SOCIAL RESILIENCE TO CLIMATE CHANGE IN LESOTHO

by

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A thesis submitted in accordance with the requirements for the degree

Master's in Sociology

in the

Faculty of the Humanities
(Department of Sociology)

at the

University of the Free State
Bloemfontein

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31ST JANUARY, 2016

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Tlaleng Molaoa

Acknowledgements

I wish to submit my gratitude for the support I received from:

- My supervisor, Dr Nola Redelinghuys, who supported me throughout this project;
- My parents, Mr and Mrs Molaoa, for their emotional support and words of encouragement to finish this programme;
- My research assistants, Mrs Noxolo Mzini, Miss Lineo Tsikoane, Miss Refiloe Mosothoane and Miss Kobasia Rabolinyane, who helped me with both data collection and data entry for the research;
- My friends in Bloemfontein and Lesotho, as well as my church congregation, for their support and their prayers;
- Ms Hettie Human, the language editor, who contributed to the final outcome of this report by ensuring that the language is at an acceptable level;
- Last, but not least, I want to thank the Almighty God, because without his guidance and everlasting love, I would not have come this far.

DEDICATIONS

This dissertation is dedicated to one of the people who were very close to my heart, the late Refiloe Cynthia Mosothoane, who inspired me to keep working when I wanted to give up, because it took me a long time to complete this research.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAP	African Adaptation Program
AfDBG	African Development Bank Group
AMCEN	African Ministerial Conference in Environment
CCES	Competence Centre Environment and Sustainability
CDM	Clean Development Mechanism
CFC	Chlorofluorocarbons
CH_4	Methane
CNA	Centre for Naval Analysis
CO	Carbon monoxide
CO_2	Carbon dioxide
COP	Conference of Parties
CFR	Council on Foreign Relations
CSIS	Centre For Strategic and International Studies
CSO	Civil society organisation
DMA	Disaster management authority
ECB	Emergency capacity building project
EEA	European Environment Agency
EESI	Environmental and Energy Study Institute
EIA	Energy Information Administration
EMT	Ecological Modernisation Theory
EPA	Environmental Protection Agency
EU	European Union
FAO	Food and Agriculture Organization of the United States
FGD	Focus group discussions
GCCA	Global Climate Change Alliance
GCM	Global climate change
GCOS	Global Climate Observing System
GCRIO	Global Change Research Information Office
GDP	Gross domestic product
GEF	Global Environment Fund

GHG	Greenhouse gas
HEP	Human Exceptionalism Paradigm
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
IIED	International Institute for Environment and Development
IFAD	International Fund for Agricultural development
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
ISDR	International Strategy for Disaster Management
IISD	International Institute for Sustainable Development
INC	Intergovernmental Negotiating Committee
JI	Joint Implementation
JICA	Japan International Cooperation Agency
LENASO	Lesotho Network of AIDS Services Organisation
LMS	Lesotho Meteorology Service
LREBRE	Lesotho Renewable Energy-Based Rural-Electrification
MDG	Millennium Development Goals
MoH	Ministry of Health
NAPA	National Adaptation Program of Action
NAPCC	National Action Plan on Climate Change
NASA	National Programme of Action on Climate Change
NEAP	National Environmental Action Plan
NEP	New Ecological Paradigm
NES	National Environment Secretariat
NGLS	Non-governmental Liaison Service
NGO	Non-governmental organisation
NO_2	Nitrogen Dioxide
NO_x	Nitrogenoxide
N_2O	Nitrous oxide
NUL	National University of Lesotho
OECD	Organization of Economic Cooperation and Development
ppm	Parts per million
PRB	Population Reference Bureau

REDD	Reducing emissions from deforestation and forest degradation
RFF	Resources for the Future
SADC	Southern African Development Community
SADCC	Southern African Development Coordination Conference
SDG	Sustainable Development Goal
SO_2	Sulphur dioxide
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNCHE	United Nations Conference on the Human Environment
UNHCR	United Nations High Commissioner for Refugees
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNEPFI	United Nations Environment Program Finance Initiative
UNFCCC	United Nations Framework for Climate Change Convention
UNESCO	United Nations Educational, Scientific and Cultural Organization
UN-OHRLLS	United Nations Office of the High Representative for Least Developed Countries, Landlocked Developing Countries and Small Island Developing State
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
UNU-IAS	United Nations University Institute for Advanced Study of Sustainability
USA	United States of America
USDA	United States Department of Agriculture
WMO	World Meteorological Organization
WFP	World Food Program
WHO	World Health Organization
WWF	World Wildlife Fund

KEYWORDS

Adaptation

Climate Change

Mitigation

Social Resilience

Vulnerability

EXECUTIVE SUMMARY

Natural phenomena have played a part in climate change over extended periods of time. Some of these natural causes of climate change include changes in topography and land-sea geography. However, since the beginning of the Industrial Revolution human activity, such as burning of fossil fuels, has caused major changes in the climate. Climate change has had an impact on and continues to affect health, agriculture, fresh water (which is essential for health), food production and sanitation. Since climate change effects on every aspect of our daily lives, developing countries remain more vulnerable to the effects of climate change.

The study aimed to meet the following objectives:

- To assess the effects of climate change on the population of Lesotho;
- To explore the current national policy framework in place to address matters relating to climate change;
- To identify gaps between the needs of subsistence-based farmers and the current national policy framework on climate change; and
- To make recommendations to improve the effectiveness of current mitigating and adaptation measures put forth by the Lesotho government to deal with the impacts of climate change.

The study involved three populations: Agriculture-based households from five villages, selected in accordance with the five ecological zones in Maseru district, focus groups involving at least five farmers each, and key informants in government and international agencies, who are knowledgeable about issues pertaining to climate change and policy development in Lesotho. The researcher used a mixed-methods approach by implementing both qualitative and quantitative research methods. The data was gathered by means of a community survey (quantitative), key informant interviews, and focus group discussions with community members (qualitative).

The study concludes with the following:

- A review of impacts of climate change on Lesotho;
- A review of policies put in place to address matters relating to climate change;

- Identification of gaps between policy makers and subsistence-based farmers.

From the conclusions reached, the following recommendations were made:

- Climate change will need to be considered systematically at all levels of development in order to have detailed knowledge on natural and human conditions;
- The government of Lesotho needs to build on initiatives that are being implemented by various stakeholders, such as the Africa Adaptation Programme;
- Government institutions should partner with civil society organisations involved with matters of climate change; and
- Technologies need to be put in place to increase Lesotho's adaptability to and resilience as it relates to the effects of climate change.

OPSOMMING

Natuurlike verskynsels het oor lang tye ‘n rol gespeel in klimaatsverandering.Van hierdie natuurlike verskynsels wat met klimaatsverandering verband hou, sluit in veranderinge in topografi en land-see geografie.Sedert die aanvang van die Industriële Revolusie het menslike aktiwiteite, soos die gebruik van fossielbrandstof, groot veranderinge in die klimaat veroorsaak.Klimaatsverandering het ‘n invloed op en sal voortgaan om ‘n invloed te hê op gesondheid, vars water (wat noodsaaklik is vir gesondheid), voedselproduksie en sanitasie.Aangesien klimaatsverandering elke aspek van ons daaglikse lewens beïnvloed, is ontwikkelende lande kwesbaar vir die gevolge van klimaatsverandering.

Hierde studie het die volgende doelstellings nagestreef:

- Om die effek van klimaatsverandering op die bevolking van Lesotho te bepaal;
- Om ondersoek in te stel na die huidige nasionale beleidsraamwerk wat in plek is om sake wat met klimaatsverandering verband hou, aan te spreek;
- Om gapings tussen die behoeftes van bestaansboere en die huidige nasionale beleidsraamwerk vir klimaatsverandering te identifiseer; en
- Om aanbevelings te maak om die doeltreffendheid van huidige versagtende en aanpassingsmaatreëls wat die Lesotho regering voorgestel het om die gevolge van klimaatsverandering te hanteer, te verbeter.

Die studie het drie populasies betrek:Landbougebaseerde huishoudings in vyf dorpies, wat gekies is volgens die vyf ekologiese sones in Maseru distrik, fokusgroepe wat ten minste vyf boere elke behels het, en sleutelinformante in die regering en internasionale agentskappe wat kundiges is ten opsigte van klimaatsverandering en beleidsontwikkeling in Lesotho.Die navorser het ‘n gemengdemetode-benadering gevolg deur sowel kwalitatiewe as kwantitatiewe navorsingsmetodes toe te pas.Die data is deur middel van ‘n gemeenskapsopname (kwantitatief), onderhoude met sleutelinformante, en fokusgroepbesprekings met lede van die gemeenskap (kwalitatief) ingesamel.

Die studie sluit met die volgende af:

- ‘n Oorsig van gevolge van klimaatsverandering op Lesotho;
- ‘n Oorsig van beleide wat in plek is om sake wat met klimaatsverandering verband hou; aan te spreek;
- Identifisering van gapings tusen beleidmakers en bestaansboere.

Die volgende aanbevelings vloei uit die gevolgtrekkings wat bereik is:

- Klimaatsverandering moet sistematies, op alle vlakke van ontwikkeling, aandag geniet;
- Die regering van Lesotho moet voortbou op inisiatiewe wat geïmplementeer word, soos die Africa Adaptation Programme;
- Regeringsinstellings moet met gemeenskapsgebaseerde organisasies wat by kwessies van klimaatsverandering betrokke is, saamwerk; en
- Tegnologie moet geïmplementeer word om aanpasbaarheid en veerkragtigheid ten opsigte van die gevolge van klimaatsverandering te verbeter.

CHAPTER 1. INTRODUCTION AND BACKGROUND

1.1 BACKGROUND TO THE STUDY

Climate change has been on the international agenda for at least the past two decades. During this time it has become an important socio-economic problem because of its effects on the natural environment and livelihoods of people in general (Mokuku *et al.*, 2002). Both natural and anthropogenic factors have been found to contribute to climate change (Koomen & Loonen, 2007; Schindler, 2010). Natural factors contributing to climate change include volcanic eruptions, variations in ocean currents and atmospheric circulation, solar output, and the earth's orbit around the sun (IPCC, 2007). Natural causes alone are, however, very unlikely to explain the speed at which observed changes in the earth's climate are taking place, especially since the mid-20th century. Instead, anthropogenic factors offer a more likely explanation for recent changes in the earth's climate (EPA, 2013). The anthropogenic factors linked to climate change include energy generation through the burning of fossil fuels (coal, oil and natural gas), deforestation and agricultural practices (e.g. cattle farming and rice cultivation) (GCRIO, 2007; IPCC, 2007; UNEP, 1999).

The impacts of climate change on human society are multidimensional, and the economy, human health and well-being, and food production are some of the societal dimensions that are affected. A specific impact is, for example, unprecedented heat waves that are being experienced in the world's largest cities, and which contribute to an increase in morbidity. Droughts are intensifying in many regions, influencing the economic development potential of many countries reliant on agricultural production (Jarman, 2007; Koomen & Loonen, 2007). All countries will need to adapt to the impacts of climate change on these and other areas of life (UN-OHRLLS, 2009).

While it affects every human society in one way or another, climate change does not affect everyone equally, and different societies do not possess the same capacity to respond to the challenges posed by climate change. Countries therefore differ regarding their social resilience and ability to cope with the impacts of climate change (Nelson, 2011). Social resilience as it relates to climate change is defined as the ability of human systems to adapt to and cope with the impacts of climate change (Marshall *et al.*, 2010). Social resilience is influenced by factors such as wealth,

access to technology, the ability to interpret and use information, infrastructure, access to resources, and management capabilities. Furthermore, social resilience regarding climate change depends on the scale, intensity and rate of change of the climate system, as well as the inherent ability of communities to adjust to new circumstances brought about by changes to the climate system (UN, 2007).

Countries in the developing world find themselves in a particularly vulnerable situation with regard to dealing with the impacts of climate change. These countries are generally less resilient, and are finding it more difficult to adapt to and cope with the impacts of climate change – this inability is the result of a combination of socio-economic, political and environmental challenges faced by these countries. This inability results in higher levels of vulnerability to the impacts of climate change for such countries (IPCC, 2007). In order to understand the difference in vulnerability of developed and developing nations better, the link between climate change and socio-economic development is elaborated below.

1.2 CLIMATE CHANGE AND SOCIO-ECONOMIC DEVELOPMENT

From the late 18th century, human activities associated with the Industrial Revolution contributed to increasing the levels of greenhouse gases (GHG)being released into the atmosphere and, over a period of time, this increase contributed to widespread changes in the earth's climate (EPA, 2011). Early industrialised countries in Europe and North America experienced increased economic development as a positive consequence of industrialisation. However, one of the unplanned negative consequences of industrial development is the increasing buildup of GHG in the planet's atmosphere (UNFCCC, 2007).

Industrialised, developed nations have contributed most to the emission of GHG into the atmosphere. From Table 1.1 it is evident that countries that emit the most carbon dioxide (CO_2) are Canada and the USA; these countries also have high Gross National Income per capita, which signifies higher levels of economic development. Nations in the developing world, which have lower gross national income per capita, however, have generally contributed much less to GHGemissions than historically industrialised nations.

Table 1. 1: CO_2emissions[1] per capita for selected countries

Country	Metric Tons of CO_2 Emissions per capita	Gross National Income PPP per Capita)
Developed countries		
Australia	48.3	US$36910
Canada	15.2	US$47310
Germany	26	US$38100
New Zealand	27	US$33690
United States of America	17.3	$38370
Developing countries		
Ethiopia	0.1	US$1800
Eritrea	0.1	US$1330
Lesotho	0	US$1850
South Africa	10.1	US$580
Zambia	0.3	US$1620

Source: PRB, 2012.

Developing countries, like Lesotho and Ethiopia, which have a very low gross national income per capita, emit a very little CO_2compared to more developed nations. In light of this, the United Nations Foundation (2009) warned that developed countries are driving an ecological crisis that will affect poor, developing nations hardest. South Africa, although it is a developing country, uses significant volumes of coal for energy generation, making the country's GHG emissions relatively high compared to other countries (Winkler & Maquand, 2009)

While developed nations are the largest contributors to GHG emissions, poorer countries carry a larger burden in terms of the impacts of climate change. Developing countries are particularly vulnerable to climate change because the impacts of climate change converge with multiple

[1] While other GHGs, such as methane and nitrous oxide, also contribute to rising GHG emissions, carbon emissions were used in Table 1.1 to give an indication of the link between economic development and GHG emissions.

stressors, such as poverty, low levels of economic development, large rural populations directly reliant on the natural environment for their subsistence needs, and a lack of institutional capacity to effectively adapt to and mitigate possible climate change impacts (Fields, 2005). Populations in developing countries are thus subjected to multiple shocks and stresses that can increase vulnerability to the impacts of climate change; this vulnerability is the result of these people's limited capacity to adapt to a changing climate (McGuigan *et al*, 2002; Morton, 2007; Ziervogel & Cabler, 2003).

Some sectors of economies are more vulnerable to climate change than others; these sectors include agriculture, coastal resources, energy, forestry, tourism and water. Due to the fact that developing countries generally have a larger portion of their economies in agriculture and forestry, it follows that these sectors then become more economically vulnerable to the impacts of climate change (Mendelsohn, 2009).

1.3 CLIMATE CHANGE AND HUMAN WELL-BEING

People's well-being is directly affected by climate change, because climate change reduces the livelihood assets of poor people, increases food insecurity and increases the prevalence of waterborne diseases. These impacts of climate change are predicted to have far-reaching implications for human development, especially in developing countries, to the extent that it will impede their ability to attain the United Nations (UN) Millennium Development Goals (MDGs)[2] (UNFCCC, 2007). For instance, climate change is expected to worsen food insecurity, particularly in Africa, and this will affect the attainment of Goal 1.[3] The increase in heat-related mortality, mortality and morbidity resulting from floods and droughts, and increased water- and vector-borne diseases also make the health-related goals difficult to reach (Goals 4, 5 and 6) (Fields, 2005; IIED, 2008). However post-2015 Sustainable Development Goals have replaced the MDGs which were born at the United Nations Conference on Sustainable Development, Rio 20, in 2012. The objective was to produce a set of universally applicable goals that balance the three dimension of sustainable development which are environmental, social and economic (UNDP, 2016).

[2]The effects of climate change on the attainment of the MDGs are dealt with in more detail in Chapter 3.

[3]Eradicate extreme hunger and poverty.

Climate change is also expected to cause a decline in the quantity and quality of drinking water. This has specific bearing on MDG 7, which pertains to achieving environmental sustainability. Climate change is, in fact, expected to severely alter the quality and productivity of all natural resources and ecosystems (Kreft *et al*., 2010). One serious impact of climate change for people directly dependent on the environment, according to Desanker (2001), is brought about by the loss of biodiversity. Biodiversity, in one form or another, plays a vital role in many African economies, as it serves as a source of food, shelter, medicine and income, through trade and tourism (Mathews *et al.*, 2007; UNEP, 2010).

Based on the above, developing countries are considered to be more vulnerable to the impacts of climate change, and display lower levels of social resilience for dealing with the impacts of climate change. As a result of vulnerability to the impacts of climate change, attention must be given to understanding the factors that make developing countries more vulnerable to the impacts of climate.

There is, therefore, growing concern that the world's poor, who contribute the least to climate change, are the most vulnerable to its impacts and are unable to adapt to the rising frequency and severity of extreme weather and climate variability. Risks brought about by climate change, such as droughts and floods, dependence on rain-fed agriculture, crop and animal disease and market shocks, are felt by individual households or entire communities (Bunce *et al*., 2010). Rural populations, in particular, are subject to multiple shocks and stresses that can increase household vulnerability to the impacts of climate change. These communities have difficulty coping with climate change due to the fact that they have limited financial resources to help them respond to the impacts of climate change (EPA, 2013; Ziervogel & Cabler, 2003). Because people who live in poverty are already vulnerable to factors such as hunger caused by drought, high rates of HIV/AIDS and other diseases, such as malaria, and political factors, the impacts of climate change worsen their existing vulnerabilities (EPA, 2013).

There is a critical need to investigate and illuminate how these multiple stressors affect the ability of households and communities to respond to climate change, and also how it affects their ability to secure and sustain livelihoods in future (Bunce *et al*, 2010). Furthermore, there is also a need to investigate national policy responses of developing nations with regard to climate change adaptation.

Many developing countries, including Lesotho, have assigned a high priority to adaptation action to climate change. For example, during March 2011 the UN office in Lesotho had invited service providers to provide quotes to develop effective platforms for climate change adaptation and policy (Lesotho Times, 2011). The platforms for climate change and policy were in part due to the economic importance of climate-sensitive sectors, such as agriculture, to these countries, and these sectors' limited human, institutional and financial capacity to anticipate and respond to the direct and indirect effects of climate change. Adaptation is necessary to ensure long-term effectiveness of poverty reduction and sustainable development, but challenges facing policy-makers involve developing and implementing policies that ensure high levels of adaptation for rural poor communities (Commission of the European Communities, 2009).

1.4 STATEMENT OF THE PROBLEM

Lesotho as a developing country is very vulnerable to the impacts of climate change, comparable to the challenges experienced by other developing nations. Natural conditions, such as erratic rainfall, poor soil quality, worsening land degradation, as well as a lack of individual incentives to maintain and improve the natural resource base, contribute to Lesotho's vulnerability to the impacts of climate change (Government of Lesotho, 2000). Lesotho experiences frequent droughts that result in poor harvests and extensive livestock losses. Heavy snowfall, strong winds and floods also affect the country, and have adverse social impacts. Lesotho's high vulnerability to climate risks and its limited adaptive capacity pose a serious threat to sectors such as agriculture, forestry and infrastructure, thereby weakening the country's overall resilience to the negative effects of climate change (Global Climate Change Alliance, 2012). Lesotho, like many other developing countries, is already experiencing low agricultural productivity, and this has extremely negative consequences for the 85% of the Basotho population who are mainly reliant on subsistence farming for their livelihoods (Matsipa, 2008). Rural farmers are particularly vulnerable to the impacts of climate change due to their greater direct dependence on the natural environment, and their overall welfare has been compromised by extreme climate variability, which is exacerbated by a lack of adaptation technologies, social protection mechanisms and adequate protection for their crops (Clement *et al.*, 2011).

