represent wealth. It is empirically hypothesised that the adoption of agricultural technologies requires sufficient financial well-being (Knowler & Bradshaw, 2007). The adoption of climate change adaptation strategies is not constrained with a lack of knowledge and information about climate change among farmers that are involved in off-farm activities. This is evident from the negative and statistically significant influence of off-farm activities on the lack of

knowledge and information about climate change. This is not surprising as farmers with alternative, secondary sources of income are in a better position to invest in innovative farm technologies, afford to plant trees on the limited available land, can afford the cost of irrigation and use of agronomic practices such as soil conservation and the use of different crop varieties.

This corroborates with the findings of Ojo and Baiyegunhi (2019), who also found a positive relationship between non-farm income and adoption of climate change adaptation strategies among rice farmers in Southwest, Nigeria. Farmers who have access to climate information or have more information have a higher probability of high adaptation (Pham Thi & Chaovanapoonphol 2014).

Access to weather information is very vital in helping farmers to plan against any unexpected outcome on their farms and in reducing shock effects (Oyekale & Oladele 2012). Access to information and communication technologies (ICT) through the use of radio is negatively signed and statistically significant in constraining smallholder farmers to adopt climate change adaptation strategies in the study area. This is attributed to the use of ICT tools in general and mobile phones in particular as it combats the market failures that smallholder farmers face due to a lack of access to market information (Okello *et al.,* 2012; Ndambiri *et al.* 2014).

This finding links to the fact that extension agents focus on promoting conservation tillage, thus a lack of information did not limit adaptation (Pereira de Herrera & Sain 1999). The availability of better climate and agricultural information helps farmers to make comparative decisions among alternative crop management practices and thus choose those that enable them to cope better with changes in climate (Baethgen, Meinke & Gimene, 2003; Jones, 2003; Kandlinkar & Risbey, 2000).

The adoption of climate change adaptation strategies is constrained with a lack of information about climate change among farmers that are susceptible to climate change impact. This is evident from the positive and statistically significant influence of susceptibility on a lack of information about climate change. The implication of the result shows that smallholder farmers that are constrained as a result of a lack of information are likely to be vulnerable to the impact of drought in the study area. This aligns with the study of Hann *et al.* (2009) who

opined that early warning systems and community preparedness plans might help communities prepare for extreme weather events such as drought. Seasonal weather forecasts distributed through local farming associations may help farmers time their plantings and prevent diversion of scarce water resources for irrigation.

7.3 Summary and Conclusions

In summarising the results and discussions of this chapter, the researcher attempted to analyse and interpret the outcome of the results. The research was based on a cross-sectional household survey data collected from a pool of 183 contributors out of 250 land reform beneficiaries during the 2017-2018 farming season. The data was collected from the sample participants in four provinces, namely Free State, Kwa-Zulu Natal, Limpopo and North West; both descriptive statistics and an econometrics model to analyse and interpret the data and give meaningful analysis and discussions were employed.

Descriptive statistics (i.e., mean, percentages, frequencies, standard deviations) were used to analyse and categorise the information gathered. Descriptive statistics and appropriate econometric models such as the Double-Hurdle with count data and Multivariate Probit models were utilised for the analyses.

The main objective of the study was to develop a model of smallholder farmers' disaster risk reduction and adaptation strategies in response to climate variations. Also, the study explored the choice and intensity of adoption in addition to the perception of smallholder farmers' choice of adaptation strategies in the context of climate change. The specific objectives of the study included profiling the perception of and adaptation strategies to climate change among the smallholder farmers in the study area; analysing the factors influencing the smallholder farmers' decision to adopt and the intensity of adoption of climate change adaptation strategies; estimating factors that constrain smallholder farmers' adaptation to climate change; and profiling adaptation strategies for the smallholder farmers in response to climate variations.

The result of the Double-Hurdle Model showed that gender, education, household size, quantity harvested, social capital, distance, transportation and information impact households' decision-making to commercialised Mopani worms.

Furthermore, household age, gender, education, exogenous income, price, the quantity of marketable surplus, the absence of institution/law and transportation are statistically significant factors influencing the intensity of Mopani worm commercialisation in the study area. The results point to higher probabilities of perceiving climate risk among farmers who experience more emotive mental imagery and those with stronger egalitarian values. The results further suggest that farmers who perceive CC based on affective impression and direct personal experience are more likely to suffer cognitive bias in their perceptions compared to farmers who perceive climate risk based on knowledge and analytic processing of climate information. The Multivariate Probit Model was used in assessing the role of information, household demographics and farm characteristics as a response to climate risks among smallholder farmers in the study. Plot characteristics, credit constraints and availability of climate-related information explain the adoption of several CC adaptation strategies. The result also found that even when financial limitations are binding, making climate-related information available can still motivate farmers to adapt.

The study recommended that the deepening of extension access with information on the appropriate adaptation strategies is crucial to help farmers make adaptation choices. The study found that access to extension advice, social capital and collective action also positively affect the adoption decisions suggesting the importance of information and networks. The impact estimate shows that the adoption of farm management practices has a positive and statistically significant impact on maize productivity, suggesting the positive synergies between adaptation strategies and food security.

The results support the use of the Multivariate Probit Model (MVP) to study the relationship among the dominant constraints of adopting climate change adaptation strategies (lack of climate change knowledge, lack of climate change information and lack of capital). The likelihood ratio test (Chi^2 (3) = 162.570; P > 0.0293) of the independence of the error terms in the different constraints. Therefore, the study accepted an alternative hypothesis of interdependence among the different constraints to the adoption of climate change adaptation strategies.

The Multivariate Probit Model is used to analyse the determinants of climate change adaptation strategies constraints among smallholder farmers in the study area. Climate change adaptation strategies constraint is described by a series of dichotomous variables defining the

possible categories of constraint viz. lack of knowledge of CC constraint, lack of CC information constraint and lack of capital constraint. MVP recognises the correlation in the error terms by simultaneously modelling the effects of a set of covariates on each of the constraints to the adoption of climate change adaptation strategies and estimating a set of binary probit models. A correlation coefficient with a positive sign is consistent with the unobserved heterogeneity in the discriminatory tendency against the farmers (complementarity). However, a coefficient with a negative value is consistent with the interpretation that factors causing farmers to be placed in the constrained category may make them less likely (substitutability) to be placed in another category.

This is in line with the existing Departmental Policy and mandate on Comprehensive Rural Development Framework on poverty decrease and hastened expansion through investment in schooling to augment human capability and infrastructure, such as roads and telecommunications and institutions, such as credit facilities both in town and countryside areas.

Although the existing attempt by the Department helps in improving adaptive capability, extra effort is needed in terms of effectual adjustment to climate transform to defend the feeble smallholder farmers. The reality of how land was obtained was constructive and important in both selection and adaptation models, highlighting its successful part in influencing the option and judgment on adjustment to climate transform. Gender and age have absolutely and considerably affected adjustment as suggested selection of adjustment stratagem depend on males, probably since they are the ones who made verdicts in the family farming actions.

Based on the findings of the study, it was found that perceptions are nearly unified for the whole sample of households, including the gender and social groups. Therefore, this study concludes that there are no multiple perceptions and varying insights among smallholder farmers with regards to adaptation strategies to climate variations.

CHAPTER EIGHT: MODELING SMALLHOLDER FARMERS' CHOICE OF DISASTER RISK REDUCTION AND ADAPTATION STRATEGIES IN RESPONSE TO CLIMATE CHANGE

8.1 Introduction

Niang *et al.* (2014) found that expansion in southern Africa exists despite a history of climate variations. Accordingly, this composes cautious adaptations that are very important as climate variations are proposed to increase temperature, adjust the chronological and spatial allocation of precipitation and augment the harshness of climate change impact across the country. However, Ford *et al.* (2015) argued that climate variations impact occur together with brisk social, financial and demographic changeover that merge to pressure expansion results, as well as intermingle that confronts across the nexus of food safety (Ford *et al.* 2015), water accessibility and energy supply (Conway *et al.,* 2015).

Davis (2011) maintains that climate change impact is subject to the confrontation of the scarcity of dependable climate change, which is acknowledged by Jones *et al.* (2015); therefore, doubts on the timing of impacts and their sporadic allocation (Davis, 2011). Stringer *et al.* (2014) also asserted that climate change is a cross-cutting subject and adaptation should be mainstreamed into sector-based strategy and across dissimilar stages of governance. According to the World Bank (2014), CO2e (carbon dioxide equivalent) emissions are currently 60% higher than the levels in 1990 and growing at about 2.5% per year. Without mitigation, CO2e emissions will continue to rise, driven primarily by increasing population and economic growth (IPCC, 2014). If the world continues on this trajectory, the Intergovernmental Panel on Climate Change (IPCC) projects that global mean surface temperatures are likely to increase from 3.7 °C to 4.8 °C in 2100 compared to pre-industrial levels (IPCC, 2014).

Climate change poses a significant threat to South Africa's water resources, food security, health, infrastructure, ecosystem services and biodiversity. In South Africa, climate change projections up to 2050 show significant warming (5-8°C) over the interior, a risk of drier conditions to the west and south of the country and risk of wetter conditions along the eastern parts of the country (DEA, 2013). Agriculture in South Africa faces a variety of risks associated with climate change, such as changes in rain patterns, increased evaporation rates,

higher temperatures, increased pests and diseases and changes in diseases and pest distribution ranges, reduced yields and spatial shifts in optimum growing regions. The emergence of such risks needs urgent, ambitious action to ensure the resilience of South Africa's agricultural sector through adaptation to climate change impacts. Strategic public-private intervention is an instrumental measure in ensuring the long-term sustainability of South Africa's agricultural sector, particularly the smallholder farmers. Environmental change influences agriculture from numerous points of view, incorporating the progressions of temperature, precipitation, atmosphere extremes, changes in ailments and changes in healthful nature.

Thus, this chapter encompasses discussions regarding the research question: *"What is the climate change adaptation model that can assist smallholder farmers to sustain and respond to the changes of climate variations?"* The chapter further developed the model for land reform beneficiaries' choice of adaptation strategies on climate change to sustain their livelihoods. Also, the chapter include discussions of climate change impact on smallholder farmers, sustainable livelihoods capitals as barriers to climate change adaptation strategies, the determinants of climate variations' adaptation strategies, climate change involvements and sustenance schemes for smallholder farmers in South Africa, proposed climate change interventions for smallholder farmers in South Africa, process flow for the implementation of the smallholders' adaptation model, guidelines for the monitoring and evaluation of adaptation strategies, key policy and strategy gaps and recommendations of adaptation policy measures.

The key issue under discussion in this chapter pertains to the development of a model (process flow), integration of findings and insights from the literature and theoretical framework with local knowledge from land reform beneficiaries (smallholder farmers) and land reform project managers in the district municipal offices to guide decision-makers (Senior Management of the Department of Rural Development and Land Reform) in promoting robust sectoral climate change strategies for the smallholder farmers. The aim of the chapter is also to ensure that the study develops a sustainable and implementable model by the Department, minimise the potential negative impacts of climate change while maximising farming opportunities for adjustment by adopting the model which incorporates a bottom-up approach that consists of the beneficiaries/smallholder farmers in the centre of Agri-Parks.

8.2 Justifications and purposes for planned adaptations

Smallholder farming adaptation strategies do not replace the reduction of GHG emissions; they are, however, an essential initiative to manage climate change impacts (Burton, 1996; Pielke, 1998). Despite the uncertainty surrounding the climate change phenomenon, adaptation can still be productive (Ali, 1999). The reasons and justifications of public adaptation policies as outlined by Fankhauser *et al*. (1998), Leary (1999) and Burton (1996), include the following:

1. It is impossible to evade climate change;
2. For adaptation to be more effective and of low cost, it has to be anticipated and preventative; the emergency, last-minute option is more costly;
3. Climate change may become hastier and more distinct compared to the present projections and approximations;
4. Removal of maladaptive policies and practices can lead to immediate benefits;
5. Immediate benefits can also be realised from improved adaptation to this phenomenon and its consequences; and
6. Climate change does not only hold threats, but it also presents opportunities.

8.3 Sustainable livelihoods capitals as barriers to climate variations' adaptation strategies

This section discusses an overview of the sustainable livelihood capitals as barriers (technological, financial, socio-economic, information, institutional support and market) to climate change and variations.

Table 8.1 Sustainable livelihoods capitals as barriers to climate variations' adaptation strategies

Technological Barriers (including Research and Development)	Financial (economic) Barriers	Institutional Support and Capacity-Building Barriers	Information Barriers	Socio-Economic Barriers (Market Development and Access)	Market-Related Barriers
This barrier investigates the prevailing adaptation strategies, frameworks and institutional provisions regarding the research, development, demonstration and distribution of technological innovations that enhance adaptation. This is the purpose of the Agricultural Research Council (ARC), as it focuses on developing technology for rural communities. These innovations include water harvesting and improved irrigation methods, climate tolerant crop varieties and improved infrastructure.	This probes into how the existing policies cater to the methods of funding climate adaptation measures. It also investigates whether these policies recognise the adaptation response function played by agricultural insurance markets. Also, it investigates the function played by financial institutions in financing adaptation. These financial institutions are the commercial banks and development finance institutions. The other chief argument in this barrier concerns agro-value chains. Thus, if their access to finance is improved, they will be able to accrue their assets, lowering their susceptibility to risks, both climate-related and non-climate related. It is important to note that the financial assets cannot directly contribute to resilience in case of reduced production due to climate change effects such as floods or drought.	This barrier examines the degree to which the policies confront the part of the government in supportive information schemes. It probes at both local and national levels. The state is meant to collect, process and disseminate weather and climate change forecast information, which includes rainfall, temperatures to the farmers through the extension services.	This barrier considers availability and access to quality data. It investigates the degree to which policies enhance knowledge and alertness of these phenomena, its risks and its impacts. This is particularly important as it aids in the reduction of vulnerability in the agricultural sector and encourages the adoption of many local-level adaptation strategies. This also includes the passing on of information of various adaptation strategies, climate forecasts in understandable language rather than scientific jargon to smallholder farmers. The information is highly valuable as it helps inform decisions on agricultural production, where and when to plant, how and what. The smallholder farmers lack information from the Department about how they can be supported on farming.	This barrier is focused on market development and access. It investigates whether the policies adequately consider investments in infrastructure that will aid adaptation to climate change. This infrastructure includes storage facilities, irrigation systems and telecommunications. It also questions how the policies address the socio-economic dynamics that effect farming (both commercial and non-commercial). The socio-economic dynamics include food security, changes in agricultural productivity and its impacts and the preservation of arable land for agricultural use.	This barrier probes into how the tariff and non-tariff barriers are catered for by the policies. These barriers include certifications and standards. Therefore, smallholder farmers lack access to market entry to sell their produce. Thus, the researcher proposes to bring them closer to the Department by adopting the Agri-Park model that is merged with the researcher's proposed integrated model.

Source: Burton (1996) & Pielke (1998)

8.4 Developing a model for Land reform beneficiary's choice of adaptation to climate variations

The proposed climate change adaptation model that included adaptation was developed in this section following widespread literature research from other authors, interviews with specialists and practitioners. The proposed model entails a lengthy process in implementing it, especially since no adaptation model for smallholder farmers to ensure that they are sustainable has been defined yet. This is because there is no elimination of any models even if they contained very little adaptation solutions. The climate change adaptation model was developed, as well as implementing farming practices more sustainably according to specific criteria, as indicated in Figure 8.1.

Unemployment, poverty and inequality threaten most of South Africa's rural areas as proven by the DRDLR when it profiled the Comprehensive Rural Development Programme sites (DRDLR, 2012). This undesirable economic inheritance is from the apartheid state and clearly shows the plight of the Black small-scale and emerging farmers who are characterised by unsustainable, underutilisation and underdevelopment use of productive land. Rural development's main purpose is to help improve the smallholder farmer's quality of life, enhance food security and help them exploit their economic potential (DRDLR, 2017).

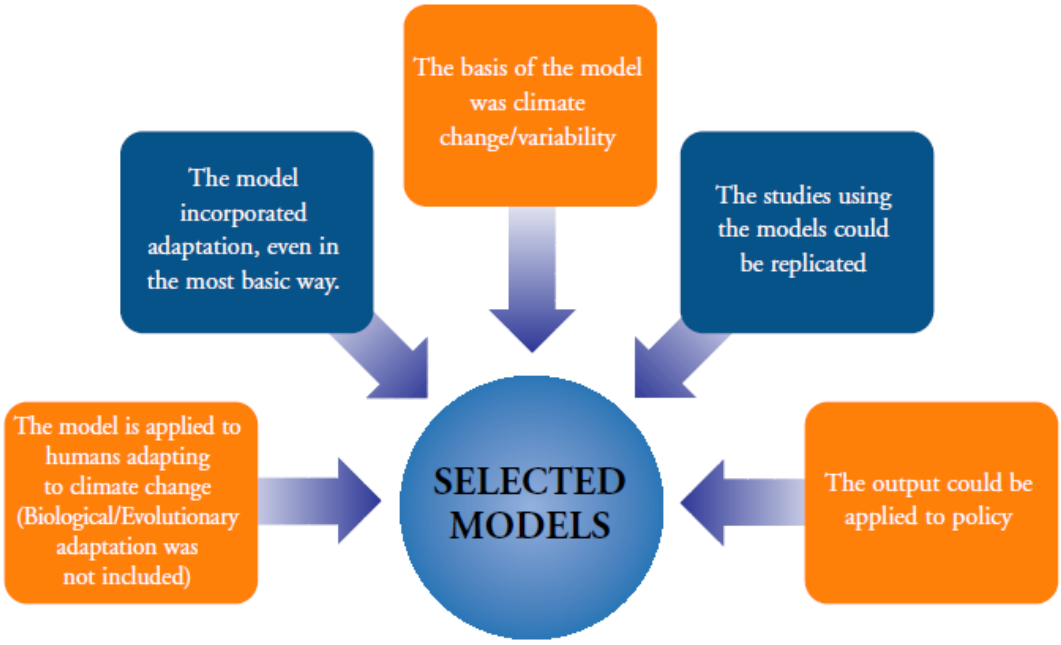


Figure 8.1 Criteria for developing a model
Source: DRDLR, 2017

There is a new concept in the Department, known as Agri-Parks that is also practiced in other parts of the world such as China, Mexico, India and the Netherlands. This proposed model aims to centralise the value chain of emerging Black commercial farmers. According to the DRDLR (2017) report, the Agri-Parks Programme is aimed at supporting small-scale agricultural production and stimulate agro-processing in rural areas through the implementation of Agri-Parks in the 44 district municipalities across southern Africa.

The report further explained that an Agri-Park is an innovative system of agro-production, processing, logistics, marketing and training, including extension services (DRDLR, 2017). It enables a market-driven combination and integration of various agricultural activities and rural transformation services within the District. Thus far, only one Farmer Production Support Unit (FPSU) situated in Makholokoeng, Eastern Free State Province within Thabo Mofutsanyana District, is functional and active due to various challenges faced by both Department officials and various stakeholders in understanding how it functions and should operate.

This model is implemented as part of the District Rural Development Plans and is also in support of the National Development Plan Vision 2030. The Agri-Park Programme consists of three interlinked components, namely FPSUs, an Agri-Hub (AH) and a Rural-Urban Market Centre (RUMC). The three components of the Agri-Park will provide a streamlined and integrated approach to rural and agricultural development in South Africa (DRDLR, 2017). Other countries' experience such as China has shown empirical evidence that the Agri-Parks model promotes agro-industrialisation within small-scale agriculture and develops profitable agro-business segments for the smallholder farmers in the country.

Agricultural and other related role-players were used to derive functional regions within the District to promote rural development with functional linkages; targeted towards the identification of areas that have unique characteristics in terms of the basic food groups. Currently, Makholokoeng FPSU, situated in Thabo Mofutsanyana District Municipality, is the only functional FPSU that is assisting farmers within a radius of 50km in Thabo Mofutsanyana.

This is a feasible explanation in dealing with social and financial dissimilarities, lack of support from the Department, unemployment and deficiency in the country. It also ensures

that the fast track of land distribution and the more inclusive restitution is accomplished. It also strengthens land rights and ensures that they are accompanied by reasonable, effectual and well-thought out land and farming expansions (DRDLR, 2017).

An Agri-Park is an innovative scheme that networks agricultural manufacture, dispensation, logistics and promotion, training and extension services in district municipalities (DRDLR, 2017). Since it is a network, it enables the growth of market-driven commodity value chains and contributes to the achievement of rural economic transformation (DRDLR, 2017). Thus, the study intends to merge the Agri-Park process value chain into smallholder farmers' adaptation to the climate change model to sustain the rural farmers and improve their livelihood.

Figure 8.2 below depicts the proposed analytical process flow/framework to assess policy and adaptation strategies towards climate change.