In recognition of the impacts of climate change on its population, Lesotho has joined the international community in calling for initiatives to control and adapt to impacts of climate change

through policies and measures closely aligned with the objectives of the United Nations Framework on Climate Change Convention (UNFCCC). Though the country has followed international guidelines and principles in drawing up laws and policies for dealing with the problems caused by climate change, Lesotho faces severe challenges in implementing these laws and policies, mainly because of resource constraints (Machepha, 2010).

At this stage, research on the overall preparedness of Lesotho to deal with the matter of climate change as it affects the Lesotho population is lacking. This study aims to fill this gap by focusing specifically on Lesotho's preparedness to deal with the impacts of climate change. This study will involve, first, exploring Lesotho's current national policy framework for addressing issues of climate change and, second, by investigating the needs of subsistence-based farmers with regard to climate change preparednessBoth natural and anthropogenic factors have been found to contribute to climate change. Farmers constitute a large proportion of Lesotho's population, and since they are more directly affected by changes in the climate, the agricultural sector is centred around the existing policy framework and the needs of subsistence-based farmers, as well as the gaps between farmers' needs and the current policy framework. Once these needs have been identified, recommendations will be made for bridging the gaps between policy and the population's needs in terms of preparedness, adaptation and mitigation of climate change.

1.5 AIM AND OBJECTIVES OF THE RESEARCH

The aim of the study is to take stock of Lesotho's preparedness to deal with the impacts of climate change as it relates to the population of Lesotho.

The following specific objectives will be pursued:

- To assess the effects of climate change on the agriculture-based population of Lesotho;
- To analyse the current national policy framework to address issues of climate change in Lesotho;
- To identify gaps between the needs of farmers and the current national policy framework on climate change; and

- To make recommendations to improve the effectiveness of current mitigating and adaptation measures put forth by the Lesotho government for dealing with the impacts of climate change.

1.6 VALUE OF THE STUDY

Lesotho's resilience in the face of the impacts of climate change, as reflected in their policy framework and the impacts of climate change experienced by the population, is a concern because the country is already experiencing low adaptive capacity with regard to climate change (UNEP, 2000 UN-OHRLLS, 2009). This study will help policy-makers understand and anticipate the likely impacts of climate change on vulnerable households in Lesotho, and identify adaptation measures for addressing the challenges posed by climate change in line with the needs of farmers. The study can also serve as a baseline for Lesotho's current preparedness to deal with the impact of climate change. This study will not only add to the body of knowledge on mitigation and adaptation to the impacts of climate change by developing nations, but policy makers can use it to ensure that appropriate strategies are identified and instituted.

1.7 CONCLUSION

This chapter provided the background to the study, the statement of the problem, study objectives as well as the value of the study. In Chapter 2, attention will be given to outlining the theoretical framework of the study. Chapter 3 is devoted to the factors that contribute to climate change, as well as the impacts of climate change on society. Chapter 4 deals with the policy framework of climate change and Chapter 5 outlines the methodology followed in this study. Chapter 6 presents the study findings, and Chapter 7 presents conclusions and recommendations.

CHAPTER 2. THEORETICAL FRAMEWORK FOR THE STUDY

2.1 INTRODUCTION

Sociological research on environmental issues such as global climate change has its roots in the subdiscipline of environmental sociology, which is a speciality field that developed in response to increased social awareness of environmental problems since the 1970s (Nagel *et al*., 2008). What binds environmental sociologists together is an interest in the interaction between the natural and social environments (Dunlap 2010; Nagel *et al*., 2008). The increased salience of environmental problems has permitted environmental sociology to gain legitimacy as a subdiscipline within the broader sociological discipline, and to make a contribution to the study of matters, such as climate change, that span the interest of the social and natural environments. The aim of this chapter is to present a theoretical foundation for the study within the subdiscipline of environmental sociology. To achieve this aim the roots and legacy of environmental sociology will be explored briefly, after which attention will turn to establishing the theoretical basis for this study specifically.

2.2 THEORETICAL UNDERPINNING WITHIN THE BROADER DISCIPLINE OF SOCIOLOGY

The establishment of sociology as a scientific discipline was influenced by two main events in history, which both spurred widespread and unprecedented social change, namely, the Enlightenment and the Industrial Revolution. These events were associated with a great deal of optimism about human beings' capabilities and the advancement of human societies (Gould & Lewis, 2009).

The Enlightenment brought about an intellectual revolution regarding the way people thought about progress and scientific reasoning. Enlightenment thinkers emphasised a sense of common purpose and hope for human progress and they challenged many of the established orders of society from an analytical and scientific view. Enlightenment scholars, such as Charles Montesquieu, believed that the Enlightenment could bring about a period of great human development, accompanied by science being applied increasingly to address humanity's problems. These scholars also believed that human beings could be perfected, given the right social conditions and institutions. The optimistic views of the philosophers and other social thinkers regarding social progress and equal opportunity became part of the impetus for political and

economic revolutions. There was steady economic growth that seemed to bear out the idea that the new key scientific method could unlock answers, not only to the physical world, but to theology, history, politics and social problems. Using the advances made possible by rational scientific inquiry, farmers pioneered improvements in agriculture and entrepreneurs experimented with new technologies and products (Frick, 1999). This scientific and philosophical climate also contributed greatly to the birth of sociology and of social scientific thought in general (Neena & Rakhi, 2011).

An exception to the generally optimistic Enlightenment views was the work of Thomas Robert Malthus (1766-1834). In his essay on the principles of population, written in 1798, he argued that, while human population grows geometrically, the amount of land put under cultivation and food output grows arithmetically. This means that people will eventually run out of food. Malthus explained that the future of the human species was one of devastation caused by famines, pestilence and wars, because nature will attempt to balance out the population size and the available food resources. Despite Malthus' views, the intellectual mood of the time remained one of great optimism (Panayotou, 2000).

During the 19th and early 20th centuries the Industrial Revolution took place in Britain, specifically between 1760 and 1850, and it soon spread throughout western Europe. An exchange of goods among the European countries during this time led to increased demand for goods – the demand was greater than the amount of goods being produced. By the mid-19th century, industrialisation was well under way in the United States as well. Massive economic, technological and social change occurred as machine technology and the factory system shifted the economic base of these countries from agriculture to manufacturing. A new social class of industrialists emerged in textile, iron smelting and related industries. Many people who had laboured on the land left their rural communities to find employment as factory workers in emerging cities, which became the centres of industrial work (Patton & McMahon, 2014).

Along with the Industrial Revolution in England during the 18th century and the rise of urbanisation and mass social change, sociological thinkers such as Comte and Durkheim began realising the need to study society in all its dynamic nature. This period was called "the great transformation" and the social science of sociology developed in this context (Neena & Rakhi, 2011). Therefore, the field of sociology was initially developed by people trying to comprehend the massive transformations of social organisation that emerged in the 19th century during the rise of

industrialisation. Thinkers such as Marx, Weber and Durkheim established the scientific study of societies and social change in efforts to understand the new patterns of social relations generated by the emergence of industrial production. The Industrial Revolution resulted in a great technological transformation in the relationship between social systems and ecosystems in that industrialisation ushered in societal dependence on enormous inputs of non-renewable energy resources in order to fuel production (Gould& Lewis, 2009).

Within this social climate, sociology focused single-mindedly on social aspects, without pertinently acknowledging the natural environment that formed the material basis for society. The only thinker who came close to formulating a viewpoint on the environment as a material basis for society was Karl Marx (Blunden, 1976). Over time, however, social scientists came to the realisation that the environment needs to be factored into any analysis of the social world, and this contributed to the rise of environmental sociology as a subdiscipline within the field of sociology.

2.3 THE RISE OF ENVIRONMENTAL SOCIOLOGY

The natural environment had not been considered an issue from a social point of view before the 1960s. During the 1920s, with the emergence of social ecology, there were some indications that the environment should be considered from a sociological point of view. This field is interested in the relationship between the environment and human life. In the 1920s and 1930s the principles of social ecology, which were outlined by Robert E. Park and his colleagues, were based on three aspects. Firstly, humans are not immediately and directly dependent upon the natural environment, having been emancipated from this dependence by the social division of labour. Secondly, technology has allowed humans to use and control the environment, rather than be constrained by it. Thirdly, the structure of human life is governed by cultural factors and social institutional structure rooted in custom and tradition. By the 1950s social ecology maintained that the natural environment comprises the raw materials of life and the conditions, both favourable and unfavourable, that affect the use of those materials. In the early 1960s social ecology developed to include both the natural and human-made social environment. In the 1960s the physical and social environment in which people lived was perceived as a vital force that influenced the development of attitude, behaviour and personality. Catton and Dunlap (Jeong, 1997) pinpointed the distinctive core of the field of environmental sociology as a new social ecology that focused on the interaction between the physical environment and social organisation and human behaviour (Jeong, 1997).

It is from their work in the field of social ecology that Catton and Dunlap began to develop the field of environmental sociology (Hannigan, 2005). They argue that sociology must examine the relationship between society and the biophysical environment and because this link was not taken seriously by mainstream sociologists, the discipline ignored the biophysical environment completely in their work (Hannigan, 2005). To remedy this situation Catton and Dunlap advocate a new paradigm based on an alternative set of background assumptions. Catton and Dunlap simply defined environmental sociology as the study of interaction between the environment and society (Bowden, 2004). Environmental sociology is therefore a subfield of sociology that is open to including ecological variables within its analysis, and has chosen to apply and develop sociological analysis where social systems and ecosystems, such as people, other animals, land, water, and air intersect, together forming what is known as ecology. Therefore, environmental sociology studies social and ecological communities while trying to understand the origins of and proposing solutions for all social and biophysical conflicts (Bell, 2004; Gould &Lewis, 2009). Environmental sociologists further, focus on fixing the problems caused by a lack of attention to the biophysical environment by mainstream sociology. The aim is to examine the relationships between modern, industrial societies and the biophysical world, as both causal factors that shape social change, and as outcomes of social structures or social processes, and to explain the causes of environmental degradation or environmental problems (Dunlap & Catton, 2006).

Environmental problems are one of humanity's major concerns in the 21st century, and sociologists can play a vital role in getting to the root of these problems. While the study of environmental problems is an inherently interdisciplinary project, the crucial role of social sciences, and sociology in particular, are increasingly recognised due to a growing awareness of the fact that environmental problems are fundamentally social problems (Buttel, 2003; Dunlap & Marshall, 2006).

Although there was scattered sociological attention on both urban problems and natural resource problems prior to the 1970s, environmental sociology largely developed in that decade as sociology's own response to the emergence of environmental problems on the public agenda. At first, sociologists who were interested in the linkages between environment and society limited their attention to analysing societal response to environmental problems, rather than examining the problems themselves. As sociologists started to pay more attention to environmental problems, some began to look beyond societal awareness of environmental problems, and to examine the

underlying relationships between modern, industrial societies and the biophysical environments they inhabit (Dunlap & Marshall, 2006).

Apart from the significant influence of ***human ecology***, which is the first formative influence of Environmental Sociology, on the development of environmental sociology, Humphrey *et al.* (2002) identify four out of the five other major influences that have contributed to a growing emphasis on the interconnectedness between the natural and the social environment.

Humphrey *et al.* (2002) regard the ***rise and revitalisation of the environmental movement*** as second formative influence of environmental sociology**.** Coming from widespread environmental concerns in the 1970s, caused by a number of environmental disasters, many people became aware of environmental problems and realised the urgency of dealing with these problems. During this decade there was increased sociological interest in topics such as environmental attitudes, environmental activism, the environmental movement, the built environment, social impact assessment and natural hazards. This led to numerous environmental sociology courses and a few graduate programmes developing specialisations in environmental sociology (Buttel, 1996; Catton & Dunlap, 1994).

A third formative influence was ***the development of the paradigm shift theory*** by Catton and Dunlap (Humphrey *et al*., 2002). This theory states that society is gradually transitioning from a ***Human Exceptionalism Paradigm*** to a ***New Ecological Paradigm***. These theorists were among the first sociologists to speculate that sociology overestimates the independence of human beings from their material environment. Catton and Dunlap presented four postulates[4] reflecting human independence from the environment and called it the Human Exceptionalism Paradigm (HEP). They also argue that, following from this paradigm, all sociological theories are anthropocentric.[5] In opposition to this paradigm they propose a "new environmental paradigm", now called the New Ecological Paradigm (NEP), according to which people move away from the view of human independence from nature (Dunlap, 2010). The NEP states that humans are one of many interdependent species in the global ecosystem and part of a large web of nature, that humans depend on a finite biophysical environment, and that those humans are not exempt from ecological

[4]These postulates will be discussed in more detail in Paragraph 2.5.2.

5A view that human society is the centre of the natural world, controlling and using the environment without regard for the natural resource-based limits to social growth.

laws (Gould & Lewis, 2009). The theory gave environmental sociology a new sociological paradigm within which social and natural environments can be studied interdependently, as opposed to mainstream sociological theories that disregard interdependence under the HEP.

The fourth formative influence identified by Humphrey *et al*. (2002) is that of ***rural sociology***. Rural sociologists were among the first to respond to environmental problems with a sociological perspective, probably because most of the earliest contributors to contemporary environmental sociology were either self-identified rural sociologists or interacted frequently with rural sociologists. Rural sociologists saw society as being linked to limited natural resources. Since they focused on issues such as resource management, resource extraction, the exigencies of space, and the genesis and impacts of technologies, they were more prepared than their counterparts elsewhere in sociology to welcome a view of social structure and social life that involved important material and biophysical dimensions (Buttel, 1996; Humphrey *et al*., 2002).

The last formative influence is that of ***urban sociology***. Urban sociologists have been studying land development and the social and environmental consequences of land development. Much of their work contributes to the sociology of the built environment. Urban sociologists study different degrees of similarity between people's lifestyles, which are shaped by social class, gender and ethnicity and the urban built environment. Therefore, urban sociology is primarily concerned with matters relating to urbanisation and the nature of the urban social life. Urban sociologists began investigating how well the built environment accommodated the characteristics and behaviour of people because much of urban sociology's focus was on the social environment, therefore the interests of environmental sociology intersect with what was mentioned above (Humphrey *et al.*, 2002; Tindall, 1995).

The five formative influences of environmental sociology were discussed to provide a view of how environmental sociology has developed. The next section will discuss environmental sociological perspectives relating to this study.

2.4 ENVIRONMENTAL SOCIOLOGY AND THE STUDY OF CLIMATE CHANGE

Environmental problems, such as climate change, are best understood within the socio-political and socio-economic context in which they manifest. The potential impacts of global climate change have captured the attention of the scientific research community and have been elevated to

the top of many international policy-making agendas (Nagel *et al.*, 2008). Social scientists have found themselves called to contribute to the scientific understanding of how society and climate change are linked. However, social scientists understand and explain these linkages from different social-scientific paradigms, namely, the conflict perspective, functionalist perspective, and social constructivist perspective. These perspectives will be discussed below to provide the context for the theoretical foundation that will underlie this particular study.

2.4.1 The conflict perspective

The conflict perspective is a critical perspective on contemporary society that is associated with theorists such as Max Horkheimer (1895-1973), Herbert Marcuse (1898-1979), Leo Lowenthal (1900-1993) and Theodor Adorno (1903-1969). Social theories that emphasise social conflict have their roots in the ideas of Karl Marx (1818-1883). The conflict view stresses a materialistic interpretation of history, a dialectical method of analysis, a critical stance towards existing social arrangements and a political programme towards radical reform (McClelland, 2000). According to the conflict perspective, the relationship between environment and society is characterised by conflict and a struggle over the control of few resources. The conflict perspective argues that environmental problems are caused by humans competing for power, income, and their own interests. Competing political and economic interests ensure that this conflict will continue. The competition inherent in the capitalist system encourages overuse of resources and pollution, simply because environmental resources are treated as infinite and free resources within the system (Guerreo, 2008).

Schnaiberg, one of the conflict theorists, argues that the capitalist system contributes to environmental degradation because the system is functioning as an environmentally destructive treadmill of production. The treadmill of production refers to exponential, capital-intensive, environment-degrading economic growth (Buttel, 2000; Dunlap & Buttel, 2002). Continuous growth drives resource exploitation which has impacted the environment more extensively than in other period in history. Due to the unsustainable consumption and production, the scarcity of natural resources on which society heavily depends on is becoming a reality. The treadmill of production is focused on decision-making in the realm of production and its model of socio-environmental dynamics stresses production rather than consumption (Gould *et al*., 2003). According to the treadmill of production capitalism requires constant economic growth and this

interferes with the organisation of ecological systems in the form of increased natural resource extraction and release of toxins in the environment. The expansion of capitalism is thus linked to environmental problems such as resource depletion, acid rain and the build-up of CO_2 in the atmosphere (Hannigan, 2005; Long, 2012).These problems have negative impacts on vulnerable and marginalised people, such as subsistence farmers, who do not benefit from the accumulation of capital that led to the environmental degradation in the first place. Many of the poor live in extreme poverty and many, for their livelihood strategies depend upon the natural resource base. Poor people, therefore survive on a limited land resource base which leads to over exploitation of the environment (Lovemore, 2001). These people are victims of the treadmill of production and pay the price for the environmentally destructive generation of capital. With regard to this study in particular, Lesotho can, according to the conflict perspective, be regarded as a country that is paying the price for environmental destruction brought about by developed countries in the pursuit of the generation of capital.

The treadmill argues that social and environmental change will likely only result from major disruptions to this system, rather than from moderate reforms and adjustments (Gould *et al*., 2003). Conflict perspective critics argue that the conflict perspective downplays the unity that exists in society and they take a negative view of society by over-emphasising conflicts, tensions and coercions (Stolley, 2005). Though there is, indeed, a struggle over limited resources, because of existing environmental crises, the challenges posed by climate change can be overcome if proper policies are put in place to try and mitigate and/or adapt to problems caused by climate change.

2.4.2 The social constructivist perspective

The basic ideas of social constructivism can be traced back to philosophical developments that flourished several hundred years ago. The philosophers Giambattista Vico (1668-1744), Immanuel Kant (1724-1804), and Friedrich Nietzsche (1844-1900), and psychologists Lev Vygotsky (1896-1934), Jean Piaget (1896-1980) and George Kelly (1905-1967) were instrumental in initiating thought around knowledge development and the influence of psychological or sociological factors in this process. The perspective of social constructivism penetrated other disciplines after Peter Berger and Thomas Luckmann, in 1966, published their classical book, *The Social Construction of Reality* (Gergen, 2001; Teater, 2010). Berger and Luckmann's book introduced constructivism to sociology. They showed how individuals and groups participate in the construction of a reality

about a specific object or fact. They argued that phenomena are created, known and institutionalised through social interaction. Social construction is an ongoing process that is maintained and reproduced by people who act on their interpretation and their knowledge. After Berger and Luckmann's work, there was an ascendance of social constructivism literature in the social sciences (Knol, 2011).

The social construction of nature and environmental problems states that the environment and environmental problems are shaped by intrinsic social processes of knowledge generation and communication. Social constructs vary from place to place and over time. This perspective considers changes in the environment as being social constructs that are formed by people who interpret the changes in the natural environment and see it from a particular angle based on a special filter of values (Kotelo-Molaoa, 2008). Social constructivism has been especially influential in the study of environmental problems, because it requires an understanding of both problem claims and scientific evidence (Wilbanks & Romero-Lankao, 2007). Since societies are different it implies that the way they interpret various phenomena will be different as well (Lockie, 2004).

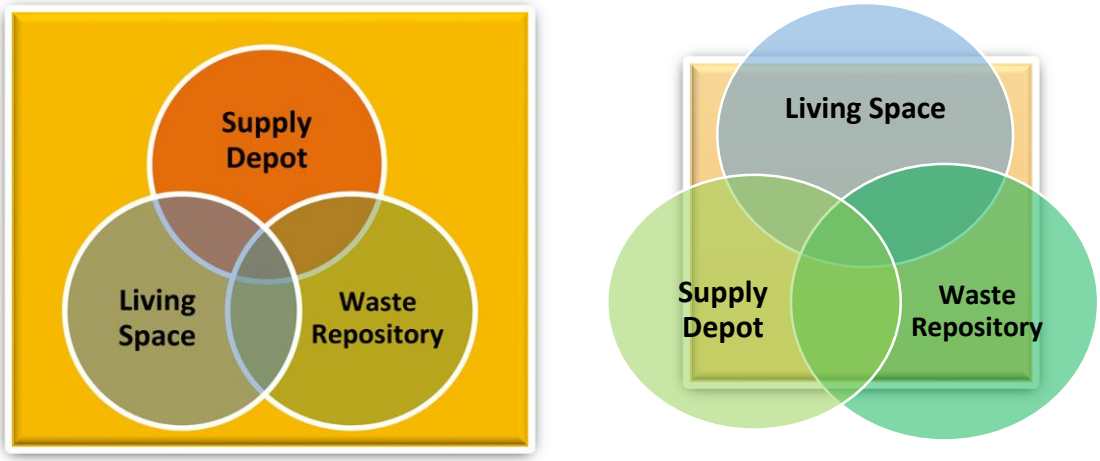
Environmental sociologists have applied the social constructivist perspective to a wide range of environmental problems, which include climate change (Dunlap & Marshall, 2006). To understand the perceptions of environmental problems, it is important to know what influenced such perceptions. With regard to climate change, entities such as the media play a powerful role in constructing norms and ideas about the nature and seriousness of the matter. Constructivism allows us to view climate change from a new perspective, with the hope of uncovering processes, actors and structures that have been obscured by the current framing of climate change. Constructivism offers important guidelines to help answer questions regarding climate change and policies (Pettenger, 2007).