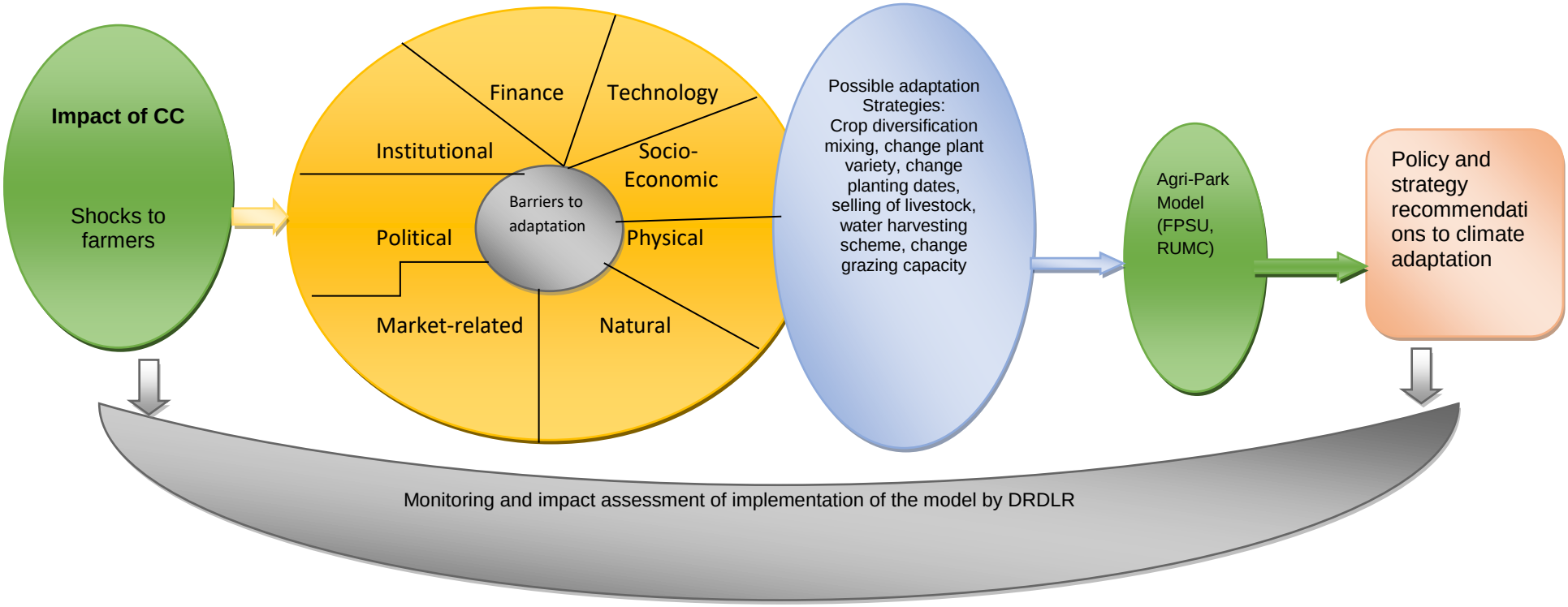


Figure 8.2 Analytical frameworks to assess and monitor policy for climate change adaptation process flow

Source: DRDLR, 2017

In Figure 8.3, the adopted merged implementation of the Agri-Park model into the climate change adaptation model is presented.

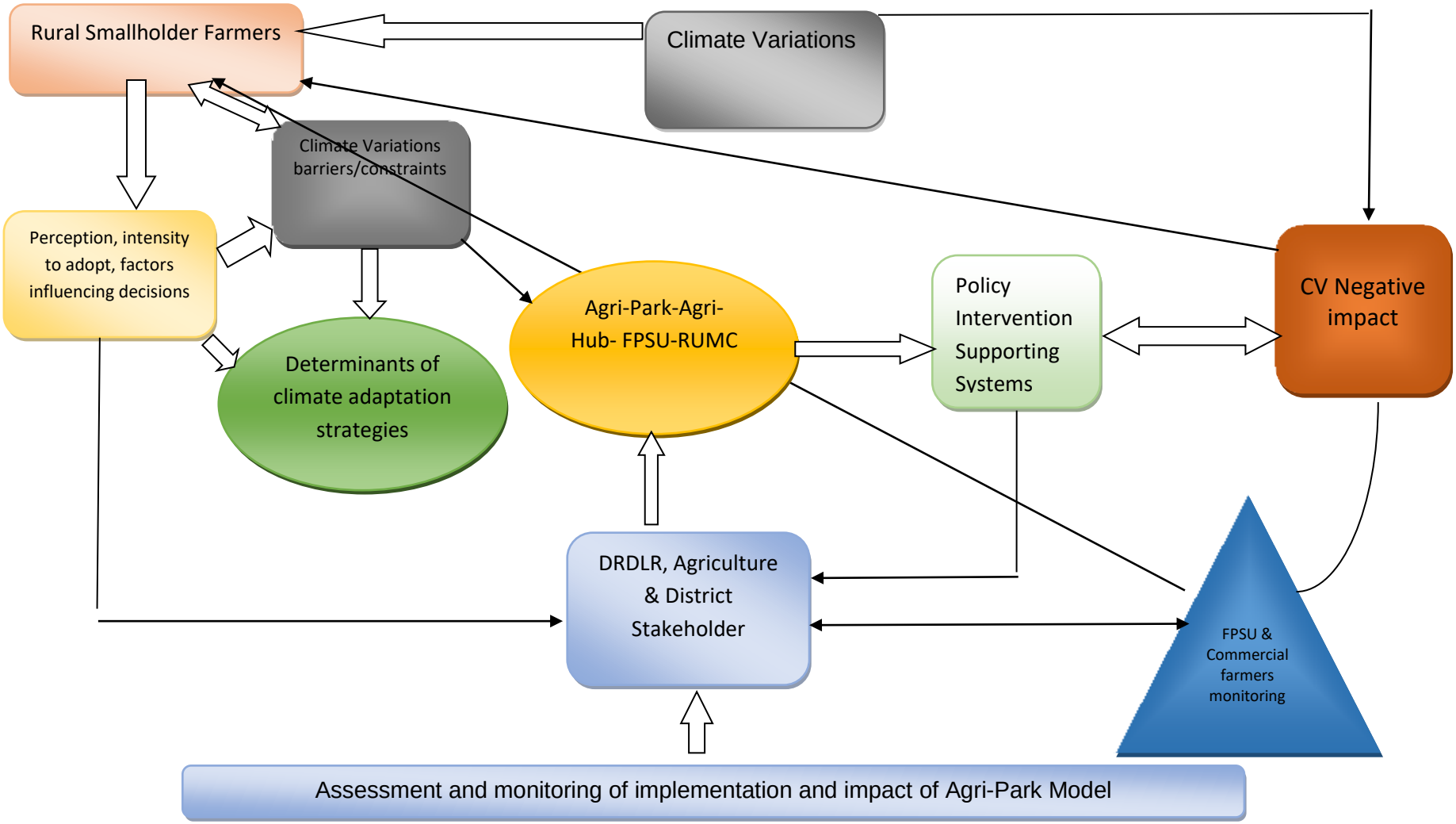


Figure 8.3 proposed adopted merged implementation of the Agri-Park model into the climate change adaptation Model. Source: DRDLR, 2017

In the proposed model for climate change adaptation strategies, the smallholder farmers will be encouraged to adopt the Agri-Park process, as shown above. These beneficiaries will receive support in such a process; they will be monitored, mentored and evaluated based on their adaptation strategies implemented and their production per number of hectares allocated to them through production inputs. The process enables them to be able to move their harvest directly to the RUMC from the FSPU and not passing via the Agri-Hub; if there is no further value-adding or packaging required. The effectiveness of the model will determine its use by smallholder farmers in support of the officials as the implementing agents thereof.

8.5 Process flow for the implementation of the Land Reform beneficiaries' adaptation model

The section outlined the process flow for implementation of the Agri-Park adaptation and implementation model which establish the institutional arrangements.

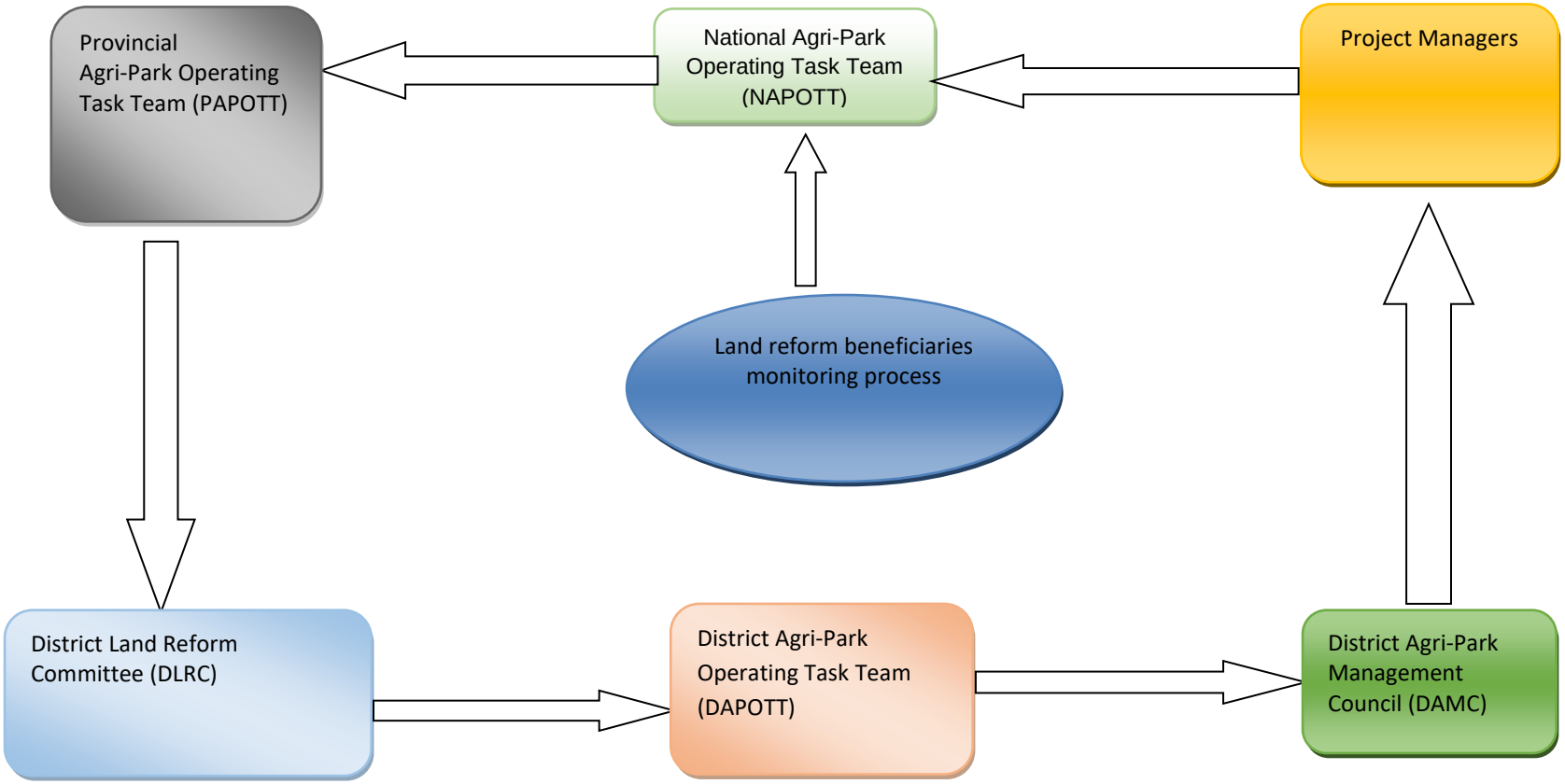


Figure 8.4 Process flow for reporting on monitoring of the model

Source: DRDLR, 2017

Initially, to facilitate its implementation in each phase, the adopted climate change adaptation model will be subject to governance influence and support of the Department, especially through the following institutions:

- District Project Managers (Rural Development and Land Reform)
- The District Agri-Park Council (DAC)
- The District Agri-Park Operating Task Team (DAPOTT)
- The District Land Reform Committee (DLRC)/ District Beneficiary Selection Committee (DBSC)
- The Provincial Agri-Park Operating Task Team (PAPOTT) oversees the implementation of Agri-Parks throughout the province.
- The National Agri-Park Operating Task Team (NAPOTT) oversees the implementation of Agri-Parks throughout South Africa.