Constructivism denies primacy to either ideas or social categories, for instance, war and peace, or to material things, for example, guns, butter. Instead, it views social facts (such as war) as real due to the fact that they always have material consequences, and that material things (such as guns) are real by virtue of social construction. Constructivists, with intent, argue that the material and ideational are complexly interwoven and interdependent. As such, any study of climate change

must give value to both, because interpretations of climate change are shaped by social and physical/material forces (Stehr & Storch, 1995).

2.4.3 The functionalist perspective

The functionalist perspective is based on the works of sociologists such as Herbert Spencer (1820-1903), Emile Durkheim (1857-1917), Talcott Parsons (1902-1979) and Robert Merton (1910-2003) (Mooney *et al*., 2007). Functionalists see the ecosystem as exhibiting a tendency towards equilibrium, where its components maintain a delicate, balanced relationship with one another. Functionalists stress that human survival depends on our ability to maintain a precarious balance among the living and non-living components comprising the biosphere (Ogunbameru, 2005). According to this perspective, the environment is a source of renewable and non-renewable natural resources, such as air, forests and fossil fuels. These resources are essential for living, therefore the environment acts, firstly, as a supply depot that provides humans with the resources necessary for life, such as clean air and water, food and shelter. Overusing these resources will result in shortages or scarcities. Secondly, in the process of consuming resources, humans produce a far greater quantity and variety of waste products than do any other species. Therefore, the environment also fulfils the function of a "sink" or waste depository for garbage, sewage, industrial pollution and other by-products. If the ecosystem exceeds its capacity to absorb wastes, it will lead to health problems and in ecosystem disruption. Finally, the environment serves as a living space that provides housing, transportation systems and other essentials of daily life. Overusing this function will result in overcrowding, congestion and the destruction of habitats for other species (Dunlap & Marshall, 2006; Hannigan, 2006). All these functions are depicted in Figure 2.1.



(a) (b)

Figure 2.1: Competing functions of the environment: (a) a functional environment; (b) current situation

Source: Hannigan, 1995.

Each of the three functions competes with each other in the environmental system, with one function often imposing on others. In recent years, the overlap and conflict between these three competing functions of the environment have increased considerably. Newer problems, such as climate change, are said to arise from competition among all three functions simultaneously. Furthermore, conflicts between functions at the level of regional ecosystems now have implications for the global environment, threatening the continuous functioning of the entire global ecosystem (Hannigan, 2006). Climate change is seen as an imbalance created by the overuse of the atmosphere as a sink for societal waste. Since the atmosphere is overburdened as a sink, the supply-depot function cannot be fulfilled either, in that, as a result of the impacts of climate change on food production, the land is unable to provide the necessary resources to sustain populations (Crow, 2002).

Society is viewed as a system composed of interdependent and interrelated parts. Each part makes a contribution to the operation of the entire system. The various parts are involved in a delicate balance, and a change in one part affects the other parts (Zastrow & Kirst-Ashman, 2007). Society is in a natural state of disequilibrium. Sudden social change is undesirable because expanding human activities lead to a vicious cycle –intensifying exploitation of the land, causing a lot of damage and resulting in the dysfunction of the environment (Ogunbameru, 2005). If the functions

of the environment are overburdened it affects the resilience of the system to revert back to a state of equilibrium.

Critics argue that functionalists have trouble explaining social conflict and other forms of instability. While there are existing structures in society, not all structures work in harmony towards equilibrium in society. There will always be inequality regarding the way our natural resources are consumed. Social systems tend to exceed their ecological carrying capacity because of environmental exploitation, mainly because those we see as owners of means of production exploit the environment for their own benefit. So, these social factors, among which technological development and population growth, are the physical drivers of negative impacts on the environment, and cause the natural system to be dysfunctional. Therefore, a world increasingly facing physical limits, will experience social conflicts, leading to instability, as there will be a struggle over available resources (SERI, 2014).

2.5 THEORETICAL UNDERPINNING OF THE STUDY

Based on the discussion of theoretical paradigms above, this study will be framed within the functionalist paradigm. Climate change is regarded as one of the most important environmental problems linked to our natural resource use (Boko *et al*., 2007; SERI, 2009) and is an indication that the environment is in disequilibrium with the social system as a result of human society's use of energy sources, resulting in some parts of the system losing their resilience in reverting to a state of equilibrium. At this stage the economic system is completely reliant on fossil fuels and all social institutions (political and economic) are set up to support the use of fossil fuels. Fossil fuels, including coal, oil and natural gas, are finite resources and their use can irreparably harm the environment (EESI, 2014), with consequences for the social and natural systems.

More specifically, two theories within the functionalist tradition will be used to inform this study, namely Ecological Modernisation Theory (EMT) and the Paradigm Shift Theory.

2.5.1 Ecological Modernisation Theory

EMT was first developed in the early 1980s by the German sociologist, Joseph Huber. This theory was developed to analyse how societies organise economic, political and cultural institutions to address environmental problems (Mol, 2003). The first contributions to this theory were

characterised by an excessive emphasis on the role of technological innovations in environmental reform (especially in the sphere of industrial production); a critical attitude towards the bureaucratic state; a favourable attitude towards the role of market actors and dynamics in environmental reforms; a systems-theoretical and rather evolutionary perspective with a limited notion of human agency and social struggles; and an orientation towards analysis at the level of the nation-state. This theory does not propose any structural change in the face of challenges to the social and environmental system, but is a technocratic approach that suggests that there is a techno-institutional solution for the environmental problems we face today. For this reason, ecological modernisation theory sees no reason to address capitalism as a system, because this system is resilient enough to permit movement towards a sustainable economy in the form of sustainable capitalism (Buttel, 2000; Mol & Sonnenfield, 2000). The theory further suggests that solutions to environmental problems of modern industrial societies require additional modernisation and super-industrialisation, rather than radical social changes, such as decentralising political and economic structures. Huber proposes super-industrialisation as the way to solve environmental problems, with the state having a big role to play in this process (Sezgin, 2013; York & Rosa, 2003).

Modern industrial societies also need to use better and more environmentally friendly technologies to deal with environmental problems while economic growth is continuing. When requisite affluence levels are reached, public concern, pressure from non-governmental organisations (NGOs) and environmental state policies will make the mitigation of environmental problems cost-effective, and encourage businesses to invest in environmental protection (Gould & Lewis, 2009: Harper, 2012). EMT as a functionalist approach to the problems of climate change emphasises the increasing role of economic and market dynamics in ecological reform and the role of innovators, entrepreneurs and other economic agents as social carriers of ecological restructuring (Mol & Spaargaren, 2000). The following assumptions underlie EMT.

a) EMT and environmental degradation

EMT suggests the possibility of overcoming environmental crises without deviating from the current path of modernisation (Hannigan, 2006). The theory does acknowledge that there is an environmental crisis, which is evident in the destruction of ecosystems, pollution and overuse of resources. However, these theorists believe that environmental problems, such as climate change,

can be overcome without changing the path of modernisation that society is currently on and which led to the destruction in the first place. Ecological theorists are of the view that, during most of the 20th century, environmental problems were caused by industrially driven processes.

Ecological modernisation theorists suggest that it is largely unrealistic to go back to some imagined utopia of a less industrialised past, as proposed by some radical thinkers, such as Paul Ehrlich, who suggest a limits-to-growth scenario (Gibbs & O'Neill, 2014). The arguments and conclusions of the limits-to-growth scenario are that exponential population growth would lead to ecological collapse, even if technological solutions to resource scarcity and pollution control were assumed to be forthcoming at unprecedented rates (Buttel, 1997). EMT proponents argue that, if people continue on the path of development as it is happening now, we will lead the world towards a future where everybody will reap the benefits of current technological and industrial development. They see a bright future for humanity, and state that people can overcome current environmental crises by means of continued economic growth and technological development. Also, most of the processes that have led to ecological deterioration, such as capital-intensive industrial expansion, corporate competition and international competition, are powerful and are not likely to be restrained or reversed, even if there was a broad consensus in favour of environmental protection (Buttel, 2003). Therefore, EMT advocates reformist policies rather than radical changes to the status quo.

b) Ecological rationality

Mol and Spaargaren (2000) contend that the recognition of environmental problems has started to reshape the institutions and social practices of modernity in fundamental ways. Material conditions, such as environmental problems, shape ideas that, in turn, reshape material conditions, resulting in constant ecological restructuring. This shaping and reshaping takes place at the level of institutions and the social practices we are engaged in. Central to the process of ecological modernisation is what is called the emancipation of ecological rationality, which involves people increasingly considering more than economical, technological, political and social reasons for making decisions about how to organise our lives (Bell, 2004).

The question of ecological rationality emerges when few ecological limits are anticipated sufficiently far in advance to avoid damage from human overexploitation. Ecological rationality

raises questions about scientific rationality, where dominant forms of science tend to continuously underestimate the seriousness of problems, and to overestimate the resilience of the ecological systems in which we are embedded. In the sphere of global politics, the failures of climate change conventions raise disturbing questions about the ecological rationality of our present systems of national and global governance and their ability to stem escalating processes of ecological injury (Plumwood, 2002).

c) Economic and political implications of EMT

In the context of expectations of continued economic development, EMT sees political actors as building new and different coalitions to make environmental protection politically achievable. Changes in the performance of the environmental state are seen as going together logically with increasing activism among economic actors and with new roles for NGOs. The potential for improved ecological outcomes is also seen as being dependent on changes in the institutional structure of society (Fisher, 2001). So, EMT proposes that policies for economic development and environmental protection can be combined to synergistic effects, creating a positive outcome between economy and ecology. Rather than seeing environmental protection as hindering growth, EMT promotes the application of stringent environmental policy as a positive influence on economic efficiency and technological innovation (Berger *et al*., 2001).

EMT treats all environmental issues, including climate change, as a challenge to eliminate inefficiency through better design. The theory promotes the use of more eco-efficient technology as well as the redesign of economic and political institutions, to create incentives that will effectively decouple economic growth from raw material use, waste and environmental damage (Howes, 2009).

d) Technological progress and EMT

EMT identifies modern science and technology as central institutions for ecological reform. In the era of reflexive modernity and in the confrontation with the ecological crisis, scientific and technological trajectories are changing (Mol & Spaargaren, 2000). EMT reconstructs the view of science and technology as both causes of and solutions for environmental problems. The key focus is on encouraging technical innovation that will make industry sustainable by both preventing and curing environmental damage. Innovation technologies are intended to be incorporated from as

early as possible in the design phase of industrial development, rather than added on as end-of-pipe measures. Technological development is intended to reduce industrial emissions at the source and encourage more efficient use of resources (Howes *et al.*, 2009).

Achieving the global reduction of GHG requires innovation to transform current technologies into cleaner and climate-resilient technologies. For this reason, innovation is the foundation of sustainable economic development (Boko *et al*., 2007; World Bank, 2012). So, the adoption of these new technologies, such as "clean" technologies that produce less pollution, will lessen societies' impacts on the environment. Because ecological modernisation theorists argue that technological advancement in capitalism can substantially lessen humanity's impact on the environment, and so help avert an ecological crisis, ecological modernisation theorists assume that advancements in "green" technologies are neutral and universally accepted (Bonds & Downey, 2012)

e) Criticism of EMT

Critics of EMT, from ecological Marxists to adherents of the "treadmill of production" school of thought, don't see accelerated development as the answer to improving the environment. York *et al.* (2003) argue that modernisation does not improve environmental conditions, instead it drives environmental deterioration (Zahran *et al.*, 2007). As stated above, Huber claims that ecological modernisation is the only way out of ecological crisis, through more industrialisation. However, this view overemphasises the role industry and technology plays in responding to climate change and neglects the social context within which changes these occur (Gibbs, 1998).

In some areas York and Rosa (Tymchak, 2010) cite lack of evidence to support claims made by EMT. Firstly, the efficiency of energy and resource use may not be enough to reduce environmental damage if growth outpaces the efficiency improvements. Second, savings that occur in one sector or country may result in increases in another location, thereby negating the original savings. Third, the rate of cases showing the value of ecological modernisation is not frequent enough to illustrate that it is important for obtaining sustainability. Finally, they argue that the institutional changes that occur in ecologically modernised nations due not have a causal relationship with an increase in ecological improvement (Tymchak, 2010). The Paradigm Shift Theory will be discussed next.

2.5.2 Paradigm Shift Theory

The Paradigm Shift Theory, developed by the theorists Catton and Dunlap, recognises our interdependence with the greater web of life and our shared moral responsibility to care for life on earth in all its diversity (Smith & Lopes, 2011). This theory suggests that, in response to the discrepancies between evidence of environmental threats and existing ideologies that do not consider environmental implications, people are slowly but surely adopting to an environmentally-oriented view of the world. People have become more aware of the real material effects that industrial life has on the environment, and their ideologies are beginning to change to match this new understanding (Bell, 2004).

Given sociology's historical neglect of the biophysical environment and the discipline's tendency to equate "the environment" with the social context of the phenomena being studied, it is not surprising that efforts to establish environmental sociology as an area of inquiry included a critique of the larger discipline's blindness to environmental matters. The field of environmental sociology was accompanied by a critique of the HEP[6] on which contemporary sociology was premised. While not denying that human beings are an exceptional species, these analysts argue that humans' special skills and capabilities fail to exempt them from the constraints of the biophysical environment. Consequently, Catton and Dunlap suggest that the HEP should be replaced by a more ecologically sound perspective (Dunlap & Marshall, 2006).

Catton and Dunlap outlined an alternative paradigm for the discipline and for society, namely the New Ecological Paradigm (NEP). According to Catton and Dunlap, a shift from the HEP to the NEP was needed, both in society at large, and in the discipline of sociology specifically, because the paradigm reflects basic changes in the way the world is seen. Instead of seeing people as fundamentally different from, and having dominion over all other creatures on earth, the NEP assumes that humans are one among many interdependent species involved in the global ecosystem. Instead of seeing people as masters of their destiny or human affairs as determined exclusively by social and cultural forces, the NEP assumes that human affairs are also shaped by intricate linkages of cause, effect and feedback in the web of nature, and that human actions have

[6]Third formative influence under Paragraph 2.3.

many unintended consequences. Instead of seeing a vast world full of unlimited opportunities for humans and the biophysical environment as largely irrelevant, the NEP assumes that humans are dependent on the biophysical environment for all needs and that the biophysical environment imposes potent restraints on human affairs. Instead of seeing the history of humanity marked by unlimited progress and all technological and social problems as soluble, the NEP assumes that even humans are subordinate to ecological laws and the limits of carrying capacity (Jermier, 2008).

Therefore, Catton and Dunlap regard the NEP as more realistic, because it puts forward postulates that take natural limits into account. Their analysis highlights the impact of ecological constraints on human societies. The HEP-NEP cleavage emphasises the sociological relevance of limits and scarcity. These two theorists argue that cleavages between HEP and NEP adherents were more fundamental for the analysis of environmental problems than cleavages between the HEP-based sociological theories (Vaillancourt, 2010).

The basis of the HEP/NEP distinction is that the HEP views human society as the centre of the natural world, with humans controlling and using the environment without regard to the natural resource-based limits to growth.[7] The NEP, in contrast, accounts for the role of the natural environment in its four assumptions mentioned in Table 2.1 (Felts, 2008).

[7]Limits to growth is a perspective arguing that there are ecological limits to the scale and kinds of economic activities in which humans can engage. If society does not pull back, further degradation will occur, which will increasingly impair earth's ability to reproduce renewable resources and naturally recycle wastes (Clow, 1995).

Table 2.1: Main assumptions of the Human Exemptionalism Paradigm and the New Ecological Paradigm

ASSUMPTIONS	HUMAN EXEMPTIONALIST PARADIGM (HEP)	NEW ECOLOGICAL PARADIGM (NEP)
Assumptions about the nature of human beings	Humans have a cultural heritage in addition to their genetic inheritance and thus are quite unlike all other animal species.	Despite exceptional characteristics, humans remain one among many species that are interdependently involved in the global ecosystem.
Assumptions about social causation	Social and cultural factors (including technology) are the major determinants of human affairs.	Human affairs are influenced not only by social and cultural factors, but also by intricate linkages by cause, effect and feedback in the web of nature
Assumptions about the context of human society	Social and cultural environments are the crucial context for human affairs, and the biophysical environment is largely irrelevant.	Humans live in and are dependent on a finite biophysical environment that imposes potent physical and biological restraints on human affairs.
Assumptions about constraints on human society	Culture is cumulative; thus technological and social progress can continue indefinitely, making all problems ultimately soluble.	Although human inventiveness many appear to temporarily extend carrying capacity limits, ecological laws cannot be repealed

Source: Bowden, 2004.

Human systems are relative newcomers as driving forces for large-scale environmental change and have only emerged as a significant force in the dynamics of the global environment as a result of the population and industrial growth of the past three centuries. Industrialisation has been a key driver of threats to local, regional and global environments through the emission of wastes and the overexploitation of natural resources. This means that the old paradigm (HEP) brought us to a point in history where the climate system continues to collapse, compelling people to reconsider their past actions with regard to energy production. The impacts of climate change influenced a social shift towards the NEP – a different way of thinking about climate issues (McDonald& Patterson, 2007; Wilbanks & Romero-Lankao, 2007).

a) Criticism of the theory

There are three categories of criticism of the NEP. First, the assertion that NEP leaves out expressions of a biocentric or ecocentric worldview that comes from late-20thcentury environmental ethics literature. A second line of criticism is concerned with the validity of the scale. Researchers have tried to document links between NEP scale results and pro-environmental

behaviour. When links between NEP scale results and behaviour are weak, some researchers (Anderson, 2012) suggest that the scale fails to measure a worldview accurately. Using the NEP scale to analyse environmental behaviour is part of extensive social-psychological research into explanations of the root causes of environmental behaviours. Finally, there is considerable debate about the dimensionality of the NEP scale. Dunlap argues that the NEP in both of its iterations measures a single dimension, endorsement of a world view that could be measured simply by adding up the responses. Numerous studies have used a statistical technique called principal components analysis to test this. These studies had different results, suggesting that the NEP captures not one dimension but often three or more dimensions. This variability in results leads to questions about NEP's validity, such as, will it measure phenomena in the same way across different populations or across time (Anderson, 2012)?

2.6 THEORETICAL JUSTIFICATION

Over the past 50 years, humans changed ecosystems more rapidly and extensively than ever before in human history, in order to meet rapidly growing demands for, among other resources, food, freshwater, timber, fibre and fuel. However, this has resulted in a substantial and largely irreversible loss of diversity of life on earth. The changes that have been made to ecosystems have contributed to substantial gains in human well-being and economic development, but in return, have degraded many ecosystem services, have exacerbated poverty levels for some people, and have impacted on vulnerable people's resilience in dealing with environmental issues that affect their livelihoods (MA, 2005). The emergence of global environmental problems as major policy issues indicate a growing awareness of the relationship between modern industrialised societies and the physical environments on which they depend. Recognition that human activities are altering the ecosystems on which we depend gives weight to suggestions that we are in the midst of a fundamental re-evaluation of the underlying worldview that has guided our relationship to the physical environment (Feygina *et al.,* 2010

Climate change is impacting on not only the natural environment, but on economies and societies (UNDP, 2013). Developing countries have no choice but to be prepared to develop and implement adaptation strategies if they are to remain functioning social entities in the face of the challenges posed by a deteriorating climate system (Ravindranath & Sathaye, 2002). Ecological modernisation is the theory that underpins proposed policies such as emissions trading schemes

and tax breaks for renewable energy industries and technologies. Thus, developing nations, like Lesotho, are, according to an EMT framework, compelled to function within existing social structures on a global, regional and local scale in order to protect their populations from the impacts of climate change. No radical changes to social structures are proposed, or foreseen, so the policy direction of Lesotho fits into the broader reformist policies for climate change mitigation and adaptation already at play in the global arena.