8.6 Guidelines for the monitoring and evaluation (M&E) of adaptation strategies

Cautious and thorough monitoring and evaluation of climate alteration adjustment projects within the complete outline of the Adaptation Plan is necessary to guarantee that insufficient resources are distributed as successfully and as resourcefully as achievable (DRDLR, 2017). Effectual monitoring and evaluation also ease the incorporation of lessons from preceding adjustment interference into up-and-coming preparation and functioning (DRDLR, 2017). Effectual monitoring and evaluation of alteration performance must permit elasticity to address unanticipated confronts, contrast institutional composition and outcomes across diverse interference and settings, as well as encourage education and discussions between players (DRDLR, 2017).

A critical step in executing monitoring and evaluation frameworks that particularly aim climate transform adjustment is to describe both the exacting climate change connected threat that the involvement is reacting to and the climate change impact result. The monitoring and evaluation schemes for adjustment projects in countryside human settlements explained here are rooted in the six-step Monitoring and Evaluation scheme placed forward by Spearman and McGraw (2011) and summarised below.

Table 8.2 summary of monitoring and evaluation steps

Source: Spearman and McGraw (2011)

Step 1: Describe the Adaptation Context	**Step 2: Identify the Contribution to Adaptation**	**Step 3: Form an Adaptation Hypothesis**	**Step 4: Create a Theory of Change**	**Step 5: Choose Indicators and Set a Baseline**	**Step 6: Use the Adaptation M&E System**
The first step is to explain the adjustment through an all-inclusive measurement of threats and vulnerabilities. This helps in recognising issues that can pressure an adjustment involvement both directly and indirectly, in improved recounting the requirements of the players, in recognising chance and in upholding elasticity. When creating the use of susceptibility appraisal, it is fundamental that data utilised in setting baselines is enough and precise, that the essential impediment and facilitating issues are recognised and that gaps in the susceptibility appraisal are recognised.	Identify contribution to adaptation strategies by smallholder farmers; and how can the Department support them by monitoring their efforts, as well as track the inputs that the Department procures for the smallholder farmers with the view on building, recognise the challenges that smallholder farmers experience as they are far from natural resources, lack various skills to run and manage their farms, capacitate them with various skills that will enable them to change their mind-set. A need for monitoring the production inputs and expenditure the Department is directing at the farmers.	Step three is to structure an adjustment hypothesis. This is prepared once it is apparent how the adjustment involvement adds to part of the climate alteration adjustment scope. An adjustment hypothesis is explained as an assertion that can be tested, which illustrates how each outcome addresses detailed threats or susceptibilities. This is where the smallholder farmers are beginning to change their mind-set, adjusting to the changes of climate and trying to develop along with adaptation measures, support and tracking their progress.	The fourth step, once the adjustment hypothesis for each involvement is drawn up, is to generate a reliable premise of transformation that associates the adjustment actions to the adjustment results. The theory of transformation follows the circumstances essential to arrive at the adjustment aim by breaking them down into attainable steps. Instituting the needed sequence of proceedings helps appreciate the purposes of interference and checking its involvement.	The fifth step is to select pointers and set a baseline. The climate alteration adjustment crash ought to be reproduced in the pointers. Pointers must be conversant by the susceptibility appraisal and must aim at the objectives of the adjustment involvement. Monitoring and Evaluation for climate transform adjustment regularly need more qualitative appraisal than is the case for alleviation interferences, which can be strictly demanding.	The concluding step is to practice the variation Monitoring and Evaluation scheme. It is significant to guarantee that the pointers are supervised dependably and regularly, information is being collected from the appropriate foundations. Value chain flow that explains how the choice and decision of adaptation strategies are taken, what influences farmers' choices and their perception, as well as their evaluation, monitoring and policy recommendations.

The value chain process map for the choice, perception and decision of RSFs adaptation strategy implementation is presented in Figure 8.5.

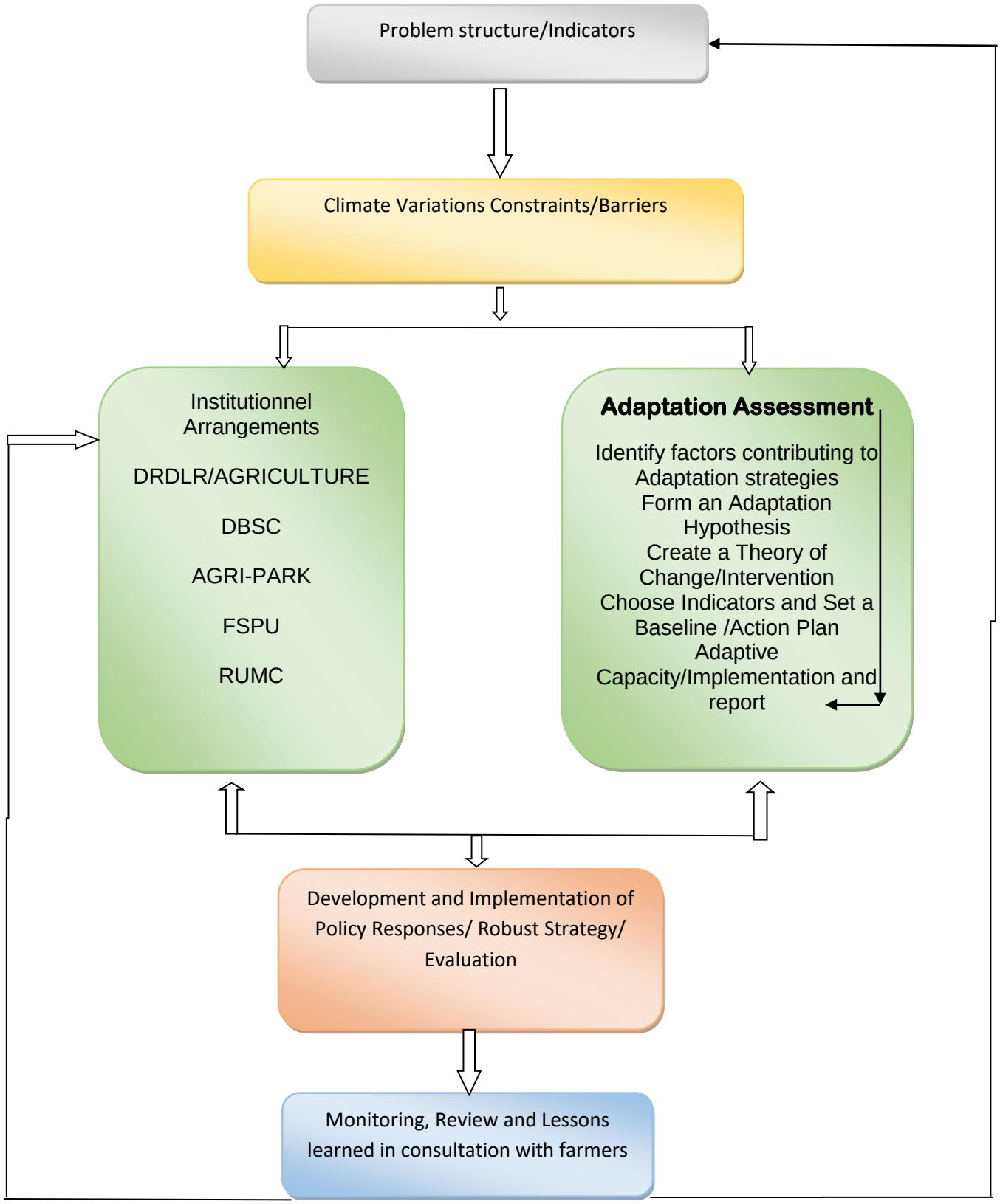


Figure 8.5 Value Chain process map for the choice, perception and decision of RSFs adaptation strategy implementation.
Source: Author, 2018

8.7 Key Policy and Strategy gaps: Policy Context for Climate Change Response

All legislation in South Africa is derived from the country's constitution, which also provisions for the promotion of sustainable climate change adaptive strategies. Section 24 (a) of the Constitution of the Republic of South Africa (1996) assures everybody of an environment that is not harmful to his or her health or well-being. The succeeding clause calls for sustainable development that will ensure socio-economic development for the present without jeopardising that of the future generation. The constitution also demands local government authorities to endorse a healthy and safe environment in Section 152 (1) (d).

The climate change policy framework for South Africa was established in line with the UNFCCC and concluded in the NCCRP (2011), the key policy document guiding response to climate change in the country. Climate change mainstreaming and policy alignment is executed by the NCCRP (DRDLR, 2017). The policy has two main objectives, which is summarised as: efficiently managing the impacts of climate change through resilience-building interventions in socio-economic, environment and emergency response capacity.

The other objective is to contribute fairly to the stabilisation of GHG concentrations world efforts in the atmosphere (DRDLR, 2017). Similarly, the NDP (2030) in its climate change response endorsement echoes the same direct link to development as imperative to establishing the resilience of the nation-state that it requires the governments to put in place appropriate policies (NDP 2011). As one of the first legislation pieces to talk about climate change response, the Disaster Management Amendment Act No. 16 of 2015 commands the preparation of a disaster management plan by all governments (DRDLR, 2017).

These plans should stipulate the assessment of the projected changes in climate, its impacts and associated risks. The preparation of the Land Reform Beneficiaries Climate Change Adaptation Strategy has taken into consideration numerous applicable strategies, plans and frameworks from the international field down to the local government. Adaptation to climate change, especially in the agricultural sector is mainly a grassroot issue. Most often, the local government institutions are aware and knowledgeable about the importance of climate change adaptation and how to go about it, although there is no connection between their policies and plans on adaptation and those at national level. Even though the national policies provide an important, principle understanding of climate change adaptation, it is a prerequisite that they are efficiently decoded into local action (DRDLR, 2017). Below is a summary of policy assessment, revealing the following gaps across the reviewed policies.