The Paradigm Shift Theory proposes worldviews about the environment and evaluates the environment's relationships with socio-demographic factors (McDonald & Patterson, 2007). Theorists claim that conventional sociology is not able to find a solution for environmental problems, because it stems from the HEP, which failed to acknowledge the biophysical basis of social structure and social life. Catton and Dunlap state that a "shift" was needed from the HEP to NEP. The NEP, unlike the HEP, considers human beings as a part of the ecological system, and achieving a balance between the environment and society can best be achieved through the spread of NEP throughout society. Furthermore, the NEP recognises the innovative capacity of humans, but stipulates that humans are still ecologically interdependent with other species. The NEP recognises that humans are impacted by the cause, effect and feedback loops of ecosystems and because the earth has a finite level of natural resources and waste repositories, the biophysical environment can impose constraints on human activity and impact on the resilience of human populations in dealing with environmental challenges (McDonald & Patterson, 2007; Erdogan, 2009).

Catton and Dunlap consider studies on environmental concerns important in order to know whether the "shift" has taken place in society. In this opinion, the "shift", which implies an increase in environmental concern, not only gives legitimacy to the environmental social movement, but also puts pressures on government regarding policy-making to implement environmental regulations.

Paradigm Shift Theory is an important theory to underlie this study because it works from the assumption that the concern over climate change globally and locally is the result of a paradigm shift. Climate change risk is mostly and often unfairly cast upon those who are vulnerable. Therefore, there needs to be a shift in the mind-sets of international development to accommodate those at grassroots level to adapt to climate change impacts (Miyaguchi & Yamaura, 2013). Climate change warrants a paradigm shift, and one of the places in which we can see such a shift

is in the attitudes of ordinary people on the ground who are affected by these changes. If a paradigm shift has taken place at a policy level, as well as in the perceptions of farmers, then it may be indicative of the population being more resilient in dealing with the inevitable impacts of climate change.

2.7 CONCLUSION

Theoretical perspectives, mainly the conflict perspective, the functionalist perspective and social constructionism, were briefly discussed, in order to gain an understanding of how theory can contribute to the study of climate change. Furthermore, from the functionalist paradigm, which will be used as a theoretical basis for this study, two theories (EMT and The Paradigm Shift Theory) provided a framework to explain environmental degradation and to dissect issues of climate change, and therefore explain how different scenarios contributed to climate change impacts. The EMT assumes that the environment can be fixed through super-industrialisation; addressing climate change in this way poses a challenge, because developing countries cannot afford to invest in new technologies. In assessing climate change effects on Lesotho, the Paradigm Shift Theory provides the best foundation for this study, because a shift from old practices that are incompatible with the challenges posed by climate change will be important for changing economic and development pathways for policy makers in Lesotho.

In Chapter 3 the factors contributing to climate change as well its impacts will be discussed.

CHAPTER 3. LITERATURE REVIEW: AN OVERVIEW OF THE PHENOMENON OF CLIMATE CHANGE

3.1 INTRODUCTION

Climate change is broadly defined as any changes in climate over time and climate variability means the way climate fluctuates yearly above and below a long-term average value (Swim *et al*., 2009). Both biophysical and anthropogenic factors contribute to the phenomenon of climate change. Natural factors, such as changes in the sun's energy output and shifts in ocean currents, affect the earth's climate. However, natural factors do not adequately explain the rapid changes in the earth's climate that have been observed in the past two centuries. Currently, climate change is largely attributed to anthropogenic factors: the emission of GHG by a variety of human activities, which include the burning of fossil fuels for energy provision, deforestation, crop fertilization, landfills and raising livestock (EPA, 2013; Sarkar, 2011; Guardian, 2010).

Over the past 50 years, human activities, such as those mentioned above, have released sufficient quantities of CO_2 and other GHGsto trap heat in the lower atmosphere so as to affect the global climate. The changes in climate affect every aspect of our social, economic, cultural and political lives and exert pressure on the natural environment.

As a result of climate change, sea levels are rising, glaciers are melting and precipitation patterns are changing, while extreme weather events, e.g., heat waves, are becoming more intense and more frequent (WHO, 2013).

With regard to the social environment, climate change threatens human well-being through its impact on human health, global food security and political security (Buhaug & Theisen, 2012). Furthermore, climate change is posing an increasing threat to cultural and natural heritage and it is likely to affect cultural diversity and socio-cultural interactions, for instance, by forcing communities to change their work habits and ways of life, to compete for resources or to migrate elsewhere (Fakultat, 2013).

With these effects in mind, this chapter will explain the phenomenon of climate change, discuss the factors that contribute to climate change, and outline the impacts of climate change on the natural environment and society. In this discussion, specific attention will be given to the historical

trends leading to the current situation, as well as on providing possible future projections regarding climate change, both in terms of the phenomenon itself, and its impacts. The chapter closes with a discussion of the impacts of climate change, particularly on Africa as a developing continent.

3.2 CLIMATE CHANGE AS A SOCIAL PHENOMENON

The concentration levels of CO_2, methane and some other GHGs in the atmosphere have been rapidly and steadily increasing since the dawn of industrialisation. In the 1780s the level of atmospheric CO_2 was about 280 parts per million (ppm), as it had been for the past 6 000 years (EPA, 2014). As a result of industrialisation, this level increased to 315 ppm by the 1930s, to 330ppm by the mid-1970s, to 360ppm by the mid-1990s and to 398 ppm in 2014 (EPA, 2014).The Intergovernmental Panel on Climate Change (IPCC) estimates that a CO_2 concentration of 450ppm would, by 2100, result in a global temperature rise of 2^{o}C above pre-industrial levels. Beyond 2^{o}C, experts predict serious consequences for the earth's climate. During the last ice age global temperatures were cooler than they are today. The warming that humans are causing will change the earth's climate in the opposite direction, but tens, or possibly a hundred, times faster than natural rates of climate change. Warming of 2^{o}C will lead to more frequent droughts and heat waves, cause higher rainfall, and possibly change the strength of storms(IRENA, 2014).

The anthropogenic contributors to increasing GHGemissions are multifaceted and complex, therefore an in-depth discussion of various anthropogenic drivers of climate change will be undertaken.

3.2.1 Agricultural production

Agricultural lands occupy over 37% of the earth's land surface and agriculture is regarded as a major emitter of GHG (Lamboll *et al*., 2011). About 25% of CO_2 emissions are linked to agricultural practices, such as deforestation, the use of fossil-fuel-based fertilizers, agricultural equipment which uses fuel for ploughing, and the burning of biomass (Ojeniyi, 2014). Deforestation for land-clearing purposes also affects regional carbon reuptake, which can result in increased concentrations of CO_2 being absorbed by the atmosphere (Climate Institute, 2010). Much of the methane in the atmosphere comes from domestic ruminants, forest fires, wetland rice cultivation and waste products from the excrement of humans and animals, such as cows, horses, goats, pigs and chickens (EPA, 2014). Ruminants contribute significantly more to greenhouse gas

emissions than monogastric livestock and emissions due to cattle are substantially higher than those from buffalo or sheep or goats. Globally ruminants contribute 11.6% of all greenhouse gas emissions from anthropogenic sources (Ripple *et al*., 2014). Conventional tillage, methods of irrigation and fertilizer use account for 70% of the nitrous oxides in the atmosphere. Smaller sources of GHGemissions include rice cultivation, which produces methane (CH_4), and burning crop residues, which produce CH_4 and nitrous oxide(N_2O) (EPA, 2014).

3.2.2 Industrial development

The industrial sector is responsible for around 19% of global GHGemissions (EPA, 2013). The industrial sector uses more energy than any other end-use sector, consuming about half of the world's total delivered energy. The GHGs emitted during industrial production are split into two categories: first, the direct emissions that are produced at the facility and second, the indirect emissions that occur off site, but which are associated with the facility's use of energy (EPA, 2014). The fuels consumed in the industrial sector vary across regions and countries, depending on the level and mix of economic activity and technological development, among other factors. The energy is consumed for purposes such as processing, assembly, producing steam, cognation, heating, air conditioning and lighting in buildings (EIA, 2013). Other emissions include emissions from chemical, metallurgical and mineral transformation processes not associated with energy consumption.

The transport sector is growing quickly and it is accompanied by negative consequences, such as noise, congestion and the emission of CO_2 (BEUC, 2009). People and goods are transported by road, rail, air, water and pipeline. Transportation systems are essential for trade and economic competitiveness in an increasingly globalised world, and to enhance people's standards of living (EIA, 2013). In 2010, the global transport sector consumed a total of 19% of global energy supplies. Around 96% of this came from oil, while the rest was from natural gas, bio fuels and electricity. More than 60% of the oil consumed globally (around 51 million barrels per day) is used by the transportation sector. Road transport accounts for the bulk (76%) of transportation energy consumption. Air and marine transport each accounted for about 10% of total transport energy consumption, while railways accounted for only 3% (WEC, 2011).

Further development of the industrial sector will result in greater energy consumption and will lead to an even greater concentration of GHGs, such as CO_2, sulphur dioxide (SO_2), nitrogen oxide

(NO_X), and carbon monoxide (CO), which all hold the potential of detrimental consequences for the earth's climate system (Atabani, 2011).

3.2.3 Land-use changes

The earth's climate is also influenced by changes in land use and land cover (National Academy of Sciences, 2012). Natural land cover, such as forests, grasslands and deserts, are being converted to human-dominated systems, including cities, agriculture and forestry. From 2000 to 2010 approximately 13 million hectares of forest land were converted to other land cover types annually (Adams, 2012; FAO, 2010).

Forests currently account for more than a quarter of the land surface area, but due to human activities, forests are shrinking dramatically (FAO, 2015; IPCC, 2007). Major loss of forest and grassland cover has been experienced in the USA and Europe over the past few centuries, particularly during phases of economic growth and expansion. More recently, over the past 60 years, developing nations have experienced similar losses, with significant loss of forest cover in biologically diverse regions, such as southeast Asia, South America and western Africa (Camill, 2010). Deforestation occurs as a result of activities, such as timber harvest, conversion of forest land to agricultural land, road-building and infrastructure development (Kanninen *et al*., 2007). Forests play a critical role in mitigating climate change because they act as carbon sinks, absorbing CO_2 that would otherwise be released into the atmosphere. Deforestation undermines the carbon-sink function fulfilled by forests. It is estimated that 15% of all GHG emissions are the result of deforestation (WWF, 2016).

Land-use changes contribute to climate change through deforestation, soil erosion and machine-intensive farming methods, and expansion of built-up urban environments. Some land-use changes, such as deforestation and agriculture, remove native vegetation and thereby diminish carbon uptake by photosynthesis, and hasten soil decomposition, leading to additional GHG release (Adams, 2012; FAO, 2010).

3.2.4 Demographic change

Many of the countries with the most rapidly growing national and urban populations have very low levels of CO_2 emissions per person, and have experienced slow growth in these emissions; in contrast, many of the countries with the slowest-growing national and urban populations have the

highest levels of GHGemissions per person and have experienced a rapid increase in CO_2 emissions per person (Satterthwaite, 2009).Currently, more than 50% of the world's population lives in cities and it is expected that 61% of the world's population will reside in urban settlements by 2030. More than 90% of the future population growth will be accounted for by the large cities in developing countries (African Development Bank Group, 2012; Floater *et al*., 2014). Disproportional parts of a country's economy, resource-consumption and decision-making powers are concentrated in urban areas. Up to 75% of the global economic production takes place in urban areas, while urban areas are responsible for 67% of total global energy consumption. Urban areas are responsible for at least 70% of GHG emissions (UNU-IAS, 2015). As a result of increasing urbanisation and the economic activities associated with this, it is expected that GHG emissions will also increase in conjunction with urbanisation (World Bank, 2010).

As can be seen from Figure 3.1 below, higher-income nations contribute more to GHG emissions than do low-income nations (Shi, 2001). By 2050 the global population will reach 9 billion, barring substantial changes in demographic trends, with 2.5 billion more people in today's developing countries. Larger populations exert more pressure on ecosystems and natural resources, intensify the competition for land and water, and increase the demand for energy. So, rapid population growth has a negative impact on human development, provision of basic services and poverty eradication, and these effects are magnified and become more urgent in the context of climate change. Rapid rates of population growth in sub-Saharan Africa are impeding its ability to contain the number of people living in extreme poverty. High population growth, fuelled by high fertility, impedes progress towards achievement of the MDGs and sustains poverty, the central phenomenon underlying vulnerability to climate change (Stephenson, 2015).

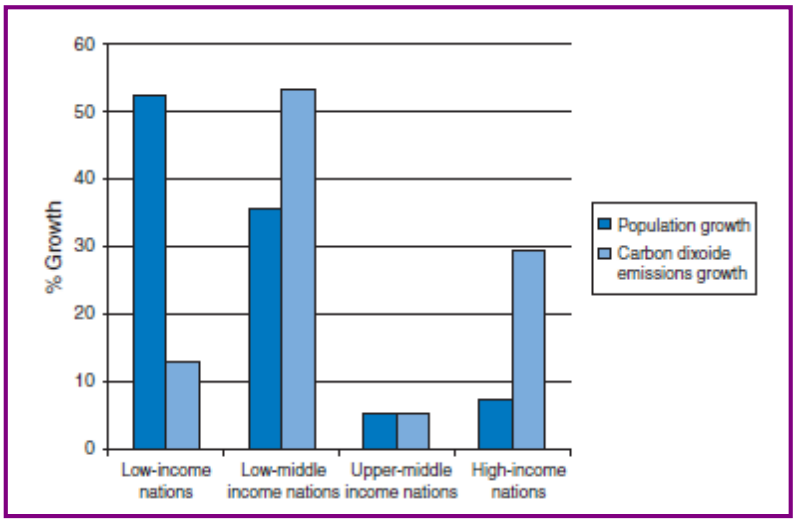


Figure 3.1: Population growth and CO_2 emission

Source: Shi, 2001

Population ageing is a key demographic trend worldwide and is the result of a demographic transition, which has seen a shift to lower total fertility rates and rising life expectancy. This trend is more pronounced in developed countries, where increased wealth, and improved nutrition and healthcare have resulted in more people surviving to older age, and living longer. Due to population ageing, in developing and developed countries alike the growth in the number of households surpasses the growth in population. This may unfold differently in developing countries, where it is more common for more than two generations live under the same roof. The increase in the proportion of households with a household member older than 65 years will increase residential energy use, which may result in higher CO_2 emissions (Zagheni, 2009). Another way in which ageing populations are likely to cause pressure on the environment is through changing consumption patterns. More leisure time and better health of retired persons may lead to higher consumption levels (e.g., through increased tourism travel) with concomitant impacts on energy use and carbon emissions (OECD, 2008).

3.2.5 Technological development

The development of scientific knowledge and technologies has profound implications for ecological systems and human well-being. Productivity improvements arising from the application of science and technology were estimated to have accounted for more than one third of total gross domestic product (GDP) growth in the USA from 1929 to the early 1980s, and for between one third and two thirds of GDP growth in Organization of Economic Cooperation and Development

(OECD) countries over the period of 1947 to 1973 (Nelson, 2006). Although technology has improved productivity, it has had detrimental effects on the environment, with industrial development accounting for over 40% of CO_2 emissions globally. CO_2 emissions in the global industrial sector grew at a rate of 1.3% per year between 1971 and 1995, slowing to 0.4% per year between 1990 and 1995. Emissions from this sector in developing countries continue to increase – at 6.3% per year in Pacific Asia and 3.4% per year in the remaining developing countries (IPCC, 2007). GHG emissions are produced by diverse processes, including the combustion of fossil fuel for heat and power.

Over the past centuries, human ingenuity has led to technological advances in agriculture that have resulted insubstantial increases in crop yields. Intensive agricultural technology, such as the use of pesticides and fertilizers, has however also contributed to GHG emissions (Climate Institute, 2010). Agricultural land accounts for 52% and 84% of global anthropogenic methane and nitrous oxide emissions respectively (Sun *et al.,* 2015). Agricultural activities, such as the cultivation of crops and livestock for food, contribute to emissions in a variety of ways; various practices for agricultural management, ranging from fertilizer application to certain methods of irrigation and tillage, can lead to production and emission of N_2O (EPA, 2015)

3.2.6 Rising consumption levels

GHGemissions are being driven increasingly by consumption of goods and services by individuals, households and organisations, and the manufacturing, transport and waste disposal that underpins that consumption. The rate of emission is dependent on the level of consumption, its composition and the techniques used to produce and transport goods and services (Rosa & Dietz, 2012). Consumption is shaped by a number of complex and interrelated factors, such as demographics, income and prices of consumer goods, technology, economic policies and available infrastructure, as well as social, cultural and psychological factors. Consumption leads directly to environmental pressures resulting from the use of products and services, for instance, by driving a car or heating a house with fossil fuels. Of greater magnitude, however, are the indirect pressures that are created along the production chains of the goods and services consumed. Both direct and indirect pressures result in environmental impacts, in particular global warming, biodiversity degradation, soil sealing and air and water pollution (EEA, 2010).

Based on the preceding discussion, climate is influenced by many factors, both natural and anthropogenic. Although natural factors have contributed to climate change, anthropogenic factors remain the main drivers of climate change. Climate change affects human society directly and indirectly, and these impacts will be discussed in the following paragraphs.

3.3 IMPACTS OF CLIMATE CHANGE

Climate change varies greatly for different types of biophysical environments, as well as for different socio-economic environments. Thus, attention needs to be given to the various impacts of climate change on the biophysical and social environments. The first impact that will be discussed is the impact of climate change on water resources.

3.3.1 Water scarcity

Climate change is likely to exacerbate regional and global water scarcity considerably. Climate change increases water scarcity due to changes in precipitation patterns and intensity (Morrisson *et al*, 2009). An increase of air temperatures of 2^{o}C above the present will mean that an additional 15% of the global population will be confronted by a severe decrease in water resources, and will increase the number of people living under absolute water scarcity by an additional 40% (Schewe *et al*., 2014). It is semi-arid and arid areas, in developing countries in particular, that are vulnerable to the impacts of water scarcity brought about by climate change (IPCC, 2007).

In Africa, it is projected that between 75 and 250 million people will be exposed to water stress by 2020 as a result of climate change (UN-OHRLSS, 2009). Drought-affected areas have already become more widely distributed as a result of climate change. It is estimated that, by the mid-21st century, water availability will decrease in the mid-latitudes, in countries such as in Britain, New Zealand and Australia. This has implications for human health and for food security in these regions. Many rural households depend directly on rainfall for water supply and, because of changing climate conditions, these households become more vulnerable to fluctuations in precipitation levels and distribution (Hassan, 2010).

Climate change is expected to alter hydrological regimes and the availability of freshwater, with impacts on both rain-fed and irrigated agriculture. Changes in runoff affecting the availability of water, either in rivers or for aquifer recharge, will add to human pressure on water resources. In the semi-arid tropics, where increased occurrence of droughts and floods is predicted, climate

change is expected to affect the rural poor in particular, by reducing crop and livestock yields (FAO, 2012).

Currently, more than a sixth of the world's population is dependent on snowmelt as a source of freshwater (ISDR, 2008; Pachauri & Chand, 2008).Climate change has an impact on snowmelt in temperate regions of northern and eastern Europe, northern Asia and North America. Climate change contributes to significant changes in seasonal runoff, that is, sudden increases in winter runoff and reductions in spring snowmelt runoff. Recent assessments for mountain river basins in the Alps and for a small watershed in Nepal show reductions in the duration of snow cover, some increases in annual runoff, and significant changes in stream-flow distribution throughout the year, due mainly to higher air temperatures (Van Dam, 2003). This contributes to existing water shortages and reduces water availability for human use and ecosystems in the affected basin (Gucinski, 2007). Droughts are projected for regions that depend heavily on glacial-melt water for their main dry-season water supply. For example, in the Andes, many people are supported by glacial-melt water during the long dry season. Furthermore, many small glaciers in Bolivia, Ecuador and Peru will disappear within the next few decades (IPCC, 2007). The ice cover in the Hindu Kush-Himalayas overall has decreased over the last two decades. Hence, water supply in areas fed by glacial melt water from the Hindu Kush and Himalayas, on which hundreds of millions of people in China and India depend for survival, will be negatively affected by climate change (Kundzewicz *et al*., 2007).

Groundwater is a major source of fresh water across much of the world, particularly in rural areas in arid and semi-arid regions (Kumar, 2012). About 1.5 billion people depend upon groundwater for their drinking water supply. The amount of groundwater withdrawn annually is estimated at roughly 600-700 km3, representing about 20% of global water withdrawals (UNEP, 2008). Due to the fact that groundwater aquifers are recharged mainly by precipitation or through interaction with surface water bodies, the direct influence of climate change on precipitation and surface water ultimately affects groundwater systems (Kumar, 2012). Additionally, rising sea levels will contribute to saltwater contamination of groundwater supplies, threatening the quality and quantity of freshwater that large numbers of people depend on (Holmes, 2009).

Water scarcity threatens not only the livelihood of millions of people, but also water-intensive industries human enterprise relies on, such as power generation and the manufacture of cement,

aluminium, steel and paper. Water scarcity therefore constrains economic growth and has an impact on businesses that are dependent on water use (WWF, 2010a).

3.3.2 Agriculture and food production

Climate change affects agriculture and food production in various ways, but the most important concern is the ability of the agricultural system to provide sufficient food for the growing world population. Climate change threatens human health and well-being through its effects on food security. One in three children under the age of five years who was born in a developing country suffers from chronic malnutrition (Costello *et al.*, 2009). The added pressure of climate change on food systems will worsen this suffering.

Maize and wheat production declined by 3.8% and 5.5% respectively during the years 1980 and 2008, with climate change being regarded as an a significant contributor to this decline in production (Lamboll *et al*., 2011). All major crop-growing areas are increasingly experiencing drought conditions. For example, maize-growing areas affected by drought have increased from 8.5% to 18.6%globally since the 1960s (Babatunde, 2014).

In the future declining crop yields are likely to leave hundreds of millions of people without the ability to produce or purchase sufficient food supplies, especially in Africa (Holmes, 2009;ISDR, 2008). A case in point is the severe drought that affected 10 million people in 2010 across Niger, Chad, Mali and Cameroon. The loss of livestock and crops as a result of the drought contributed to increased food prices and led to food insecurity, and an estimated 7.1 million people suffered from hunger in Niger alone (Atkinson, 2010). In 2011, Djibouti, Ethiopia, Kenya, Somalia and Uganda suffered the worst drought in 60 years, causing the Horn of Africa to experience the most severe food crisis in the world at that stage. Over 12 million people were severely affected and were in urgent need of humanitarian aid (UNEP, 2011). As a result of the relationship between declining agricultural production and poverty, impacts of climate change will worsen existing challenges in rural communities, as agriculture is an important source of livelihood for a large proportion of rural communities (Kurukulasunya & Rosenthal, 2003).

In most developing countries, the agricultural sector is the primary source of livelihood and employment and it contributes considerably to national GDP. Agriculture provides at least 40% of exports, 30% of GDP, and up to 30% of foreign exchange earnings in developing countries

(Issahaku, 2014). Agriculture supports the livelihoods of 80% of the African population, provides employment for about 60% of the economically active population, and for about 70% of the poorest people on the continent (African Development Bank Group, 2010; Issahaku & Maharjan, 2014). However, the agricultural sector is already characterised by growing job insecurity, low rates of pay, poor working conditions and growing levels of poverty, and climate change is only expected to increase these problems in the sector (Albano *et al*., 2013; Olsen, 2009). For example, agriculture in Ethiopia is the largest contributor to overall economic growth and poverty reduction in this country, accounting for about 45% of the national GDP, almost 90% of the goods exports and 84% of the labour force – agriculture remains the economy's most important sector (World Bank, 2010). When Ethiopia was struck by drought in 2002, GDP decreased by 3.5% and around 7 million people were in need of food aid due to low farm productivity; this number doubled to 14 million in 2003 (Harsdorff *et al*., 2011).

Food insecurity is endemic to Lesotho, with climatic factors such as rainfall variability being major contributors to food insecurity. Agriculture, which accounts for 10% of the country's GDP, is the lifeline of the rural population and the sector employs about 70% of the country's labour force. The principal crops, namely, maize, sorghum and wheat, are said to have accounted for about 84.7% of the cultivated area between 2006 and 2008. Crop growth during the cropping seasons was drastically affected by climate. Lesotho experiences a prolonged dry spell and high temperatures during the critical period of the 2006/2007 cropping season (January-March 2007), which resulted in large-scale and irreversible damage to the maize and sorghum crops. The absence of rains from January to March was the main cause of the damage to yields, coupled with an excessive dry spell that prevailed from December 2006 (Mekbib *et al*., 2012). The total area under cultivation fluctuates between 136 500 and 300 500 hectares, down from 450 000 hectares in 1960 (Zhou, 2010).

3.3.3 Human health

Human health is affected directly by changing weather patterns and indirectly through changes to water, air, food quality and quantity, ecosystems, agriculture, and livelihoods. The emergence and re-emergence of infectious diseases, heat stress, cold stress and respiratory illnesses, and waterborne and airborne diseases, are some of the health impacts that cause concern with regard to the impacts of climate change on human health (Pachauri & Chand, 2008; Tsai &Liu, 2005).

Significant environmental changes can encourage the spread of serious endemic and epidemic diseases, such as leishmaniasis, haemorrhagic transmissible fevers and dengue fever. These diseases spread from their original endemic areas in Southeast Asia, neo-tropical Americas and Africa, southwards and northwards as a result of climate change (Rodriguez-Morales *et al.*, 2010).

Changes in temperature, humidity, rainfall, soil moisture and even sea level influence the transmission of infectious diseases such as diarrhoea, and vector-borne infections, including malaria (Haines *et al.,* 2006; WHO, 2005). Climate change can accelerate biological development and increase the vector populations available to transmit pathogens and diseases (Rodriguez-Morales *et al*., 2010). Malaria is a major global health concern, with some 40% of the world's population at risk of contracting malaria and about 75% of the cases occurring in Africa. There were an estimated 207 million cases of malaria in 2012 and an estimated 627 000 deaths. Ninety percent (90%) of all malaria deaths occur in sub-Saharan Africa. In 2012, malaria killed an estimated 482 000 children under five years of age; that is 1 300 children every day (WHO, 2013).

Climate change also affects human health through the transmission of food-borne diseases. Higher air temperatures can increase cases of salmonella and other bacteria-related food poisoning, because bacteria grow more rapidly in warm environments. These diseases can cause gastrointestinal illnesses and even, in severe cases, death. With regard to animal-borne diseases, the geographic range of ticks that carry Lyme disease is limited by temperature. As air temperatures rise, the range of these ticks is likely to continue to expand northwards. The symptoms of Lyme disease include fever, headaches, fatigue and characteristics of skin rash (EPA, 2013).

At the extremes of temperature exposure, the long-recognised clinical entities of hypothermia and hyperthermia are well-documented causes of death. Scientists have documented the phenomenon of excess mortality during heat waves extensively; this can occur even in high-income countries, and scientists recognise it as a consequence of global warming (Samet, 2010).

Lastly, biodiversity loss as a result of climate change threatens to reduce the pool of available genes to fight disease significantly, with permanent consequences for the pharmaceutical industry. At least 60% of medicinal plants are gathered from the wild. However, their natural habitats are being threatened by habitat degradation and conversion (WWF, 2010b). As the medicinal plants are already threatened by over harvest, the additional challenges posed by climate change will push

some species to extinction. Extreme weather conditions, such as droughts and floods, will greatly affect medical plants throughout their life cycles. Extremely dry soil conditions resulting from drought prevent adequate seed production, and there is either no germination or less seedling establishment (Khan *et al*, 2015). This has serious implications for humankind's ability to adjust to and cope with changes in disease patterns as a result of the effects of climate change.

3.3.4 Ecological productivity, biodiversity and forests

Living organisms, such as plants, animals and microorganisms, interact to form complex, interconnected webs of ecosystems and habitat, which, in turn, supply services on which all life, including human life, depends (WWF, 2012). Through human intervention, the earth is subjected to many human-induced and natural pressures on biodiversity. These pressures include increased demand for resources, selective exploitation or destruction of species, land-use and land-cover change, the accelerated rate of anthropogenic nitrogen deposition, soil, water and air pollution, introduction of non-native species, diversion of water to intensively managed ecosystems and urban systems, fragmentation or unification of landscapes and urbanisation and industrialisation. Climate change exacerbates human pressure on ecosystems, biodiversity and ecosystem goods and services (IPCC, 2002).

Many ecosystems around the world are now affected by the combined impacts of natural climate variability and anthropogenic climate change and their interaction with other human stressors, such as encroachment on, as well as the fragmentation and destruction of natural habitats. Often, various wild animal and plant species respond to climatic stressors by migrating and shifting their ranges to areas with more favourable conditions. Warming could force species to migrate to higher latitudes or higher elevations, where temperatures are more conducive to their survival. Similarly, as sea levels rise, saltwater intrusion into freshwater systems may force some key species to relocate or die, thus removing predators or prey that were critical in the existing food chain (EPA, 2014). This has already been noted in the case of birds, marine life forms, butterflies and insects, in response to changes in the climate that have already taken place, particularly the increase in temperature. Many range-restricted species, chiefly polar and mountaintop species, show severe range constriction and were the first groups among which entire species extinction due to changes in climate has been noted. It has also been observed that tropical coral reefs, and amphibians have been severely affected (Mwingira *et al*., 2011).

Climate change directly and indirectly affects the growth and productivity of forests; directly due to changes in atmospheric CO2 and climate, and indirectly through complex interactions in forest ecosystems. Climate change also affects the frequency and severity of many forest disturbances (EPA, 2013). A gradual increase in temperature will alter the growing environment of many tree species, reducing the growth of some species (especially in dry forests). Mortality may increase in older forests stressed by low soil moisture, and regeneration may decrease for species affected by low soil moisture and competition with other species during the seedling stage (USDA, 2012).

Forests are important in that they provide environmental benefits, such as species habitat, biodiversity and soil. They also act as a carbon sink, soaking up CO_2 that would otherwise be freed into the atmosphere and contribute to ongoing changes in climate patterns (WWF, 2016). Forests can also play an important role in protecting water catchments and enhancing conservation, regulating rainfall and preventing landslides. They also provide utilitarian support for people and communities. Some communities depend on forest resources for their main livelihood, and many people in developing countries still rely on forests for medicinal remedies derived from indigenous plants (FAO, 2011; COHAB, 2010).

Indirectly, changes in ecosystem services affect livelihoods, income, migration patterns and, on occasion, even contribute to political conflict (Harper, 2012; WHO, 2014).People who are most dependent on natural resources and ecosystem services for their livelihoods are the most sensitive to environmental change. For instance, in terms of needs, a change in soil moisture can undermine nutrition in subsistence farming households, a decline in fish abundance can undermine nutrition and income for fishers, and a decline in surface or groundwater quality can undermine maternal and child health in communities without reticulated water supply (Barnett *et al.*, 2010).

3.3.5 Human settlement and rising sea levels

There are around 15 billion hectares of land worldwide (UNEP, 2013). Around 2% of this area is covered by cities and infrastructures (built-up land), and this area is growing. Built-up land is expected to cover 4 to 5% of the global land area by 2050. In many cases, built-up-area expansion occurs at the expense of agricultural land (UNEP, 2013). Land-use activities, whether converting natural landscapes for human use or changing management practices on human-dominated lands, have transformed a large proportion of the planet's land surface. By clearing tropical forests, practicing subsistence agriculture, intensifying farmland production, or expanding urban centres,

human actions are changing the world's landscapes in pervasive ways. Although land-use practices vary greatly across the world, their ultimate outcome is generally the same, namely, the acquisition of natural resources for immediate human needs, often at the expense of environmental conditions (Foley *et al*., 2005).

At least half of the earth's human populations live near coastal areas and some of the world's largest cities are situated on coastal land (Creel, 2014). Sea-level rise threatens hundreds of millions of people living in low-lying areas, such as those in Bangladesh and India and small island states. The sea level was relatively stable from BCE 200 to CE 950. Then, in the 11th century, the sea level rose by 0.6 mm per year for about 400 years, an increase which is linked to a warm climate period known as the Medieval Climate Anomaly. This era was followed by a second period of stable sea level during a cooler period (the Little Ice Age), which lasted from 1400 until the late 19th century. Since then, the sea level has risen at an average rate of 2.1 mm per year (Janin & Mandia, 2012). If sea levels rise by just a metre, many major coastal cities will be threatened. Some of the cities under threat are also some of the most populated cities in the world, namely Alexandria, Buenos Aires, Dhaka, Kolkata, Lagos, Los Angeles, Mumbai, New York, Osaka-Kobe, Rio de Janeiro, Shanghai, and Tokyo (Sioufi, 2010).

Large-scale population movement will intensify, because the impacts of climate change on human settlements will lead to the abandonment of flooded, arid and uninhabitable environments. The consequences of climate change have the potential to generate population displacement on a large scale. People affected by these changes will have to adapt, and for many it is likely to mean moving to another place if they are to survive. Large population movements may spark conflicts between newcomers and existing communities, exacerbating competition for resources such as water, food, and grazing land (Climate Institute, 2010).

3.3.6 Economic development

Climate change is expected to hamper economic growth, especially in developing countries. Current extreme weather events are already taking their toll on developing countries' economies, leading to loss of human and economic capital. Regions with limited adaptive capacity will be constrained further in their development prospects due to additional loss of life and private assets, reduced productivity of important economic sectors, and destruction of infrastructure. In addition, poor adaptation to climate change will increase the impacts of extreme events, increasing the costs

of rehabilitation and diverting funds from longer-term-development purposes. This is particularly true for small countries and countries with low economic diversity, where the impacts of climatic extremes cannot be absorbed by economic activity in other regions or sectors (Chinowsky *et al*., 2010).

Overall, economic damage and loss arising from climate change impacts could cost the global economy up to US$970 billion in total by 2030 (Deichmann & Zhang, 2013). A 2.5^{o}C temperature increase would result in a loss of 1.0 to 1.5% of GDP in developed countries, but a 2 to 9% loss of GDP in developing countries. When Hurricane Sandy struck the east coast of the United States of America (USA) and the Caribbean in October 2012, it affected millions of people and destroyed billions of dollars' worth of economic assets. An estimated 1.8 million structures and homes were destroyed and damaged, with economic losses exceeding US$65 billion, which also contributed to rising insurance costs (Liverman & Glasmeier, 2014). With regard to sea-level rise, lost property and damage to economic infrastructure could cost somewhere between US$20.4 and US$138 billion by 2100 if the sea rose by 50cm worldwide (Gromilova, 2011).

Energy supply has been negatively affected by changing weather patterns. One cause relates to changing water availability. As water levels decrease due to lower precipitation and increased evaporation, capacity for electricity production may decline. Decreasing water availability can also negatively affect cooling and cleaning systems required for concentrated solar power, nuclear power, and various other thermal-generation technologies (Klawitter *et al*., 2012).

Coal has led the recent surge in demand for energy provision globally and is on a strong growth path. Statistics from the World Coal Institute show that coal provides 25% of global primary energy needs and generates 40% of the world's electricity. Production of coal has increased by 78% over the last 25 years. The impacts of climate change on supply and demand will vary greatly by region (Enete & Alabi, 2011). In 2012, world production of coal amounted to 7 865 million tons. The top producer in 2012 (and one of its largest consumers) was China, which mined 3,650 million tons. The USA is second, having mined 922 million tons. Despite its abundance and contribution to the world's energy supply, coal has disadvantages. The extraction and burning of coal releases SO_2, NO_2 and many heavy metals that are harmful to human health and have been linked to acid rain into the environment. Furthermore, the burning of coal, especially by power

plants, releases large quantities of CO_2, which cause climate change and global warming (Wicander & Monroe, 2013).

Growing numbers of climate-related refugees will undoubtedly affect the global and regional economies further. As state services in host countries become overwhelmed by vast populations of destitute people, the number of crimes and conflicts might increase and the receiving states may enter economic and political crises (Gromilova, 2011). The highest refugee concentrations are in some of the poorest countries in the world, where the refugees compound already prevailing economic, environmental, social and political difficulties. Refugees compete with local citizens for scarce resources, such as land, water, housing food and medical services. Overtime, their presence leads to more substantial demands on natural resources and other services (UNHCR, 1997).

3.3.7 Social upheaval and conflict

Many developing countries lack the government and social infrastructures to cope with the types of stressors that could be caused by global climate change. When governments can no longer deliver services to their people, ensure domestic order, and protect the nation's borders from invasion, threats, extremism and terrorism emerge (CNA, 2007). Violence and political conflict would be more likely to occur in the next 20 to 30 years as climate change impacts become more pervasive and severe. Potential drivers of conflict and social upheaval include stresses with respect to access to water, food security, access to energy and cultivable land, and forced migration. Climate change impacts may add to existing social and environmental stresses, or create new stresses, thereby exacerbating existing political tensions, contributing to new tensions and ultimately fuelling greater global political and social instability (UNFCCC, 2008). Therefore, it is not surprising that climate change has been listed as one of the major threats facing humanity in coming decades, along with terrorism, demographic changes and rising global energy demands (Wisner *et al*., 2007).

Furthermore, because climate change is a factor in the outbreak of conflict, it will exacerbate inter-communal conflict when communities cannot meet their basic needs as a function of the earth's diminished carrying capacity or as a result of competition over scarce resources. For instance, there will be conflict over water when demand from a growing population overtakes supply (Matthews, 2013).

Developing countries already face poverty and low income levels, lack of infrastructure, lack of training and education, inaccessibility of technological improvements, fewer job opportunities, inadequate legal systems and a degraded resource base (Pachauri & Chand, 2008).Because developing countries are affected more by climate change, its impacts on particular vulnerabilities of developing countries will be discussed in detail.

The effects of climate change may be particularly critical when considered in the light of efforts to achieve higher levels of well-being in developing countries. The expected impacts of climate change on, among others, access to natural resources, food security, and the spread of vector-borne diseases such as malaria have direct implications for the achievement of several MDGs[8].

Adverse climate change impacts on natural systems and resources, infrastructure and labour productivity may lead to reduced economic growth and increasing poverty. These effects threaten the achievement of MDG 1. Loss of livelihood assets, displacement and migration may lead to reduced access to education opportunities, thus hampering the realisation of MDG 2. Depletion of natural resources and decreasing agricultural productivity may place additional burdens on women's health and reduce time for decision-making processes and income-generating activities, worsening gender inequality and women's lack of empowerment (MDG 3). Increased incidence of vector-borne diseases, increases in heat-related mortality, and declining quantity and quality of drinking water will lead to adverse health effects and thereby threaten the achievement of MDGs in general (Chandran & Sandhya, 2012).

An international post-Kyoto agreement on climate change was negotiated and finalised at the UNFCCC COP21 in Paris. The Rio+20 Conference on Sustainable Development in 2012 initiated a UN process to create the post-2015 Sustainable Development Goals (SDGs), which replace the MDGs, and which will shape the international and national development priorities of all countries until at least 2030. The poverty goal (SDG 1) is the most important goal and addresses one of the biggest threats facing humanity. However, in recent years, progress towards achieving the poverty MDG has been uneven for women, as gender imbalances in employment and education persist,

[8] The MDGs are a set of development targets agreed upon by the international community, which centre on halving poverty and improving the welfare of the world's poorest by 2015 (IMF, 2014). From a development perspective, MDGs are important because climate change has a direct impact on the achievement of the MDGs, and could delay development initiatives further.

and this is why the gender equality goal (SDG 5) is another important goal. Regarding the water and sanitation goal (SDG 6), access to safe drinking water sources and improved sanitation facilities are prerequisites for improving health and development. Although the safe drinking water MDG target was one of the first targets to be met, achieving the sanitation target is one of the targets that has seen the least progress. Finally, achievement of the energy goal (SDG 7) is crucial for all dimensions of sustainable development, given its strong links with carbon emissions and the climate agreement.