Table 8.3: Summary of policy assessment, revealing the following gaps across the reviewed policies

Source: DRDLR, 2017

Technological barriers	Financial barriers	Institutional barriers	Information barrier	Socio-economic barriers	Market-related barriers
In reviewing this barrier, it was noticed that most policies developed to advocate for agro-climatic region-specific irrigation in terms of suitability. These policies, however, do not value the background in which these irrigation schemes are meant to be designed and executed. They tend not to consider the research and development options as they disregard transforming these to market-ready technologies and products.	The review of this barrier shows that funding towards carrying out the planned adaptation strategies is not prioritised. At municipality-level, the institutional configuration and components of the local level adaptation strategies are distinct. All this is attributed to the absence of national procedures and funding methods for municipalities to replicate.	This review revealed that there is not much devotion to empower the extension services and to brace risk management tools and weather predictions. The failure to acknowledge the connections between the access to water, food security, land tenure and climate reflects feeble planning and institutional arrangements.	The review showed that the issue of accessibility and passing on of climate variability data, especially via the extension services, is not sufficiently dealt with.	The review revealed that a lot of the policies do not mention anything on the issue of infrastructural development and access to markets. It also remains silent on the effects that climate has on food obtainability and food charges. Some other strategies and tactics include the IGDP, APAP, the National Food and Nutrition Security Policy and DAFF's Strategic Plan, which are agricultural-related and unsuccessful in considering the changing balance between rain-fed and irrigated agriculture due to climate change.	The review showed that except for the National Climate Response White Paper, most policies failed to cover the issues linked to the relationship between trade, agriculture and the climate. In cases where they were mentioned, it was only from a trade intercession and enablement viewpoint, which had nothing to do with the climate link. To identify, understand and address the climate effects on the economy, the South African Government has come up with multiple policies, strategies and plans. The above analysis has shown that even though most policies and strategic plans in South Africa deal with climate change, they are too widely framed, thus their opportunity to deal with the complicated issue of climate change adaptation is limited.

The DAFF's (2015) Strategic Plan 2015/16 to 2019/20 emphasises the department's ambitious aims to deal with climate change. Its strategy recognises climate change threats and risks towards food security and that it is worse when coupled with insufficient investment in agriculture. The proposal asserts that the department will hire maintainable expansion programmes to ensure biomes and threatened types of protection, refurbishment of tarnished land and extenuation and variation approaches towards climate transformation.

The proposal omits issues linked to crop and livestock adaptation strategies. Although it mainstreams floods and droughts, it does not provide for how they should be dealt with. The Integrated Growth and Development Plan (2102) defines the present truths and contests the agronomy, forestry and fisheries sector and summarises the goals, objectives and involvements that need to be done to accomplish the vision of *"an equitable, productive, competitive and sustainable agriculture, forestry and fisheries sector, growing to the benefit of ALL South Africans"* (IGDP, 2012).

The Department of Environmental Affair's (DEA) National Climate Change Response White Paper (2011) defines climate change tactics for diverse divisions of the nation's financial system, together with the Farming, Forestry and Other Land Use subdivisions. The White Paper highlights the requirement to devote finance in and advance investigation on aquatic, nutrient and soil preservation machinery, as well as methods, including advance manufacture, proprietorship and bankrolling prototypes to encourage the growth of climate change farming. Such interferences are not mirrored in tactical farming-specific brochures, such as DAFFs Strategic design and the Agricultural Policy Action Plan. Certainly, strategies intended to tap substantial alleviation and variation openings in farming fit seamlessly within the overall climate change strategy agenda.

According to the DEA (2011) mechanisms of a comprehensive agrarian strategy agenda should subsidise alleviation and variation aims, even when such aims are not a strategy primacy. The DAFF report (2012) emphasises the importance of investing and improving investigation on aquatic, nutrient and soil preservation machinery and methods; grow climate-resilient harvests and livestock; and grow manufacture, proprietorship, and bankrolling prototypes to encourage the expansion of climate-smart farming. It is noteworthy that these involvements are not echoed in the agriculture-detailed strategic documents, such as DAFF's Strategic plan and the Agricultural Policy Action Plan.

A comprehensive Agricultural Policy framework and its components should contribute towards the mitigation and adaptation aims despite that such purposes may not be a priority to the policy.

8.8 Chapter Summary

It is paramount that climate change leads the agenda to firm efforts to strengthen the adaptive capacity of smallholder farmers. Policies designed to lessen barriers to smallholder farming systems adaptation are more likely to enhance smallholder farmers' adaptation to climate change. When programming mitigation projects, the focus should be on conserving soil and water and on coming up with crop and animal varieties that are resistant to the vagaries caused by climate change. These programmes should also aim to improve smallholder farmers' access to credit, farming implements and improve all the other barriers they are faced with in order to adapt.

The policies by the Government should particularly make provision for research, development and dissemination of suitable knowledge to enhance farmers' adaptation. Evaluation of these policies showed that they are particularly mute on the importance of adaptation to climate change and on the use of disaster risk reduction interventions to ensure food security. Regardless of the significant influence they have on food security, it remains to be the case. The policy seems to pay attention to ensuring sustainable food and availability without linking them to climate change and its impacts.

The study also shows that national policies are failing to apprehend the local context of the phenomena and its mitigation strategies. Coupled with all the challenges the smallholder farmers are faced with due to climate change, specialised production worsens the situation. It is a crucial adaptation strategy for smallholder farmers to diversify their livelihoods. The APAP does not know the local level climate change effects and adaptation measures that district-level officials need to be armed. Awareness of such local information is crucial to improve adaptation in specific local social and cultural settings.

Adaptation strategies should not be viewed as independent because they need to complement each other to work better. However, it is the greatest susceptible and impacted segment by climate transformation placing the incomes of countryside unfortunate in jeopardy and susceptible to food uncertainties. Most smallholder agriculturalists significantly felt these

effects in countryside regions. They are the greatest susceptible collection owing to the point that they have extraordinary reliance on delicate climatic incomes which are rain-fed.

Nevertheless, countryside smallholder agriculturalists are drifting in the direction variation by altering their sowing days, intercropping and varying, however, some smallholder agriculturalists are slow to adapt due to their knowledge deficit, amongst others, of their challenges and characteristics. The next chapter concludes the thesis with the summary, conclusions and recommendations of the study to the Department of Rural Development and Land Reform.

CHAPTER NINE:

SUMMARY, CONCLUSION AND RECOMMENDATIONS

9.1. Introduction

In this chapter, the summary of the study, conclusion and recommendations are provided as they are drawn from the research findings on smallholder farmers' adaptation strategies to climate variations in South Africa.

9.2. Summary

This chapter provides a summary, conclusions and recommendations based on the research findings of smallholder farmers' reworking approaches to climate transformation in the four selected provinces in South Africa. The study used cross-sectional data collected from 183 households in the production year 2017/2018 and applied STATA version 13th software, descriptive and econometric approaches to analyse the data.

The main objective of the study was to develop a model for smallholder farmers' disaster risk reduction and adaptation strategies in response to climate variations. Similarly, the study explored the choice and intensity of adoption in addition to the perception of smallholder farmers' choice of adaptation strategies in the context of climate change. The specific objectives of the study were to profile the perception of and adaptation strategies to climate change among the smallholder farmers in the study area; analyse the factors influencing the smallholder farmers' decisions to adopt and the intensity of adoption of climate change adaptation strategies; estimate factors that constrain smallholder farmers' adaptation to climate change; and profile an adaptation strategies model for the smallholder farmers in response to climate variations.

The study sought to investigate the perception of rural smallholder farmer's choice of reworking strategies in the context of climate variations. This aim further accomplished the objectives by responding to a set of questions: What is the perception of and adaptation strategies to climate change among the smallholder farmers in the study area; What are the factors influencing the smallholder farmers' decision to adopt and the intensity of adoption of climate change adaptation strategies; What factors constrain smallholder farmers' adaptation

to climate change; and what adaptation strategies model is suitable for the smallholder farmers in response to climate change.

9.3 Conclusions

In this study area, most of the smallholder farmers showed awareness of changes in temperatures and precipitation levels of the last 10 years. The majority of the participants (98.4%) perceived a reduction in rainfall and 95.2% of the respondent's perceived increments in temperature over the last 10 years. Despite this inequality in the supposed direction of changes in these elements of climatic change, adaptation strategies such as different crop variety and improve crop and livestock are the most commonly practiced adaptation strategies to climate change by the households. Furthermore, strategies such as conservation of soil and water and irrigation have been exercised by some proportion of the farmers. In general, approximately 88.75% of the farmers have taken at least one adaptation measure in response to climate change.

The study used cross-sectional data collected from 183 smallholder farmers in the production year 2017/2018 and applied descriptive and econometric approaches to analyse the data. The model summary is significant at the 1% level of confidence, as shown by the P-value, which is less than 0.01. This implies that the variables utilised adequately model the 2-step decision model concerning the decision to adapt and the number of adaptation strategies utilised. It was also found that household income, extension services provided, title to land and land reform agents providing information on adaptation strategies were significant factors concerning the decision to adopt climate change adaptation strategies at the $P<0.01$ level. Non-farm training and neighbour as a source of adaptation strategies were significant at the 0.05 while radio as a source of adaptation strategy information was significant at the 0.1 level.

The study was conducted to investigate the characteristics of smallholder farmers' adaptation strategies and to develop a model for disaster risk reduction response strategies for climate variations. The model that is adopted from the Agri-Park model of the Department or Rural Development and Land Reform explored the efficiency merging institution arrangements for the development of adaptation models for the smallholder farmers (land reform beneficiaries); employed to handle climate change issues and improve their livelihood. Farm

households were categorised in accordance with crucial variables such as demographic attributes, livelihood activities, levels of education, access to irrigation water sources and credit services.

According to the participants, the smallholder farmers are characterised by poverty and very low levels of literacy. The ability of these smallholder farmers to endure the effects of drought for rational periods is limited and this is devastating given that subsistence farming is the main economic activity. There is a dire need to revamp their economic structure using the systematic agricultural development policy together with mobilisation of resources accompanied by human resource development to improve the smallholder farmers' resilience to the climate change phenomena and its effects.

Findings of the study on perceptions towards climate change were compiled for both the smallholder farmers and those of the sector departments (DRDLR and DAFF) and compared against the empirical findings of the study. The findings indicate that the level of climate change is relatively high amongst the households and the sector's government departments.