Table 3.1: The impact of climate change on meeting SDGs (continued on next page)

CLIMATE CHANGE IMPACTS ON THE ATTAINMENT OF SDGS	
SUSTAINABLE DEVELOPMENT GOAL	EXAMPLES OF CLIMATE CHANGE IMPACTS
Poverty (Goal 1)	• Climate change and climate variability worsen existing poverty, exacerbate inequalities and trigger new vulnerabilities. • Food-related impacts indirectly affect poverty under low crop productivity.
Hunger and food security (Goal 2)	• All dimensions of food security – availability, access, utilisation and stability – are vulnerable to climate change. Climate change may lead to 170 million more undernourished people in 2080.
Health and well-being (Goal 3)	• Climate change may increase the prevalence of some vector-borne diseases, and vulnerability to water-borne, food-related or other contagious diseases.
Education (Goal 4)	• Education facilities could be vulnerable to climate-related disasters. For instance, in Ethiopia and Malawi, droughts and floods have increased pressure to take children out of school. Also, the issue of absenteeism when classrooms are used to host victims of natural disaster
Gender equality (Goal 5)	• There are significant gender dimensions to climate change. With migration, for example, in Niger, male migration is increasing, leaving women with no labour support.
Water and sanitation (Goal 6)	• Climate change is likely to alter the quality and productivity of natural resources and ecosystems, some of which may be irreversibly damaged, and these changes may also decrease biological diversity and compound existing environmental degradation. • A shift to hotter, drier conditions can damage the health of forests, impeding their ecological functions and reducing their economic productivity.

CLIMATE CHANGE IMPACTS ON THE ATTAINMENT OF SDGS	
SUSTAINABLE DEVELOPMENT GOAL	EXAMPLES OF CLIMATE CHANGE IMPACTS
Sustainable energy for all (Goal 7)	• Climate change could lead to conflicts over diminishing natural resources, directly undermining the prospects of global cooperation and partnerships. • Climate change is a global problem and the response required involves global cooperation to mitigate and help developing countries adapt to the adverse impacts of climate change. • Climate change will also impact on hydrogenation
Growth and employment (Goal 8)	• Changes in climate will have an enormous impact on employment and the labour market in general, especially in developing countries that already have weak economies.
Infrastructure (Goal 9)	• Climate change poses a series of interrelated challenges to a country's most densely populated places. In the USA, for instance, which is highly urbanised, about 80% of the population lives in cities and metropolitan areas. Cities depend on infrastructure, like water, sewerage systems, roads, bridges and power plants, and these are affected by rising sea levels, storm surges, heat waves and extreme weather events causing stress on essential services.
Inequality (Goal 10)	• Women often experience additional duties as labourers and caregivers as a result weather events and climate change, as well as responses (e,g., male outmigration), while facing more psychological and emotional distress, reduced food intake, adverse mental health outcomes due to displacement and, in some cases, increasing incidence of domestic violence.
Cities and human settlements (Goal 11)	• Climate change poses challenges to human settlements because assets and populations in both developed and developing countries are increasingly located in coastal areas, slopes, ravines and other risk-prone areas.
Sustainable consumption and production (Goal 12)	• Rising temperatures may threaten efforts to reduce food losses, including post-harvest losses, as changes in temperature can result in geographical shifts of pests and diseases.
Climate change (Goal 13)	• As adaptation is far more difficult under high-emission scenarios, costs would increase and delaying climate action will increase costs for the future.
Marine Resources (Goal 14)	• Marine species' composition changes as the ocean warms. Nineteen of the 33 countries with fisheries classified as highly vulnerable are least-developed countries. For example, CO2 uptake is increasing the

CLIMATE CHANGE IMPACTS ON THE ATTAINMENT OF SDGS	
SUSTAINABLE DEVELOPMENT GOAL	EXAMPLES OF CLIMATE CHANGE IMPACTS
	ocean's acidity, threatening shellfish by reducing their ability to form shells.
Ecosystems and biodiversity (Goal 15)	• Ecosystems and the biodiversity and services they support are intrinsically dependent on climate, and people depend on ecosystems for resources that are harvested. Changing climate is likely to alter ecosystem services.
Peace and justice (Goal 16)	• Heatwaves are associated with violence, and transboundary climate impacts, including those on shared water resources, can increase rivalry between different groups.
Means of implementation (Goal 17	• Climate change will increase the financial resources and capacity building requires for least-developed countries to achieve the SDGs, in a context of increasing competition for such resources. In small islands, placing long-term climate adaptation needs above presently critical development needs could inadvertently reduce resilience.

Sources: Wallingford, 2015; IIED, 2015; Field *et al.*, 2014; Olsen, 2009; USGS, 2013.

Developing countries are located in parts of the world that are badly affected by temperature and precipitation changes resulting from climate change because of their geographical location. For example, low-lying countries, such as Bangladesh, are vulnerable to climate change that causes sea-level rise and extreme storm surges because of geographic location (EPA, 2013).

Table 3.2 gives an overview of some of the most pronounced impacts of climate change experienced in different parts of the world, to emphasise the particular vulnerability of developing countries to the impacts of climate change.

Table 3. 2: Current and future consequences of climate change in different world regions

CURRENT AND FUTURE CONSEQUENCES OF GLOBAL CLIMATE CHANGE	
CONTINENT	EXAMPLES OF CLIMATE CHANGE IMPACTS
North America	• Decreasing snow pack in the western mountains; 5-20% increase in yields of rain-fed agriculture in some regions; increased frequency, intensity and duration of heatwaves in cities that currently experience them. • Cities that currently experience heatwaves are expected to be challenged further by increased number, intensity and duration of heatwaves during the course of the century, with potential for adverse health impacts. • Coastal communities and habitats are stressed by climate change impacts interacting with development and pollution.
Latin America	• Gradual replacement of tropical forests by savannah in eastern Amazonia; risk of significant biodiversity loss through species extinction in many tropical areas; significant changes in water availability for human consumption, agriculture and energy generation. • Changes in precipitation patterns and the disappearance of glaciers are projected to affect water availability for human consumption, agriculture and energy generation significantly.
Europe	• Increased risk of flash floods; more frequent coastal flooding and increased erosion from storms and sea-level rise; glacial retreat in mountainous areas; reduced snow cover and a decline in winter tourism; extensive species losses; reductions of crop productivity in southern Europe. In southern Europe, climate change is projected to worsen conditions (high temperatures and drought) in regions already vulnerable to climate variability, and to reduce water availability, hydropower potential, summer tourism and, in general, crop productivity in the future. • Climate change is also projected to increase the health risks due to heatwaves and the frequency of wildfires.

Table 3. 3: Current and future consequences of climate change in different world regions (continued)

Africa	• Yields from rain-fed agriculture could be reduced by up to 50% in some regions by 2020; crop net revenues could fall by as much as 90% by 2100, with small-scale farmers being the most affected. Access to food may be severely compromised. • Towards the end of the 21st century, projected sea-level rise will affect low-lying coastal areas with large populations. The cost of adaptation could amount to at least 5 to 10% of GDP. • By 2080, an increase of 5 to 8% of arid and semi-arid land under a range of climates is projected. • Between 25 and 40% of mammal species in national parks in sub-Saharan Africa will become endangered. • North Africa, particularly the Mediterranean regions, is vulnerable to climate change impacts and its effects on the marine and coastal domain are already perceptible for natural reasons, lifestyles and the development concentrated on coastal areas.
Asia	• Freshwater availability is projected to decrease in central, south, east and southeast Asia by the 2050s. Coastal areas will be at risk due to increased flooding, the death rate from diseases associated with floods and droughts is expected to rise in some regions. • Climate change is projected to compound pressures on natural resources and the environment due to rapid urbanisation, industrialisation and economic development. • Endemic morbidity and mortality due to diarrhoeal disease primarily associated with floods and droughts are expected to rise in east, south and southeast Asia due to projected changes in the hydrological cycle.

Sources: IPCC, 2007; NASA 2013; Radhuoane, 2013.

3.4 CLIMATE CHANGE IN THE AFRICAN CONTEXT

Africa has contributed only 3.8% of the total historical GHG emissions, but the continent is among the most vulnerable in the world with regard to climate change impacts (African Economic Research Consortium, 2013; PACJA, 2009). The African continent is the world's second-largest and second-most-populous continent, after Asia. With about 1 136 million people (PRB, 2014), Africa accounts for about 14.2% of the world's human population. Approximately 50% of the continent's population continues to live in poverty and 39 of the world's poorest countries are located on this continent (ISDR, 2011).

Africa's particular vulnerability to climate change is influenced by a wide range of factors, including anthropogenic pressures, natural climate variability and low levels of socio-economic development. This vulnerability is compounded by the interaction of multiple stresses and low overall adaptive capacity (Dewar, 2012). Climate change poses a direct threat to Africa's aspirations for growth and poverty reduction through the effects of changing water availability, loss of biodiversity, declining or volatile agricultural yields, climate-related humanitarian disasters (including floods and droughts), increased incidence and prevalence of vector-borne diseases, weakened infrastructure, political instability due to heightened conflict over resources, and movement of people. Gradual changes in average temperatures associated with climate change will worsen already existing stresses, such as those mentioned above, since African populations have limited coping strategies upon which to draw in times of stress, and face existing developmental challenges, such as endemic poverty, complex governance and institutional dimensions (Madzwamuse, 2010).

3.4.1 Water scarcity

Africa has more than 160 lakes that are larger than 25 km^2 and more than 22 large river basins. The total renewable freshwater resources of Africa have been estimated between 4 050 and 4 590 km3 per year. Up to 75% of the total surface water is concentrated in the eight main river basins in Africa, namely the Chari-Lagone, the Congo, the Niger, the Nile, the Ogadugne, the Sanga, the Volta and the Zambezi (ECA, 2011). By 2025, water availability in nine countries, mainly in eastern and southern Africa, is projected to be less than 1 000 m3 per person per year. The population at risk of water stress could involve up to 460 million people, mainly in western Africa (ECA, 2011). Rising temperatures can alter runoff patterns and increase water evaporation rates, which can severely reduce the availability of water. For example, the Niger River basin, in west Africa, serves a route of migration and commerce and is seriously threatened by man-made climate change. Climate change is expected to result in severe water stress over much of Africa; particularly the agro-pastoralist region of west Africa, where the Niger River basin is located. Consequently, not only will freshwater become scarcer in already dry regions, but changing freshwater temperatures could also affect natural ecosystems and water quality (Okpara *et al*., 2013). Southern Africa has rich history of water harvesting, which ranges from simple village ponds that support a range of local productive and domestic activities, to large impoundments

(Msangi, 2014). Considering the impacts of climate change alone, southern Africa is expected to experience reductions of up to 50% (World Bank, 2013).

Climate change is also contributing to the disappearance of glaciers on Mount Kilimanjaro. An estimated 82% of the icecap that crowned the mountain when it was first thoroughly surveyed in 1912 no longer exists. Most of the glacier on Mount Kilimanjaro will disappear by 2016 if climate change continues at the present rate. The snow and glaciers of Mount Kilimanjaro act as a water tower, and several rivers are dying out in the warm season due to the loss of this frozen reservoir (Desanker, 2001). The problem at hand is that people depend on the water for agriculture, economic development and domestic use, and excessive water withdrawal can increase the likelihood and impact of drought. Water shortages can cause starvation if alternative food sources are not available. Furthermore, indirectly, water shortages also contribute to the spread of diseases, because people lack water for basic hygiene (Uram & Ozor, 2010).

3.4.2 Agriculture and food production

Agriculture, which provides a livelihood for about three quarters of Africa's population, is mainly rain-fed. Low farm productivity in Africa has many causes, including use of traditional crop varieties, increasingly depleted soils, shrinking plots of land, scarce and unreliable water supply, crop losses from pests and diseases, inequitable land-distribution patterns, inefficient and unfair markets, and poor agricultural and transportation infrastructure (Toenniessen *et al*., 2008). Severe and prolonged droughts, flooding and loss of arable land due to desertification and soil erosion are reducing agricultural yields and causing crop failure and loss of livestock, which endanger rural and pastoralist populations. The Horn of Africa's pastoralist areas (Ethiopia-Kenya-Somalia border) have been severely struck by recurrent droughts; livestock losses have affected 11 million people who are dependent on livestock for their livelihoods, and has triggered mass migration of pastoralists out of drought-affected areas (Basada & Sewankambo, 2009; ISS, 2010). In southern Africa, the effects of climate change are compounded by the region's high poverty levels, weak infrastructure, poor natural resources and management and dependence on rain-fed agriculture. As a result of climate change, the region could see net reductions of more than 10% in the production of maize and other major crops, such sorghum, millet, sugar, cane and wheat (IFAD, 2008).

Climate change is also contributing to oceanic acidification, and an increase in surface water temperatures around the African continent is negatively affecting fish stocks and threatening the

livelihoods of coastal and small-scale fishing communities (Besada & Sewankambo, 2009). The impacts of climate change on agriculture and other key economic sectors in the food production and supply chain, such as forestry and energy, threaten food security across Africa (Besada & Sewankambo, 2009).With respect to fisheries and aquaculture, it has been projected that rising temperatures of around 1.5^{o} to 2.0^{o}C will adversely affect coastal regions that have major lagoons of lake systems, change freshwater flows and lead to a greater inflow of salt water into lagoons, which will affect inland fisheries and aquaculture (Urama & Ozor, 2010).

In most countries where agricultural productivity is already low and the means of coping with adverse events are limited, climate change is expected to reduce productivity to even lower levels and make production more erratic. Long-term changes in the patterns of temperature and precipitation that are part of climate change are expected to shift the production season pest and disease patterns, and modify feasible crops, affect production prices, incomes and, ultimately, livelihood and lives (Edame *et al*., 2011).

The yields of major cereal crops (rice, wheat, maize, sorghum) that most African households use as staple foods in the tropical and subtropical regions are likely to decrease with rising temperatures. Experts estimate that each 1°C rise in average temperature will reduce dryland farm profits in Africa by nearly 10% (AfDBG, 2015).

3.4.3 Human health

Africa's disease burden is at least twice as high as in any other region in the world (Field *et al.*, 2014). Climate change is expected to worsen the incidence of some important health problems in Africa, such as malnutrition, diarrhoeal diseases and vector-borne diseases, which affect women and children the most. Cholera, which is primarily associated with poor sanitation, poor governance and poverty, is projected to worsen in areas of Africa that are expected to get warmer and wetter (Field *et al.*, 2014). Diseases such as Rift Valley fever, malaria, meningococcal meningitis, and Ross River virus are some of the potential health concerns in the wake of increasing climate change (Grantham Institute for Climate Change, 2009).

Shifts in malaria exposure and transmission zones are expected to expand and contract throughout the 21st century. The moving of the malaria mosquito to higher altitudes as a result of temperature increases presents a great number of formerly unexposed people to infection in the densely settled

east African highlands (UNFCCC, 2007). Higher rainfall in eastern Africa is expected to lead to the spread of malaria mosquitos, some to some new areas on the continent, particularly southwards into South Africa. These increases in range will be altitudinal, rather than longitudinal. In contrast, malaria transmission may become rare in large parts of southern central Africa and the western Sahel by around 2050. Increased drought could cause decrease in vector-borne diseases in some areas, including reductions in malaria exposure around the Sahel and in semi-arid southern Africa (PACJA, 2009). There will be between 40 000 and 70 000 additional deaths in Africa in 2030 as a result of climate change, with malaria and diarrhoea responsible for the largest proportions of these deaths (African Development Fund, 2011).

3.4.4 Ecological productivity, biodiversity and forests

Africa is endowed with a highly diverse fauna and flora and the continent is home to about a fifth of all known species of plants, mammals and birds in the world, and a sixth of the amphibians and reptiles. Africa has 3 000 protected areas, including 198 marine protected areas, 50 biosphere reserves and 80 wetlands of international importance. Eight of the world's 34 international biodiversity hotspots are found in Africa. Diverse ecosystems in Africa include rainforests, wetlands, deserts, savannahs, mangroves, coral reefs and coastal deltas. Savannah, which is the richest grasslands in the world, is the most common ecosystem in Africa, and deserts and dry lands cover some 60% of the total continental surface. Forest and woodlands occupy roughly 22% of the land area in Africa and the region accounts for about 17% of the global forest cover. Of the total area of forests and woodlands, only 5% is protected (Devisscher, 2010).

Biodiversity is an important resource for African people for both consumptive (food, fibre, fuel, shelter, medicine, wildlife trade) and non-consumptive (ecosystem services and economically important tourism industry) purposes. Given the heavy dependence on natural resources in Africa, many communities are vulnerable to the biodiversity loss that could result from climate change (African Union, 2011; Desanker, 2001).

About 5 000 African plant species have been negatively affected by climate change. It is estimated that 51-61% of South Africa's fynbos and succulent Karoo biomes have already been lost, affecting both tourism and the economy (Ahmed Yunus *et al.*, 2014). About 25-40% of animal species in national parks in sub-Saharan Africa are expected to become endangered as a result of increased rainfall in the dry Sahel encountered through evaporation. If species continue to decline

in number at the present rate, pharmaceutical companies will find it harder to develop new drugs and agriculture will lose an irreplaceable source of potential new crops, further compromising the ability of the continent to respond to health challenges (African Union, 2011). With a 1.5°C rise in global temperatures, Africa may lose 30% of its animals and plants; a rise of 3°C in global temperatures could mean a loss of 40% of all mammal species in Africa by the end of the century (African Union, 2011).

3.4.5 Land use and human settlement

Africa's urban populations were estimated to number 373 million people in 2007 (PACJA, 2009). This figure is set to double by 2030, when half the continent's population is expected to be living in cities. Many of these urban populations are residing in coastal cities. Africa has around 320 coastal cities (each with more than 100 000 inhabitants) and nearly 56 million people live in low-elevation coastal zones. Africa is also experiencing a growing population and economy and strong trends of urbanisation. Many of these coastal cities are important ports, which are key to national and regional trade, imports and exports. Here, flooding has become more frequent and intense, and flooding now occurs in areas that were previously not at risk. This is caused by several factors, including changes and variability of the climate, weak infrastructure, and a lack of flood-warning alerts and response mechanisms. Floods in Mozambique during 1999 and 2000 displaced more than one million people; a large number of people died in the floods. Rural people and those living in slums in and around Maputo and other towns were hardest hit. Water supplies were contaminated, and irrigation systems, roads and bridges were damaged. This incurred direct losses of US$273 million and reconstruction costs of US$428 million (PACJA, 2009).

Africa has 33 countries with coastlines, and 7 adjacent island nations and territories. The coastline is estimated to be more than 38 000 km in length, with a further 7 000 km when the adjacent island nations and territories are included. The coastal zone (defined as the land up to 10m above sea level) around the continent varies in width from a few hundred metres (Red Sea and mountainous areas) to more than 100km (in the Niger and Nile deltas). This zone includes mangrove forests and swamps, coral reefs, cliffs, sand and mudflats, and tidal marshes, as well as urban settlements. Climate change will exacerbate existing physical, ecological/biological and socio-economic stresses on the African coastal zone. Most existing studies focus on the extent to which a rising sea level could inundate and erode low-lying areas or increase flooding caused by storm surges

and intense rainstorms. The coastal nations of west and central Africa have low-lying lagoonal coasts that are susceptible to erosion, which are threatened by sea-level rise, particularly because most of the countries in this area have major and rapidly expanding cities on the coasts (Watson *et al*., 1997).

Climate change is expected to further increase the number of Africans living in slums. In 2010, 61.7% of sub-Saharan Africa's urban population were slum-dwellers, more than anywhere else in the world (UN-Habitat, 2010). By 2100, Africa's coastline and river deltas, with their densely populated low-lying areas, will be affected by sea-level rise of up to one metre. This will lead to increased flooding and coastal erosion, and unpredictable disasters may occur quickly and without warning. By 2080, north Africa, west Africa and southern Africa will be three of the world's five regions most at risk from flooding (PACJA, 2009).

Climate change is projected to compound the pressures on natural resources and the environment, because people will settle in disaster-prone areas (UN, 2011). Many people are already forced to live in hazardous places, building their homes and growing their food on floodplains in towns and cities. Others construct their shelters on steep, unstable hillsides, or along the foreshores of former mangrove swamps or tidal flats. They are already vulnerable to destructive floods, damaging landslides or storm surges, and climate change is making the situation of the urban poor worse (Mendel, 2006).