Regardless of these results, the relevant stakeholders, including the government departments have not visibly done anything towards mitigating the climate change impacts. This situation will probably harm the household and community level efforts to build resilience towards climatic shocks and to adapt to climate change. Farmers depicted awareness of the changing climate through to varying levels. The major categories of climate variabilities that were raised included the distribution and amount of precipitation, the timing of the beginning and end of the rainy season; thus its length which is critical for the grazing area development and commencement of the planting and farming season, temperature increases, drought length and decline of water streams. Despite this awareness, farmers and other stakeholders are not putting in much effort to take advantage of it and adapt by employing new or traditional technologies. This failure by farmers incapacitates innovations intended to mitigate the impacts of these climate shocks. The evidence of this highly unreliable rainfall patterns in terms of start and end dates and length is mainly in the eThekwini and Vhembe districts. Many farmers have limited resources and are faced with scarcities of food throughout the drought length, sporadic stream flows, worsened grazing resources and poor livestock production.

Most of these households stated that they tend to resort to charcoal making and deforestation. This is evidenced by the woodlands resource base deteriorations and conflicts amongst the locals over the use of the natural resources. This study has detected appalling occurrences that reveal that there seem to be no lessons learned from the previous climate experiences and the only development actions are business as usual. In this regard, the development of effective and sustainable climate change adaptation strategies that could lead to permanent resolutions is impossible.

It is unavoidable that climate change is a recurring phenomenon, therefore, the need exists to adopt, implement, monitor, review and maintain the adopted and proposed model set in order to enhance the smallholder farmer's adaptation. The study has revealed quite inspiring adaptation strategies that are currently being implemented by farmers, which, if analytically considered and recognised can boost efforts to enhance their resilience. There is, however, an increasing disparity between the demand and supply of technology and unless this gap is narrowed and/or closed immediately, the realisation of the sustainable adaptation strategies would be impossible. Numerous household variables, asset ownership and access to other physical resources influence the adoption of alternative options. For the governments to best tackle the challenges of adaptive capacity amongst the rural communities, it is important for the best adaptation strategies suitable for each area's climate variability to be identified.

Review from various kinds of literature written by several researchers who studied the farmers' perceptions of climate change and their choice of adaptation strategies showed that most farmers perceived high or no rainfall weather patterns and drought. In order to delay the planting season, some studies perceived irregular excessive rainfall, although others identified unfamiliar increases in temperature. Some studies attributed climate change to human activities, which have occurred over the years. Despite their climate change awareness, farmers lacked comprehensive knowledge of the phenomenon. This study also showed that although the smallholder farmers had noticed a reduction in the number of crops and livestock, as well as grazing and arable land in the study areas during the period 2005 to 2015, they had not been conversant about climate change.

9.4 Recommendations and Policy Implication

Based on the conclusions drawn from this research, recommendations intended to enhance the mitigation of the climate change impacts on agriculture are presented. It is a crucial policy

measure to enhance the adaptive capacity of the farmers to climate change. This, therefore, calls for the government and concerned institutions to pay more attention to this matter in order to successfully address this issue. In the study areas, the most common challenge remains food insecurity because of crop failure, which is also due to late or little rains. In this case, the most appropriate intervention will be the provision of early maturing crop varieties to the farmers to strengthen their adaptive capacity.

There is a need for improved social and physical infrastructure and for strengthening institutions that enhance farmers' adaptation, for instance, the meteorological services to improve timely access to information such as weather and climate forecasts, thus improving decision-making amongst the farmers. In this situation, the meteorological department is vital in providing forecast information about weather conditions to the farmer using different mechanisms (e.g., radio and/or television). This effort of creating awareness should be complemented with varied types of crop and livestock management and adaptation strategies.

All branches of the Department should undergo this collaborative approach. This consciousness formation attempt should be shared with the dissimilar categories of crop and livestock manufacture and administration actions that farmers might employ dissimilar variation machinery to climate transformation.

The crafting of policies that seek to enhance farm-level adaptation is of utmost importance, although more emphasis should be on the provision of climate change information to increase the level of awareness of smallholder farmers and on better production techniques to improve adaptive capacity. To be able to deal with challenges of climate change, it is important for the Government to first deal with the local level barriers to adaptation in the study areas. This includes the provision of detailed knowledge on climate change to improve awareness, ensuring availability and accessibility of the necessary inputs at reasonable prices and continuous assistance from the extension services. A good example is the supply of technical and material support to the smallholder farmers to tackle the adverse impact of climate change.

Furthermore, Government policies should provide for improved access to education, to an agricultural extension to credit and climate change and adaptation measures information. Also, policy interventions that promote informal social networks such as farm to farm

extension services can encourage group discussions. This is a crucial platform for the smallholder farmers to share experiences, information and knowledge between themselves. In addition, agricultural insurance that covers livestock and crops plays an important role in mitigating climate change-related risks.

Success in the adoption and implementation of the proposed model will greatly rely on the presence of robust and efficient institutional arrangements and collaboration. Institutional and social factors are crucial in determining the extent of vulnerability of smallholder farmers to various climate risks. The National Department of Rural Development and Land Reform constructs strategic plans. These should be financially provisioned for and passed on to the grassroots. They should also have a distinct purpose and be liable. It is thus important that the different stakeholders should clarify their mandates and be accountable, so they can easily be linked with others for the betterment of their coordination to achieve a common goal.

In all the study areas, farmers complained about the Department not providing enough support to sustain them. The gross anomaly of rainfall patterns worsens the situation in addition to increasing land shortages in all the areas under study. Furthermore, there is an increasing tendency to shift to mostly livestock production by the landholders; however, a shift to off-farm employment by the landless is relatively low. In these instances, the chances of establishing a steady source of revenue are highly unlikely and the chances of achieving a climate change resilient economy are very low. The researcher, therefore, proposed that it should be a bottom-up approach of engaging with the affected communities (i.e., the smallholder farmers).

Government should prioritise ways of funding to implement climate change adaptation response strategies. Stakeholders in collaboration with departments should try to improve research on water, nutrient and soil conservation technologies and techniques, climate-resistant crops and livestock. Smallholder farmers should have or consider having agricultural insurance market as an adaptation response. Having insurance can build financial resilience as it helps farmers access credit assistance more easily, allowing them to innovate and invest in technologies that boost productivity (Zwane & Montmasson-Clair, 2016). The departments should hold information sessions about awareness programmes that are related to climate change risks in order to protect and strengthen food security.

At a provincial level, especially on the ground at district level, a challenge of water and some farmers not having enough resources to prevent this problem remains critical. The major issue is the lack of funds and the departments related to agriculture do not have enough awareness programmes regarding climate change risks. Farmers should have alternative water sources such as infrastructure or building capacity such as dams.

The proposed model is, therefore, recommended for adoption to encourage livelihood diversification and packages of the different options should be prepared in such a manner that it is attractive for stakeholders. As mentioned before, there is a need for access to credit provisions to enhance climate change adaptation amongst the smallholder farmers. According to this study, the existing system is as such that there are limited credit facilities for livelihood diversification. This calls for government and departmental efforts to ensure ease of access to credit by farmers to enable them to purchase productive technologies and run small and micro-enterprises.

The study also revealed that even with the endeavours by the government to boost education levels in the nation, there remains a great number of illiterate farm households in the study areas. It appears that those labelled as educated and some having attained formal education, they still lacked skills-based training. The researcher further recommends that the Department of Rural Development and Land Reform must work in collaboration with the Department of Agriculture, Forestry and Fisheries for the success of the Agri-Park adaptation model of smallholder farmers.

This will ensure the sustainability of the smallholder farmers within the Department through the implementation of monitoring, impact assessment and review of the process flow. Furthermore, it is recommended that the adopted and merged model be accepted and implemented for the following guiding principles and reasons:

- The farmers must implement the model;
- The model must be the reagent that will enhance rural development and land reform;
- In order to ensure economic sustainability, Government must support the model for at least 10 years;
- Success of the model will reinforce the relationship between Government and private sector stakeholders, as well as the smallholder farmers to guarantee augmented

admittance to amenities (water, energy, transport) and manufacture on the one hand, while evolving prevailing and generate new markets to strengthen and surge value-chains in-line with APAP;

- The amalgamation and accepted model will maximise the benefit of smallholder farmers to present state land farms with agriculture possibility in all provinces, where likely possible;
- It will fully exploit market admission utmost predominantly the emergent farmers and rural communities;
- Guarantee promotion of the whole utilisation of the best agricultural land (high production capability);
- Promote complete utilisation of prevailing agribusiness infrastructure that is agro-processing, bulk and logistics infrastructure, counting having obtainability of water, energy and roads; and
- Assistance to emerging towns and revitalisation of rural towns, in terms of high economic development, high populace expansion over the past 10 years and promote rural-urban linkages.

Furthermore, it is recommended that the following institutional arrangements be in place:

- The design, development and operationalisation of the Agri-Parks will be driven by key private sector actors including, commodity groups, smallholder farmers, cooperatives, organised agriculture, agricultural businesses and existing markets;
- Inputs and support from private sector stakeholders will prove essential for strengthening and enhancing the Agri-Park specific commodity value-chains;
- The multi-stakeholder approach will ensure that the needs and interests of the many actors involved, including, producers, consumers, Government and investors are addressed;
- Inclusive participation will bolster the performance of Agri-Parks;
- In line with this, the Department introduced the National Agri-park Advisory Council and the District Agri-park Council; and
- District mayor appointed to drive and deliver on the District Implementation Plans.
- The District Director can ensure effective implementation in collaboration with the above stakeholders.

Since smallholder farmers form part of most of the food insecurity in the developing world, despite being the bulk of production in many countries, this would lead to an increase in their productivity and income and, therefore, directly improve access to food amongst the most vulnerable households. This also led to increased supply to both local and national markets. This, in turn, will also, for most of the rural households and communities, enhance material and social conditions.

Finally, it is recommended that the Department of Rural Development and Land Reform adopt and learn from the global application of land restructuring based on the investigation and lessons learned from other countries above, to directly establish a brilliant, action-oriented corporation which will report every six months to the legislature on advancement with regards to land restructuring matters.

This corporation ought to contain senior leaders in Government departments, the ruling party and the private sectors, particularly agri-businesses. Its work should be based on the following five key tasks.

Task one: Completing restitution speedily

South Africa desires a devoted mission team and organisation which will resolve the compensation stalemate immediately. There is great ambiguity and associated disinvestment in areas with unsettled claims and arrogances are toughening on all sides in these areas. This is having an undesirable effect on South African farming, the projections for fruitful land rearrangement, race relations in the countryside and assurance in the administration and the state. Resources must be dedicated to subcontracting some of the Land Claims Commission's roles.

The Government must instantly create a public-private mission team to resolve outstanding cases of gazetted compensation. This must comprise procurement of land competently and speedily, offering a variety of other selections, counting cash settlements, bursaries to agricultural colleges or other prospects. The resolve of the compensation stalemate is a first-order priority for fruitful land improvement because it lies at the base of countless other difficulties in almost all parts of the country. It is also reported that large Agri-companies are offering their support.

They have imaginative plans for how to enable prompt development in substantial settlements. These tactics would procure collected compensation applicants with farm workforces and others who would be attracted to farming as a means of livelihood to pool skills and guarantee that no one is disadvantaged when claims are settled.

Task two: Getting redistribution of land on the right track and then going to the scale/target the country needs

Investigation specifies that there is a substantial land asset appetite in South Africa. Land will be desired for Black settlement and ownership in the countryside and city in South Africa. Redeployment must encounter these wants efficiently. There are two conditions for getting reallocation on the right path before the agenda aims to transfer the necessary quantities of land. *First*, there is a need for a precise appreciative of patterns of land demand and land supply. This will need, amid other steps, an instant and convincing audit of existing state land.

As the study has found, the administration has only been capable of auditing 33% of state land (and it is not clear if this includes municipal land). In corresponding with an improved appreciative of the prospective of state-owned land, some of which may be of good worth, farmers immediately need to build up a much clearer appreciative of regional patterns of land demand and demand for what purpose, in both rural and urban areas. *The second* crucial requirement for prosperous large-scale land redeployment is to ensure that reallocated land does not fall into communal tenure but remains in private ownership. Communal land is successfully taken out of the land market; it is frozen and cannot be used as security for investment, prohibiting people on communal land from accessing many of the remunerations of ownership and the resources and dexterity presented by the financial sector.

Persons living on communally owned land are far less expected to be able to flourish and put together a better future than rearrangement recipients who own and manage their land themselves. One perturbing feature of current approaches to land restructuring has been the introduction of communal ownership into commercial agricultural land. Once these prerequisites are met, a joint venture approach is necessary to obtain land in a market-supporting way that:

- meets the real and diverse needs of land-hungry, poorly housed and unemployed people cost-effectively and sustainably;

- spreads and reinforces private ownership of land, with all the benefits that this bestows on owners and the benefits it creates for economic growth and security;
- reinforces market processes, which are self-sustaining and in themselves redistributive;
- helps rural and urban South Africans to establish sound foundations for future development; and
- does not establish a precedent of much larger subsidies for some landowners than for others.

By using an amalgamation of improved LRAD grants and (in certain instances) loan finance, a public-private joint venture should obtain, through competitive purchase on the open market, important tracts of land for Black settlement and ownership in city and countryside South Africa over the next ten years. Allotment actions will require to be wholly transparent. This public-private joint venture must be staffed with people with knowledge in the cost-effective purchase of urban and rural land.

Task three: Deracialise commercial agriculture and the countryside

Urgent ways must be taken to additional deracialise commercial farming. At the centre of this scheme were effectual local public-private partnerships. Here, the researcher re-emphasises the three largely significant steps that need to be engaged. *First*, a lot more commercially workable private sector land reform initiatives are required throughout the country. An outstanding case is the sugar industry, Inkezo Land Company, which has accomplished much achievement in reallocating sugar land and backing up-and-coming farmers; however, it is now relentlessly inhibited by land claims.

The researcher also calls on other farming sectors to establish similar organisations in their sectors, provided administration can promise surroundings in which they can practically function. This scheme will speed up deracialisation by structuring around demonstrated best practices in farming, practical commercial banking practice and normally functioning land markets. *Second*, there is a requirement to make complete use of farmworker equity schemes and BEE deals. These permit Black South Africans to tap into the land and agricultural value chain at the stages where profits are maximised and not simply at the hard (and often unprofitable) end of land ownership.

Numerous big companies are prepared and willing to play an active part in making this happen. *Third*, there is a need to create autonomous accommodation in villages for the farm workforce to enable them to commence a charitable course to end 'feudalism' in South Africa's rural area. The tradition of farm workforce living in housing provided by their employers can be a remnant of apartheid. It, at times perpetuates social patterns that can disallow farm employees their dignity.

Reasonably priced accommodation prospects with safe tenure need to be created in towns and villages where, if they wish, farmworkers and their families could choose to relocate. In these villages, workers would be able to lead independent lives and access education, health care and job opportunities cost-effectively. It is essential to emphasise that the move from on-farm housing to independent housing will always need to be genuinely voluntary and will need to ensure that people who do relocate are better off afterward. There are important roles for both public and private sector actors in this area.

The procedure of establishing these autonomous accommodations in villages would also offer a chance to renegotiate and amend the Labour Tenants Act (LTA) and the Extension of Security of Tenure Act (ESTA) to enable, for instance, that a dwelling in a properly situated new village becomes a way of settling a claim for secure tenure. Both the LTA and ESTA have proved very tricky to put into effect in their current forms, have raised expectations that have not been met and have had the perverse unintended consequence of causing farmers to dismiss farmworkers.

Task four: Tackle rural poverty directly

Some well-watered spaces are surrounding the previous homelands, where people on minor ranches might make a valuable impact on the deficiency. However, to trust that this technique might make a large-scale or cost-effective influence to plummeting deficiency in the greatest of rural South Africa is to yield to impractical and retrospective 'rural romanticism.' In its place of using land as the sole – and often luxurious – means of lecturing countryside deficiency, countryside growth should be explored more lengthily. A key part of this is to recognise that development is a central constituent of an actual countryside expansion approach. For frequent disadvantaged individuals in the countryside parts, growth

requirements to emphasis on portable possessions can be used in a diversity of contemporary municipal contexts.

The first is to demand the private sector, predominantly agribusiness and the intercontinental development communal to obligate capitals to the expansion of thoughts for rural expansion and roads out of poverty. There is also a need for an examination subsequent to the republic about the role of countryside parts in the 21st century in South Africa and how to enlarge chances for persons who live in countryside parts. These examinations require deliberating the authenticities of farming in a globalising budget and the encounters of climate transformation. A private sector, market-based method to country shortage and prosperity formation might be a noteworthy influence from corporate influential and global associations to studied administration approaches.

Second, the administration must allocate R1 billion a year for 5-10 years to a Rural Education Fund. The trust must be administered as a corporation between the public and private sectors and must be leveraged to have the determined influence on offering excellent schooling chances for fledgling countryside persons. For instance, the account might deliver money to agrarian academies; and offer dues to gifted countryside pupils to learning mathematics, science and linguistics at respectable colleges, thus serving the nation; set its goal of replicating the sum of matriculants with symbols enough to permit them to arrive at infrequent extremely accomplished occupations such as manufacturing and medication.

Task five: Spend more on land reform and spend it better

Undertaking all of this correctly will not be low-priced. The land improvement economical will require to be augmented meaningfully. These are the recommendations for the investigator's propositions to work. It is an endorsement for attaining the administration's specified goals with regards to land restructuring. However, then this should be completed if the novel public-private corporations are recognised, which delivers the capacity and influence to safeguard that the currency is healthily expended. An augmented economic requirement be used to influence marketplace forces and to supply with finance for the specialised subcontracting of land assessments, land handovers and post-settlement sustenance. Healthier quantities and qualities of both land and human capital need to be devoted to land reform and rural development.

However, the valid concerns of the National Treasury about greatly increasing the allocation of national resources to land issues need to be allayed. The researcher, therefore, recommends that the overarching public-private partnership overseeing each of these tasks should receive its own budget – with specified allocations to each task and that it should report to parliament/Minister of Department of Rural Development and land reform every six months on its progress and expenditure.

In all these efforts, the public-private partnership driving the initiative would need to change the increasingly problematic language in which land reform is discussed. There is a need to move away from misleading Zimbabwe-style terminology and away from unhelpful and ill-informed debates about the role of the market or the concept of *'willing seller, willing buyer'* (which has never applied to restitution).

There is a need to move towards concepts such as co-operative relationships between state and market, sustainable development, escaping rural poverty and expanding educational and economic opportunities for rural South Africans. The public-private partnership needs to provide the leadership of South Africa with evidence that it can resolve a difficult issue arising from the country's history and do it in such a way that everyone benefits from the process.

Task six: Post-settlement Support

Support to farmers' business plans should come from extension officers from the Department of Agriculture, Rural Development and Land Reform, Government departments, Treasury and Market-Linkages.

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Appendix I

SURVEY QUESTIONNAIRE

My name is Thabang Thinda. I am writing a thesis titled "Modelling Land Reform Beneficiaries' Choice of Disaster Risk Reduction Strategies in response to climate variations" for the degree Philosophae Doctor (PhD) in Disaster Management' at the Disaster Management Training and Education Centre (DiMTEC), University of the Free State, South Africa. The objective of this study is to develop a model for land reform beneficiaries' choice of disaster risk reduction strategies in response to climate variations.

This research has a significant contribution attempting to reduce and mitigate climate change and variations related problems for land reform farmers. Therefore, your valid contribution and accurate information are highly valuable in achieving the objective of this research. Information collected from you will serve only for academic purposes and kept confidential. Thus, please feel free to convey the required information honestly.

Thank you in advance for your cooperation

KARNEELS THABANG THINDA
PhD STUDENT: UNIVERSITY OF THE FREE STATE

SURVEY QUESTIONNAIRE

Put (x) marks in spaces provided for closed-ended questions and write your response in the space provided for open-ended questions.

Questionnaire No: ……..…… date: …….

PART I. SUPPORTIVE INFORMATION

Demographic and Socioeconomic Characteristics of Participants:
General Information

i. Name of interviewer: .....

ii. Date: ...../...../..... Time spent on interview: From.....to.....

iii. Name of respondent .....

ID: …….

iv. Farm:……District:…….

Local:…….....…….. Ward: ……

PART II QUESTIONS ON HOUSEHOLD HEAD DEMOGRAPHIC CHARACTERISTICS

1. Gender of the household head: Male [ ] Female [ ]
2. Age of the household head (in years).....
3. Marital status: a) Married: [ ] b) Single: [ ] c) Divorced: [ ]
   d) Widowed: [ ] e) Other (Specify)_____
4. Which age group do you belong to? (tick the appropriate answer)
   A. 18 – 25 years [ ]
   B. 26 – 45 years [ ]
   C. 46 – 55 years [ ]
   D. 56 – 65 years [ ]
   E. 0ver 66 years [ ]
5. What is your highest educational or professional qualification (tick the appropriate answer)?
   A. No education [ ]
   B. Primary [ ]
   C. Middle School [ ]
   D. Secondary School [ ]
   E. High School [ ]
   F. College [ ]

G. University [ ]

H. Informal or other (Please specify)

……..

6. The number of total family members: Male..... Female.....
7. Number of active household members aged between 15-64 years

   Male [ ] Female [ ]
8. Farm experience of household head …….