Sea-level rise is also expected to have a variety of impacts on densely populated African cities. Half of the continent's 37 million cities are within or have parts within the low-elevation coastal zone. For example, frequent coastal floods result in the destruction of homes and property, the loss of human life and the increased incidence of diseases such as cholera and typhoid. Around 17% of Mombasa's land area could be submerged by a sea-level rise of 0.3 m, with a larger area rendered uninhabitable or unsuitable for agriculture, because of waterlogging and salt stress. Inundation of land and salination of water supplies not only affect densely populated areas, but also encourage people to relocate, thereby increasing population densities elsewhere. Elsewhere in Africa, Niger and Senegal have large urban and rural populations at risk of water scarcity (Bloch, 2012)

3.4.6 Economic development

Recurrent extreme weather events, such as floods, cyclones and droughts, are devastating most economic, social and environmental systems in Africa. In the period 2000-2008, 20% of all the weather and climate-related disasters that occurred globally occurred in Africa (ISDR, 2011). One third of Africans now live in drought-prone areas, mainly in the Sahel, around the Horn of Africa and in southern Africa. In the past 30 years, seven out of the 10 worst drought disasters in the world occurred in sub-Saharan Africa (ISDR, 2011). Climate change has exerted pressure on people living in these areas, because their agricultural practices are less productive and water is in increasingly shorter supply (Matthews, 2007; PACJA, 2009). Roughly 70% of the African population is dependent on agriculture for their livelihoods, and 40% of all exports are agricultural products. By 2100, many parts of sub-Saharan Africa are likely to show agricultural losses amounting to2 to 7% of their country's GDP (Below *et al*., 2010). At the other extreme, floods also cause large economic and human losses (Matthews, 2007). The number of people exposed to floods in the region increased from 500 000 per year in 1970 to almost 2 million people per year in 2010. Flood mortality risk is still increasing consistently in sub-Saharan Africa, despite a downward global trend (ISDR, 2011).

Regarding agriculture, some countries in Africa already face semi-arid conditions that make agriculture challenging, and climate change is likely to reduce the length of growing seasons and force large regions of marginal agriculture out of production. Projected reductions in yields in some countries could be as much as 50% by 2020, and crop net revenues could fall by as much as 90% by 2100 (Radhouane, 2013).

3.4.7 Social upheaval and conflict

Human security and environmental protection are mutually dependent. Climate change may seriously threaten political stability, for instance when communities and nations struggle to access scarce water resources or when forced migration places previously separated groups in conflict over the same resources. Given the history of ethnic, resource and political conflicts in Africa, climate change could aggravate territorial and border disputes and complicate conflict resolution and mediation processes. Conflict zones and potential flashpoints in Africa, such as Darfur, the Sahel, the Horn of Africa, the Democratic Republic of Congo and northern Kenya, all have populations living in fragile and unstable conditions, making them vulnerable to climate change

impacts and the risk of violent conflict, because these areas are politically and economically fragile (Besada & Sewankambo, 2009). In Darfur and South Sudan competition for shrinking pasture or water sources has aggravated existing cleavages between pastoralists and agriculturalists and has exposed rivalries within and among ethnic groups. All these pressures are exacerbated by unequal distribution of land, environmental destruction caused by resource extraction and intensive farming, and the effects of climate change (Downie & Cooke, 2011).

Africa has seven distinct zones and ecosystems, ranging from that of the Sahara to the rainforests of central Africa. The impact of climate change will vary between and within countries and could include increasingly scarce resources in central Africa, declining and failing agricultural yields in the Horn of Africa, encroaching, desert-like environments in Algeria, Chad and Mali, the destruction of marine and coastal resources, and damage to property and infrastructure. These changes are already undermining the carrying capacity of large parts of the dry pastoral regions in Africa, causing destabilising population movements and raising tensions over dwindling key resources. Under these circumstances climate change has the potential to become a significant factor that can tip fragile states such as the Democratic Republic of Congo and Somalia into socio-economic and political collapse (ISN, 2012).

In semi-arid Africa, pastoralism is the main economic activity, with pastoral communities, including transnational migrants, in search of water and new seasonal grazing. In drought situations, these pastoralists may come into conflict with settled agrarian systems. With reduced runoff and rivers drying up, communities are forced to trek long distances from their own communities to look for water. This has created pressures and tensions at the new water sources, with resultant conflicts. One example is Nigeria, where Fulani cattle owners and farming communities compete for grazing land and access to water bodies; this competition has lead to the deaths of several farmers and pastoralists in the region (Urama & Ozor, 2010).

3.5 CONCLUSION

This chapter discussed climate change as a major environmental problem affecting every aspect of our daily lives. It has been widely accepted that human activities, through the burning of fossil fuels and changing land-use practices, are the dominant reasons for climate change. Human drivers of climate change include agricultural production, industrial development and land-use patterns, which all contribute to GHGemissions.

The impacts of climate change, such as changing rainfall patterns and rising sea levels, worsen existing economic, political and humanitarian stresses and affect human development in all parts of the world, especially in poor communities that lack proper systems and capacity to cope with these impacts. Poorer nations are vulnerable to climate change impacts for a number of reasons. First, they lack the ability to adapt to and cope with climate change impacts, which require economic resources, technology and social safety nets. Second, for many countries, climate change is only one of the many environmental problems they are confronted with, and it exacerbates existing environmental stresses. Due to high levels of poverty and resource depletion, these factors make developing countries more vulnerable to the impacts of climate change.

As a result of the awareness of the impacts of climate change, the matter is receiving growing attention in scientific and political circles. It goes without saying that climate change requires urgent attention from a legal and policy context too, internationally and locally. In Chapter 4, legal and policy contexts relating to climate change will be discussed.

CHAPTER 4. INTERNATIONAL AND NATIONAL POLICY FRAMEWORK FOR CLIMATE CHANGE

4.1 INTRODUCTION

Climate change affects all sectors of development and has been labeled a threat to sustainable development (Obata, 2010). This makes a policy response to climate change, on an international and national level, imperative. A policy framework is a set of principles and long-term goals that form the foundation of rules and guidelines and giving overall direction to planning and development at different levels of governance (Asner, 2012). Climate change policy provides support to local governments and rural communities to develop a framework for mainstreaming climate change adaptation into integrated development planning at the local level, and to enable the investment of international adaptation resources to deliver effective action on the ground (UNDP, 2012). This chapter seeks to outline various policy options, and explains how the various policy options inform current international and national policy decisions on climate change.

4.2 APPROACHES TO POLICY DEVELOPMENT

In addressing the matter of climate change, consideration has to be given to preventing further climate change and dealing with the inevitable impacts of climate change. There are various approaches to dealing with climate change. Three policy responses include mitigation, adaptation to reverse current impacts, and preventing future impacts (Pelling, 2011). Most policies currently under consideration internationally have elements of mitigation and adaptation, shining the spotlight on the complexity of climate change as a social and environmental problem.

Adaptation and mitigation are both approaches to dealing with climate change; the aim is to avoid the negative impacts of climate change in the long run. Mitigation refers to efforts made to reduce the accumulation of GHG in the atmosphere. The extent and scope of climate change impacts will depend on the degree of mitigation achieved (OECD, 2009). The goals of mitigation are to avoid dangerous human interference in the climate system and stabilising GHG levels in 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 (NASA, 2015). Reductions in GHG emissions can reduce damage caused by climate change, in its turn reducing the amount of adaptation that will be necessary. GHG mitigation relies on difficult policy

choices, as well as technological development. The so-called technocentrism approach advocates that environmental protection is incorporated into existing political and economic institutions of modern society and, crucially, that this should be achieved without threatening economic growth, material prosperity or liberal democracy (White, 2015). It is an approach based on the assumption that human beings exploit nature because nature is seen as being in the service of humanity. Human beings and their systems (i.e. scientific, managerial, economic) should be and are capable of managing natural resources in a sustainable manner (Van der Geest & Ros, 2007). Responses to climate change have, to a large extent, become dominated by technocentric solutions.

The Kyoto Protocol (1997), the utilisation of market instruments like the Clean Development Mechanism (CDM) and emissions trading, aimed at stimulating technological development and diffusion without damaging economic development, are some of the ways that technocentrism has become entrenched in policy responses to climate change (Bailey & Wilson, 2009). A good example of technocentrism is mitigation measures that aim to reduce GHGs emitted by human activities, for example, from the combustion of fossil fuels and enhancement of carbon sinks. Mitigation happens mainly on a national and global scale, for the global benefit. It therefore targets the main emitters measured in absolute terms, such as the USA, the European Union, Russia and Japan (Urban & Nordensvard (2013).

Emissions are bound to keep rising before they eventually taper off. As a result, climate change will inevitably continue for several decades to come, in spite of mitigation efforts (OECD, 2009).

Adaptation is defined as an "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC, 2007). Therefore, adaptation measures are designed to reduce unavoidable impacts of climate change in the short and medium term. Adapting to climate change requires taking the right measures to reduce the negative impacts brought about by climate change through the use of appropriate adjustments. Adaptation therefore aims to reduce vulnerability to climatic changes and vulnerability of communities, regions and nations to climate variability (AMCEN, 2011; Davoudi *et al*., 2009).

Mitigation and adaptation are closely interconnected because they both have the same purpose, which is reducing the consequences of climate change (Parker-Flynn, 2015). Five ways are proposed to develop links between adaptation and mitigation measures (Olubumni, 2010):

- Avoid trade-offs between mitigation and adaptation and in designing adaptation measures such as policies, to take into account the consequences of mitigation strategies;
- Identify synergies between both adaptation and mitigation in responding to options within specific policy sectors;
- Enhance both adaptive and mitigation response capacity simultaneously and put such capacity into action, particularly in developed countries;
- Build institutional links between mitigation and adaptation in order to bridge the communication gap between policy makers; and
- Mainstream climate policies into the overall sustainable development policies at all levels of governance.

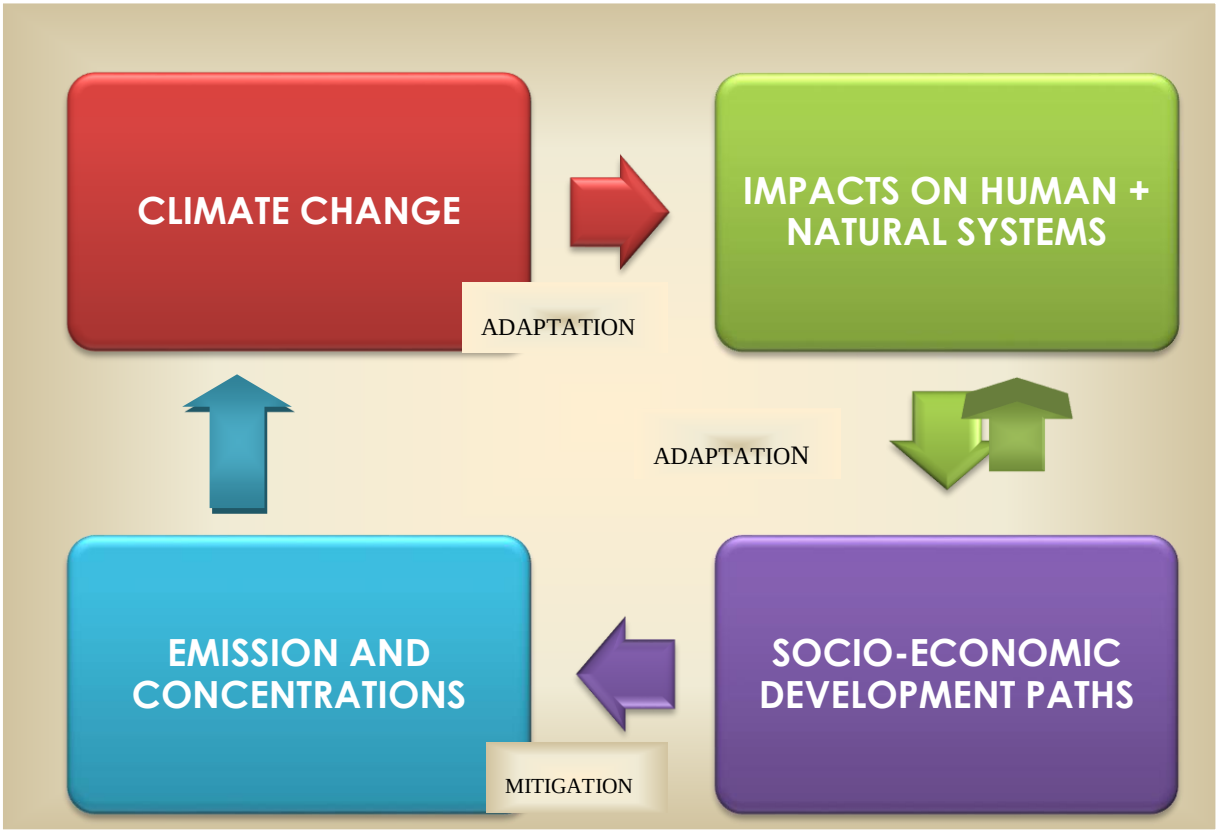


Figure 4. 1: Interconnectedness of adaptation and mitigation in dealing with matters of climate change

Source: Osman, 2007.

With this interconnectedness in mind, it is important to consider how policy options are applied in practice on international, regional and national levels.

4.3 GENERAL INTERNATIONAL CONFERENCES AND CONVENTIONS INFORMING CLIMATE CHANGE POLICY AT THE INTERNATIONAL AND NATIONAL LEVELS

We must acknowledge that, even if countries succeed in limiting and then reducing GHG emissions globally, the climate system will continue to respond to the atmospheric buildup of GHGs that has occurred since the 1970s. Additionally, given that climate change has an impact on natural and human systems, and that these impacts will continue to evolve for the foreseeable future, measures to manage these impacts in terms of moderating the harmful impacts, are essential. Climate change policy is required to deal with these challenges (Department of the Environment, Community and Local Government, 2012).

The discussion will take as its starting point the international conference dynamic that has contributed to informing environmental policies and conferences and conventions that have been convened with the express aim of addressing climate change.

4.3.1 Stockholm 1972: United Nations Conference on the Human Environment

The UN Conference on the Human Environment was held in Stockholm, Sweden, in 1972. The Conference adopted a declaration that set out principles for the preservation and enhancement of the human environment, as well as an action plan containing recommendations for international environmental action.

In a section on the identification and control of pollutants of broad international significance, the Stockholm Declaration raised the matter of climate change for the first time. In this declaration governments were warned to take note of activities that could lead to climate change and also to determine the likelihood and magnitude of climatic effects on their populations (UN Chronicle, 2007).

In addition to the Stockholm Declaration, the Stockholm conference launched the UN Environment Program (UNEP), which has acted as a general authority for environmental matters since its inception (EPA, 2014). UNEP, which was based in Nairobi, was formed with a mandate to promote the idea of environmentally sound development. It provided the UN with an agency to examine the world's growing environmental and development problems by making recommendations to national governments and international bodies on appropriate actions to be taken on environmental matters such as climate change (EPA, 2014; Buss, 2007). This conference

also laid the groundwork for subsequent acceptance of the concept of sustainable development, as promoted by the Brundtland Commission in 1987 (Weeks, 2008).

4.3.2 First World Climate Conference (1979)

The First World Climate Conference was convened in 1979 by the World Meteorological Organization in collaboration with the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Food and Agricultural Organization of the United Nations (FAO), the World Health Organization (WHO), UNEP, International Council of Scientific Union and other scientific partners, as a world conference of experts on climate and mankind (Zillman, 2009). This conference acknowledged that climate change is a serious problem and explored how climate change might affect human activities. It issued a declaration calling on the world's governments to anticipate and prevent potential man-made changes in climate that might be averse to the well-being of humanity (Bonseok-Koo, 2011; UNFCCC, 2014b).

Following the First World Climate Conference in 1979, UNEP adopted "impacts of climate change and variability" as one of its areas of responsibility. This responsibility is administered under UNEP's World Climate Impacts Studies Program, one of the four components of the World Climate Program.

4.3.3 The Vienna Convention (1985)

In 1985, an important international conference on GHGs was held in Villach, Austria. Since these initiatives, the question of the impacts has been addressed in increasing detail at numerous meetings and conferences (Yoshina, 1997).

At this conference, participants resolved to step up scientific research activities and international cooperation and instituted the first World Climate Research Program. The conference provided crucial impetus for large-scale collaborative research, inspiring some countries to launch national climate protection programmes.

Other international and national conferences dealing with climate change followed soon after the first World Climate Conference (Bruns *et al.*, 2009).

4.3.4 The World Commission on Environment and Development (1987)

The World Commission on Environment and Development was ratified by the United Nations General Assembly in 1983, and brought out a report entitled, Our Common Future, in 1987, commonly referred to as the Brundtland Report. The Commission defined sustainable development as "development that meets the needs of the present without compromising the ability of the future generations to meet their own needs". The Brundtland Report outlined a path for global sustainable development and served a key role in bringing sustainability into the public eye worldwide (Borne, 2010; EPA, 2014). This report highlighted problems of poverty, depletion of natural resources and the deterioration of quality of life as a result of environmental degradation. The report also contributed to the recognition that global warming and the depletion of the ozone layer were becoming increasingly important in the international public debate and political agenda (EPA, 2014).

The Brundtland Commission Report led directly to the first Earth Summit – the United Nations Conference on Environment and Development in Rio de Janeiro in 1992, with a series of follow-up meetings, notably the one in Kyoto in 1997, at which a framework was established for a worldwide treaty to limit long-term carbon emissions (Weeks, 2008). In 1987, the World Meteorological Organization and UNEP governing council agreed that the two organisations should take steps to jointly organise an Intergovernmental Panel on Climate Change (IPCC), a forum for examining greenhouse warming and global climate change; it convened for the first time in November 1988 (Jackson, 2007).

4.3.5 The International Panel on Climate Change (1988)

On the basis of the Brundtland Commission Report in 1987, the UN adopted a resolution (Maunder, 1994) calling for major efforts to achieve sustainable development for all countries of the world. The resolution pointed out that the environmental deterioration resulting from human activities represented a serious threat to the accomplishment of such development, and that far-reaching environmental protection measures were necessary. The IPCC was to prepare a report on all aspects of climate change impacts, using the available scientific information that already existed with a view of formulating strategies for responding to environmental issues. The initial task of the IPCC was to prepare a comprehensive review and recommendations with respect to the state of knowledge regarding the science of climate change, the social and economic impact of climate

change and possible response strategies and elements for inclusion in a possible future international convention on climate (IPCC, 2007).

4.3.6 The Montreal Protocol (1989)

The international community established a mechanism for cooperation to take action to protect the ozone layer. This was formalised in the Vienna Convention for the Protection of the Ozone Layer, which was adopted and signed by 28 countries on the March 1985.

This led to the drafting of the Montreal Protocol in September 1987, which dealt with substances that deplete the ozone layer. The Montreal Protocol legally enforced a phase-out of the production and use of ozone depleting substances – chemicals often used in refrigeration, air condition and foam manufacturing (World Bank, 2013). The treaty was opened for signature on 16 September 1987 and came into force on 1 January 1989. It has since undergone seven revisions.

Since the Montreal Protocol came into effect, the atmospheric concentrations of the most important chlorofluorocarbons (CFC) and related chlorinated hydrocarbons have decreased substantially (Speth, 2004; UN Chronicle, 2007). In June 1990, because scientific evidence demonstrated a more rapid deterioration of the ozone layer than had been estimated, representatives of 59 countries signed revised goals, committing to the phase-out of most CFCs by the year 2000 and the creation of a US$160 million fund to aid developing countries in their transition to other chemicals that cause less damage to the ozone layer.

Due to its widespread adoption and implementation the Montreal Protocol has been hailed as an example of exceptional international cooperation, and has been ratified by 196 states (Speth, 2004; UN Chronicle, 2007). A number of other conventions were also called, such as the UNEP General Council meeting in Nairobi and the Paris G-7 Summit. The fourth IPCC meeting was held in Sundsval in August 1990, and the resulting report was presented at the Second World Climate Conference held in Geneva in October (Lancaster, 1992).

4.3.7 Second World Climate Conference (1990)

The Second World Climate Conference was held in Geneva in November 1990 under the sponsorship of World Meteorological Organisation, UNESCO, UNEP, FAO and International Council of Science Unions. Efforts were made to raise awareness of the effects of climate change

(UN Chronicle, 2007). The Conference Statement included a recommendation for the urgent establishment of a Global Climate Observing System. The five-page Ministerial Declaration from the Conference represented the most broadly based call for cooperative international action on the climate change problem.

As a result of this conference, the UN General Assembly established the Intergovernmental Negotiating Committee as a single intergovernmental negotiating process under the auspices of the General Assembly. The Committee met for five sessions between February and May 1992, and finalised the United Nations Conference on Environment and Development (UNCED) in time for its launch in June at the Rio de Janeiro Earth Summit, where 154 states signed the agreement (Zillman, 2009).