PART III QUESTIONS ON HOUSEHOLD HEADS' SOCIO-ECONOMIC CHARACTERISTICS

9. Farming system you follow currently

   i. Crop production only [ ]

   ii. Livestock: rearing [ ]

   iii. Mixed farming [ ]

   V. Others (please specify).....

10. What is your average annual household income?

A. Less than R5 000.00 [ ]

B. Between than R10 000.00 and R50 000.00 [ ]

C. Between R55 000.00 and R 110 000.00 [ ]

D. Between R150 000.00 and R300 000.00 [ ]

E. Between R300 000.00 and R500 000.00 [ ]

F. More than R500 000.00 [ ]

12. Respondents' agricultural activities details: Landholding details (fill in the boxes indicating the amount of ha)

Land area owned	**Cultivated area in past 10 years**	**Grazing areas**	**Cultivated land this year**	**Land under irrigation**	**Cultivated leased land**

Area cropped once a year	**Area cropped twice a year**	**Area cropped three times a year**

12. Do you/any members of your family have any source of non-farm income (i.e., income from remittance, petty trade, employment in government or private enterprise etc.)?

Yes [ ] No [ ]

13. If yes to the above question, how much money did you/your family make in the last production year from off-farm activity? Please specify in Rands: .....

14. Total farmland operated, including any grazing land (including rented land and excluding rented out land) during the last production year_(in hectares)_____Size of land rented in _____ Size of land rented out_____

15. Do you have a certificate for your land? Yes [ ] No [ ]

16. What are the physical characteristics of your farm, in terms of exposure to erosion?
Susceptible to erosion [ ] Moderately susceptible to erosion [ ] Not susceptible at all [ ]

17. How many tons of yields/livestock have you harvested/reproduced per hectare?
Maize.....
Wheat.....Barley.....Bean/Pea.....Livestock……Others (specify, if any).....

18. Do you have any communication devices, for example, TV [ ], Radio [ ], Mobile phone [ ]?

19. If your answer to question 18 is "Yes" what types of communication devices do you have? TV Mobile [ ] Phone [ ] Radio [ ] Others specify.....

20. How many of the following types of livestock do you have? Please fill in the headcount column.

s/no.	**Types of livestock**	**Head count**
1	Cattle	
2	Calf	
3	0xen	
4	Horses	
5	Donkey	
6	Camels	
7	Goats	
8	Sheep	
9	Poultry	
Other		

PART IV QUESTIONS ON INSTITUTIONAL FACTORS

21. How far is the market where you sell your agricultural yield? Distance in km.....
In terms of time: it takes (in hour).....

22. In undertaking your usual farming activities, have you ever faced shortage of funding, for example, to purchase agricultural inputs such as fertiliser, oxen and others?
Yes [ ] No [ ]

23. Do you have access to land reform/agricultural extension services on your farm?
Yes [ ] No [ ]

24. Do you receive any support from land reform/agricultural extension which could help improve your farming activities? Yes [ ] No [ ]

25. Please specify the kind of services you receive from them.

.....

26. Have you ever received any formal training which helps improve your farm productivity? This might be how to protect soil from erosion, conserve rainwater, use modern agricultural inputs, reduce post-harvest loss, etc. Yes [ ] No [ ]

27. Did you have non-formal training of the above kind from farmers or did you give training to other farmers in your locality? (Farmers-to-farmers extension services)
Yes [ ] No [ ]

28. If yes to '26' & '27,' how do you find it in terms of its contribution to improving your farming income? Very important [ ] Important [ ] Has no effect [ ]

PART V QUESTIONS ON PERCEPTION OF CLIMATE CHANGE AND ADAPTATION METHODS EMPLOYED

29. Comparing the 2005s with the recent past 10 years (2015s), have you perceived any changes in climate? Yes [ ] No [ ]

30. Comparing the 1990s with the recent past 15 years (2005s), have you noticed any changes in the rainfall patterns? Yes [ ] No [ ]

31. If yes, please specify the pattern of the change in rainfall that you have noticed.
Increasing [ ] Decreasing [ ]

32. Comparing the 1990s with the recent past 15 years (2005s), have you noticed any changes in temperature? Yes [ ] No [ ]

33. If yes, please specify the pattern of the change in temperature you have noticed.
Increasing [ ] Decreased [ ]

VII INFORMATION ON THE EXISTING ADAPTATION STRATEGIES

Please tick in the appropriate box matching the factors that motivated you to change farming practices against the changes that you have made in response to the changing climate.

Adaptation strategies	**Possible factors**					
	Negative CC effect	**Financial capital**	**Good markets**	**High living costs**	**Other influences**	**Household size**
Shift to higher-yielding crop varieties						
Introduce new crop varieties						
Shift to shorter cycle crop						
Stop cultivating some varieties						
Shift to crops that command good market prices						
Shift to drought-resistant crops						
Intensify irrigation						
Diversify household income costs						
Increased livestock production						

34. In the third column, please provide more details, including examples, regarding adaptation strategies you have been using.

Code	**Adaptation Strategy**	**Details on the responses (e.g., new crop varieties, livestock breeding, other economic activities opted for, etc.)**
A	Shift to higher-yielding crop varieties	
B	Introduce new crop varieties	
C	Shift to shorter cycle crop varieties	
D	Stop cultivating some crop varieties	
E	Shift to crops that command good market prices	
F	Shift to drought-resistant crop varieties	
G	Intensify irrigation	
H	Diversify household income sources	

35. Socio-economic implications of the effect on the changes farmers have made in their farming practices as adaptation options.

What are the socio-economic implications of the changes you have made (as your adaptation to the changes in the local climate that you have been experiencing) on your farm, as well as at the community level? (Please fill in the two blank columns as accurately as possible)

Code	Implications	Details on the implications	Level (F-Farm or C-Community)
A	Average annual income has increased		
B	Average annual income has decreased		
C	Awareness of climate change has risen		
D	Water shortage for domestic and other uses		
E	Human health threats have increased		
F	Food insecurity threats have increased		
G	Quality of life has deteriorated		
H	Migrations have increased		
I	Social cohesion is threatened		
J	Social conflicts over diminishing resources have increased		

37. Knowledge of the appropriate adaptation options.

How do you get to know that the options you select and adopt (as listed in the table above) are good support for you to adapt to such changes? (Please tick your choices)

A. The radio [ ]
B. Newspaper [ ]
C. TV [ ]
D. Neighbours [ ]
E. Family members [ ]
F. Community meetings [ ]
G. Land Reform officer [ ]
H. Traditional & cultural Knowledge including forecasting [ ]
I. Other sources [ ]

38. What type of information do you think you need to increase your ability to adapt to climate change impact? (Tick as appropriate)

No	Type of information	Tick
1.	**Scientific information**	
1.1	The causes of climate change	
1.2	Weather and meteorological information (e.g., early warnings)	
1.3	Knowledge about soils and how to improve its fertility	
1.4	Predictions concerning climate change	
2.	**Agricultural practices, knowledge and information**	
2.1	Better management of agricultural land for sustainable production	
2.2	Proper use of agricultural inputs	
2.3	Climate change and sustainable farming systems	
2.4	Crop varieties tolerant to harsh climatic conditions	
2.5	Intensification of agriculture	
2.6	Adaptation knowledge and technologies for farmers	
3.	**Economic/commercial information**	
3.1	Crops commanding good practices in the market	
3.2	Financial opportunities arising from climate change	
3.3	Credit availability and access	
3.4	Incentives availability and access to inputs	
4.	**Social information**	
4.1	Local and traditional adaptation knowledge and technologies	
4.2	Culture and sustainable adaptation	
4.3	Blending scientific and local knowledge to support adaptation	
5.1	Land tenure issues	
5.2	Land rights	
5.3	Contracts issues	
6.	**Strategic and Policy information**	
6.1	Government efforts to address challenges of climate change and variability	
6.2	Alternative livelihood options to reduce the severity of climate change impact	
6.3	Crop Insurance	
6.4	Sustainable climate change adaptation policies and strategies	

39. Policy and strategic interventions for enhanced adaptive capacity and long-term Resilience.

NO.	Have you experienced the following types of climate change and variability indicators?	Response		How often? (in the past decade)
		Yes	No	
1	**Drought**			
2	**Floods**			
3	**Off-seasonal rainfall**			
4	**Too much rain**			
5	**Too little rain**			
6	**High temperature**			
7	**High winds**			
8	**Other (specify)**			

40. In response to climate change, have you taken any adaptation measures to reduce the impacts of climate change? Yes [ ] No [ ]

If your answer to the question above is no, why?.....

Reasons for not taking adaptation

No	Reasons for not taking adaptation	Yes	No
1	Lack of information		
2	Lack of capital		
3	Lack of knowledge		
4	Shortage of farming land		
5	Not observing the climate-related problems		
6	Giving less emphasis on climate change problems		
7	Others		

If your answer is yes to the question above, have you employed any of the following climate change impact adaptation strategies on your farm in the past 10 years?

No	Climate change adaptation	Response		If no, please specify the reason why not?
		Yes	No	
1	Buying insurance			
2	Change crop variety			
3	Mixed farming			
4	Temporary migration			
5	Planting early maturing crop			
6	Soil and water management			
7	Planting trees			
8	Irrigation			
9	Changing planting date			
10	See off-farm employment			
11	Reduce the number of livestock			
12	Other (specify if any)			

In the past two years, did you receive any land reform/agricultural technical support from the government in implementing adaptation? Yes [ ] No [ ]

If yes, what kind of technical support did you receive in your effort to reduce the impact of climate change and improve your farming system? Please List.

i. ……ii. ……..

iii. ……..v. ……

If no, what kind of support would you want to receive? Please list

i. ……ii.……

iii.……v. ……..

Do you have access to climate change information? Yes [ ] No [ ]

If no to the above question, please specify the reason.

……
……
……

What do you suggest should be done to reduce the impact of climate change in your district?

……
……
……

Thank you!

Annexure II: Approved data collection memo

approved data collection memo 1.p

Annexure III: Raw data collected and captured

UFS NEW
DATA-location.xlsx

Annexure IV: Data Analysis Results

MVP RESULTS.pdf

ADAPTATION RESULTS.pdf

Annexure V: Language Editor Certificate

LANGUAGE PRACTITIONER: Anneke Denobili

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DECLARATION

I, Anneke Denobili, hereby declare that I did the language editing of the thesis of Karneels Thabang Thinda titled, *Modelling Land Reform Beneficiaries' Choice of Disaster Risk Reduction and Adaptation Strategies in Response to Climate Change,* for submission purposes in partial fulfilment of the requirements for the degree of Philosophiae Doctor (PhD) in the Disaster Management Training and Education Centre for Africa (DiMTEC) at the University of the Free State. All the suggested changes, including the implementation thereof, were left to the discretion of the student.

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Sincerely

SATI Registration #: 1003466