4.3.8 Rio Earth Summits (1992-2013)

UNCED was held in June 1992 in Rio de Janeiro, Brazil. It took place over 12 days and brought together heads of government. The so-called Earth Summit was an attempt by the world community to design a framework and adopt practical steps needed to achieve globally sustainable development.

In the wake of the Brundtland Report and the establishment of the IPCC, the UN General Assembly intended to examine progress on the Brundtland Report. A number of potential environmental agreements were discussed and one of these agreements was the UNFCCC, which was signed by 154 states as well as the predecessor of the European Union, the European Community. The signing of the convention was only the first step in creating the first global climate change treaty. Although the UNFCCC did not set binding targets, it committed the 40 industrial countries, largely responsible for climate change, to take the first major steps towards limiting emissions and mitigating impacts. The convention explicitly stated that each of the industrialised countries agreed to adopt national policies and implement corresponding measures for mitigating climate change, by limiting its anthropogenic emissions of GHGs and protecting and enhancing its GHG sinks and reservoirs. Signatories to the UNFCCC were expected to implement domestic policies that would reduce their GHG emissions to 1990 levels (Fisher, 2004; Helme, 2008).

With negotiations at UNCED falling short of setting binding targets for emissions reduction, the first Conference of the Parties (COP 1) to the UNFCCC took place in Berlin in 1995, to set targets

for negotiating a protocol that would involve emissions-reduction targets beyond 2000 (Harris *et al*., 2015; McDonald, 2012). Parties agreed that the mechanism to stabilise GHG concentrations in the atmosphere at a level that would prevent dangerous interference with the climate system, under the UNFCCC, was inadequate, and they agreed to what was later called the Berlin Mandate, of which the declaration includes industrialised countries' commitment to, through legally binding obligations, reducing GHG emissions. Developing countries were exempt from binding obligation. The Mandate laid the groundwork for the Kyoto Protocol (CFR, 1995). In the Mandate participating nations acknowledged that the voluntary approach to reduce emissions of heat-trapping gases had failed and they agreed that there would have to be binding commitments by industrialised countries to reduce their carbon emissions after 2000 (Schroeder & Lovell, 2012).

COP 2 was held in Geneva, Switzerland, in 1996. Attendees endorsed the results of the IPCC's second assessment report in 1995, which had extensively reviewed the physical impacts of climate change on human society and natural systems. The second assessment report had stimulated many governments into intensify negotiations on the Kyoto Protocol. The Geneva Ministerial Declaration, which, in part, called on parties to accelerate negotiations on a legally binding protocol, was noted, but not adopted. In July, the USA announced that it would support legally binding targets and timetables to reduce the accumulation of GHGs, and suggested that other industrialised nations do the same. This resulted in more than 100 countries announcing they would develop targets for the reduction of carbon emissions.

In an interim negotiating meeting in Bonn, Germany, in March 1997, Europeans took the lead by offering specific targets, proposing that all industrialised countries be required to reduce their emissions of GHGs by 15% from 1990 levels by the year 2010. The USA government proposed a system of international trading in emission rights that would significantly reduce the costs of reductions (Hongyuan, 2008; EESI, 2014).

The Kyoto Protocol was formally adopted in December 1997 at COP 3 in Kyoto (Harris *et al*., 2015), by consensus by more than 150 signatories. The Protocol included legally binding emissions targets for developed countries for the six major GHGs, which are CO_2, methane, N_2O, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. The Protocol offered additional means of meeting targets by way of three market-based mechanisms: emissions trading, the CDM, and Joint Implementation (JI). Under the Protocol, industrialised countries' actual emissions had

to be monitored and precise records had to be kept of the trades carried out (Avi-Yonah & Uhlmann, 2009).

Developing countries had no binding targets for GHG emission reductions up to 2012 under the Kyoto Protocol and the UNFCCC. One of the Kyoto Protocol's flexible instruments was the CDM, through which developing countries voluntarily participated in climate change mitigation. Under the CDM, industrialised countries bought emissions reduction credits, as certified emission reductions, from projects in developing countries, which industrialised countries used to meet their own reduction commitments, while its main goal was ensuring the cost effectiveness of mitigation measures. The CDM had a second aim, which is to benefit host developing countries by promoting investment in sustainable development and facilitating technology transfer, thereby contributing to a more climate friendly economy (Castro, 2010).

The conclusion of the Kyoto Protocol negotiations led directly to another negotiating round, with the decision to adopt the Kyoto Protocol at COP 3. The call was for further work on three flexibility mechanisms, namely, emissions trading systems; JI of emission reduction projects between Annex I parties; and the CDM (IISD, 2009).

In practice, the post-Kyoto negotiations did not really start until COP 4 in 1998, when the so-called Buenos Aires Plan of Action was adopted (EESI, 2014). In essence, the Plan of Action was to advance efforts and to devise mechanisms for implementing the Kyoto Protocol, to be completed by year 2000. In parallel, the Plan of Action also launched negotiations aimed at developing the Kyoto Protocol further, including such topics as financial assistance, technology transfer and the special circumstances of particularly vulnerable developing countries. Although the deadline was not clearly articulated, there were expectations that this mammoth negotiating round on both the Convention and the Protocol would result in a package deal on all the regime development issues of COP 6 in 2000 (Depledge, 2005).

COP 5 was held in Bonn, Germany, in November 1999, and the goal of the meeting was to respond to the concerns of the parties and to ensure that the Kyoto Protocol would be ratifiable after COP 6, which was to take place the following year in The Hague. The major issues discussed at COP 5 involved methods for assessing national emissions, rules for crediting countries for forests (carbon sinks), establishing monitoring of compliance, emissions trading, and procedures for projects in the developing world. These involved joint implementation and the CDM (Fisher, 2004)

COP 6 Part I was held in The Hague, Netherlands, in 2000. Negotiations faltered, and parties agreed to meet again at Part II, in Bonn, Germany, later that year. Consensus was reached on what was called the Bonn Agreements. All nations except the USA agreed on the mechanisms for the implementation of the Kyoto Protocol.

A second session of the COP 6 talks in 2001 worked out terms for compliance and financing. The Bush administration had rejected the Kyoto Protocol and the USA was only an observer to the talks (Harris *et al*., 2015).

Between 2001 and 2010, the COP conferences took place in various countries, such as Morocco, India, Milan and Canada. The main focus of the conferences during this time was to assist least-developed countries through adaptation programmes.

For instance, COP 7 was held in Marrakesh, Morocco, in 2001 and COP invited the Global Environment Fund (GEF), as the financial mechanism of the Convention, to establish and operate two new funds related to the UNFCCC: The Special Climate Change Fund, which was established to finance projects, and the Least Developed Countries Fund, which was established to support a work programme to assist least-developed countries to, inter alia, prepare for and implement National Adaptation Programmes of Action (NAPA).

COP 8 took place in Delhi, where parties adopted the Delhi Ministerial Declaration that, among other things, called for developed countries to transfer technology to developing countries (Shah, 2002).

COP 9 was held in Milan, Italy, in 2003, and this is where the Special Climate Change Fund and the Least Developed Countries Fund were developed further (IISD, 2003). Parties began discussing adaptation options and addressed and adopted numerous decisions and conclusions on issues relating to development and transfer of technologies; land use, land use change and forestry; the UNFCCC'S financial mechanisms; developed countries' national communications; building capacity, adaptation and response measures; and UNFCCC Article 6 (education, training and public awareness). Examining the issues of adaptation and mitigation, the needs of least developed countries and future strategies to address climate change, COP 10 was held in Buenos Aires, Argentina, in 2004 (Climate Action Network International, 2004).

COP 11/CMP 1 (conference of parties serving at the meeting of parties) was held in Montreal in 2005, and here the parties addressed matters such as capacity building, development and transfer of technologies, the adverse effects of climate change on developing and least-developed countries, and several financial and budget-related issues, including guidelines for the Global Environment Facility (CCES, 2005).

COP 12/CMP 2 was held in Nairobi, Kenya, in 2006. Delegates made some progress on important issues for developing countries, such as the Adaptation Fund, the Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change, and the CDM (Sterk *et al*., 2007).

COP 13 was held in Bali in 2007, and diplomats approved a schedule for post-Kyoto negotiations to end in 2009 (Harris *et al*., 2015). Governments agreed to kick-start strategic programmes to scale up the levels of investment for the transfer of both the mitigating and the adaptation technologies that developing countries need to create more attractive investment environments, and to provide incentives for the private sector for technology transfer (Burleson, 2014; NGLS, 2007).

In 2008, COP 14/CMP 4 was held in Poznan, Poland, where countries began negotiating on the financing mechanism to help poor countries adapt to the effects of climate change. Negotiations about what would succeed the Kyoto Protocol, continued (Christensen, 2011).

In 2009, COP 15 was held Copenhagen, and the Copenhagen Accord declared the importance of limiting warming to under 2^{o}C, yet without any binding targets. Developed countries pledged to provide financing to developing countries to the value of US$30 billion annually, increasing to $100 billion by 2010 (Harris *et al*., 2015).

The Cancun Agreements, adopted at the UN Climate Conference in Mexico (December 2010), included a comprehensive finance, technology and capacity-building support package to help developing nations adapt to climate change and to adopt sustainable paths to low-emission economies (EEA, 2013).

Between 2011 and 2015, there were a number of climate change conferences that took place. First was the Durban Platform. Participating countries in Durban in 2011 agreed to adopt a universal legal agreement on climate change as soon as possible, and no later than 2015, to take effect by 2020 (Harris *et al*., 2015). The Durban Platform for Enhanced Action was drafted and accepted by

the COP at COP 17, except for Russia, Japan and Canada, which did not commit. Under the Durban Platform, parties agreed to a framework to establish a new international emissions reduction protocol. The details of the new protocol were to be finalised by 2015, and it will come into force in 2020. The Doha Amendment to the Kyoto Protocol was adopted by the CMP at CMP8.

At COP 18, held in Doha, Qatar, in 2012, parties agreed to extend the expiring Kyoto Protocol, creating a second commitment phase that would begin on 1 January 2012 and end on 31 December 2020. This is considered as a bridge to the Durban Platform for Enhanced Action, agreed upon in 2011, and set to come into force in 2020. Parties failed to set a pathway to provide US$100 billion per year by 2020 for developing countries to finance climate change adaptation, as agreed upon at COP 15. The concept of loss and damage was introduced in the 1990s but it was accepted an as element of international negotiations since the Cancun climate conference in 2010, whereby developed countries and small island nations pay for losses and damages caused by climate change they are already experiencing (EESI, 2014).

At COP 19, held in Warsaw, Poland, in 2013, parties were expected to create a roadmap for the 2015 COP in Paris, where a legally binding treaty to reduce GHG emissions was expected to be finalised. Key decisions adopted at COP19/CMP9 include decisions on further advancing the Durban Platform, the Green Climate Fund and Long-term Finance, the Warsaw Framework for Reducing Emissions from Deforestation and Forest Degradation (REDD+) and the Warsaw International Mechanism for Loss and Damage. At COP 19 negotiations focused on the implementation of agreements reached at previous meetings, including pursuing the work of the Ad Hoc Working Group on the Durban Platform for Enhanced Action. There were differences of opinion between developing and developed countries about responsibility for GHG emissions, which led to a ruling on the wording and a plan to be discussed further at the COP 20. A non-binding agreement was reached among countries to set up a system tackling the loss and damage issue, although details of how to set up the mechanism were not discussed. Concerning climate finance, the REDD+ programme, aimed to preserving the world's forests, was formally adopted.

Little progress was made on persuading developed countries to commit to the plan of providing $100 billion per year by 2020 to developing countries (EESI, 2014: IISD, 2013).

In addition to mentioning the important climate change conventions, it is important to explain how the policies drawn up for some of these conventions impacted on both developing and developed countries with regard to climate change mitigation and adaptation.

4.4 THE IMPACT OF THE INTERNATIONAL POLICY FRAMEWORK ON NATIONAL CLIMATE CHANGE POLICY

Impacts of climate change are being felt worldwide and adapting to these impacts is a significant challenge for all nations. Adapting to the impacts requires action at all levels, from the local to the international, within both public and private spheres (Burton et al., 2006). The UNFCCC convention strongly affirmed the rights of all countries to purposeful sustainable development; it makes repeated reference to the principle of common but differentiated responsibility and it commits developed countries to providing such financial resources as needed by developing countries to fulfil their country's key mitigation obligations (Cosbey, 2009). National and international climate policy has focused on meeting emission targets, often through the implementation of emission trading systems for GHGs. Most proposed trading systems have included international GHG offsets as a central feature (Erikson & Lazarus, 2011).

Agreed upon in 1997, the UNFCCC's Kyoto Protocol was the first step towards achieving more substantial global emissions reduction. It set binding emissions targets for developed countries that ratified the Protocol, such as European Union (EU) member states, and it limits the emission increases of the remaining countries for the first commitment period from 2008 to 2012. The 28 EU member states and the EU have acted jointly to reduce at least 40% of domestic emissions by 2030. The USA, which has a large share of total global GHG emissions, has not, however, ratified the protocol, neither did China and several other countries with large GHG emissions. Countries were expected to meet their targets mainly through domestic policies and measures. They may meet part of their emission reduction targets by investing in emission-reducing projects in developing countries (the CDM) or in developed ones (JI). The CDM is also meant to support sustainable development by, for instance, financing renewable energy projects (European Environment Agency, 2013).

The EU has and continues to play a significant role in designing European climate change legislation as well as encouraging and interacting with national climate change activity within its member states. In 2000 its European Climate Change Programme began a process of screening measures in the fields of energy, transport and industry. Since the launch of the Programme the EU has put in place more than 30 initiatives to counter climate change (Damro *et al*., 2008).

Asia plays a particularly important role in global efforts to reduce emissions and energy use. It is home to some of the largest current and future emitters of global GHGs, as well as being the most vulnerable to the impacts of a changing climate. The region is host to several densely populated countries and major centres of urban growth and development. Many of the rapidly developing economies in Asia will be major sources of the world's growth in energy demand in the next several decades and these economies are therefore critically important to patterns of energy consumption, production, and use and drivers for investment and technology development and deployment. Asian countries are heavily engaged in efforts to reduce emissions and provide for future energy security and are working, on both a regional and on a bilateral basis, to cooperate and to institute the kind of policies, investments and technological research and development that will ease the transition to sources of lower-carbon energy, and ensure greater energy security.

Under the Kyoto Protocol, Japan had a legally binding commitment to reduce its GHG emissions by 6% by 2012. The midterm target under the Fukuda cabinet, announced in June 2009, was an 8% reduction below the 1990 baseline by 2020 (not including emission trading). The target has since become 25% by 2020 and 80% by 2050 under the cabinet of former Prime Minister Hatoyama, which came into power in September 2009. The 25% reduction target was also formalised by the Japanese commitment under the Copenhagen Accord in December 2009 (CSIS, 2010; Kuramochi, 2014).

Australia contributes approximately one and half per cent to total global greenhouse emissions. However, Australia's per capita GHG emissions are the highest of any OECD country and among the highest in the world (Australian Government, 2013). As party to the UNFCCC and the Kyoto Protocol, Australia has an obligation to prepare, publish and update GHG inventories on an annual basis. Australia developed a range of measures to improve the national greenhouse inventory system and produce more accurate and comprehensive estimates. These measures include adoption of new data and methods for estimation of GHG emissions and the implementation of national

greenhouse and energy reporting legislation. Australia also recently established the Australian National Registry of Emissions Units, to meet Kyoto Protocol reporting requirements (Australian Government, 2010)

The Australian government committed the country to reducing national emission by 5% by 2020, in the absence of a binding international agreement. In order to achieve this national goal the Australian government passed the Clean Energy Legislative Package and associated legislation in November 2011. The Clean Energy Act, which commenced on 2 April 2012, is the central piece of the legislation package and establishes the carbon pricing mechanism along with assistance for emissions-intensive trade-exposed industries and the coal-fired electricity legislation (ACT, 2012).

The USA is party to the UNFCCC and participates in ongoing negotiations under the UNFCCC. The USA signed the Convention in June 1992 and ratified it in October of the same year, becoming the first industrialised country and the fourth country in the world to do so. Under the Convention, USA funding supports technology transfer, capacity building, and adaptation programmes in developing countries. The USA is also engaged in a number of multilateral and bilateral partnerships and activities that promote clean and efficient technologies and the sharing of critical scientific information among the wide range of government, private sector, academic and other interested stakeholders (EPA, 2015).

Small island states hardly contribute to global warming, as they are responsible for less than 0.003% of total GHG emissions. However, small island developing states are particularly vulnerable to global climate change, climate variability and sea-level rise. Climate change and sea-level rise were major driving forces for the convening of the Barbados Conference in April-May 1994. Because populations, agricultural lands and infrastructural lands and infrastructures tend to be concentrated in coastal zones, any sea-level rise will have significant and profound effects on settlements, living conditions and island economies.

Since the Barbados Conference, the mechanisms by which small island developing states will be affected by climate change have been elucidated further by the IPCC. Countries such as the Maldives have drawn up plans for adapting to sea-level rise, including measures related to coastal protection, and have enumerated needs in terms of resources, training and financial support. The Johannesburg Summit emphasised the importance of mobilising adequate resources and

partnerships for the adaptation needs of small island developing states, consistent with commitments under the UNFCCC (UNESCO, 2016).

As many as 41 small island developing states are currently party to the UNFCCC, and 29 are also signatories to the Kyoto Protocol (UNFCCC, 2005). Small island developing states have a major stake in international climate change negotiations. Many have argued that their particular vulnerability calls for new norms of justice, sovereignty, and security in the climate regime, but to date, this has remained without major consequences. Hence, small island states have to be directly involved in day-to-day political negotiations to strengthen and defend their interests. Regardless of the fact that these states are small, with little power in the international political and economic arena, research on the role and influence of small island states concludes that they do influence climate change agendas and negotiation and that climate impact vulnerability of countries is positively correlated with their influence in climate negotiations. The Alliance of Small Island States, established in 1992 and bringing together and representing island countries in climate change negotiations, and, to a lesser extent, the Pacific Islands Forum, is believed to have improved the effectiveness of small island states in influencing negotiations (Mol, 2013).

Most African countries have such low levels of GHG emissions that mitigation is not regarded as a priority. And, unlike industrialised nations that are party to the Kyoto Protocol, African countries do not have binding targets for the reduction of their emissions. However, all countries are now expected to identify Nationally Appropriate Mitigation Actions, by means of a document that identifies the most urgent needs and puts a price tag on chosen adaptation projects. All countries are now also supposed to prepare national adaptation plans to identify medium and long-tern needs, and ways to address them (UNESCO, 2013).

Climate change adaptation in developing countries was recognised at the Seventh Conference of the Parties to the UNFCCC in 2001. The Marrakesh Accord established at COP 7 in Marrakesh, Morocco, included an Adaptation Fund, basically a 2% tax on CDM transactions, to finance high-priority adaptation. The fund, being largely synonymous with sustainable development clarifies that Marrakesh adaptation fund – which very optimistically might accrue US$100 million annually – will simply not suffice, given the scale of the global sustainable development challenge (Venema & Cisse, 2004).

The outcome of COP 13 in Bali was a major milestone for developing countries. The Bali Action Plan was agreed upon, and, for developed countries, the decision called for "measurable, reportable and variable national appropriate mitigation commitments and actions … including qualified emissions limitations and reduction objectives". The agreement was a major deviation from the intention of the USA to replace the Kyoto Protocol with a voluntary pledge and review mechanism. For developing countries, the Bali Action Plan called for national appropriate mitigation commitments and actions in the context of sustainable development, supported and enabled by technologies, finance and capacity building in a measurable, reportable and variable manner. However, at COP 15 in Copenhagen, the initiation of the Copenhagen Accord presented a major setback to the actions agreed to in the Bali Action Plan, as the USA pursued the voluntary pledge and review mechanisms as well as conditions for financing climate mitigations (Pressend, 2011).

REDD+ was another mechanism to create an incentive for developing countries to undertake forestry and related activities at the national (and in some cases subnational) level that, together, would contribute to climate change mitigation. The incentive is provided through the creation of financial value for the carbon stored in trees, The REDD+ concept was included in the Bali Action Plan, which was agreed by COP 13 (Naidoo *et al*., 2013).

The cross-practice of the Africa Adaptation Plan (AAP) is to integrate UNDP expertise in capacity development, poverty reduction, governance, gender learning and knowledge management, to deliver a comprehensive suite of technical assistance to the 20 AAP countries[9] (Burkina Faso, Cameroon, Congo, Ethiopia, Gabon, Ghana, Kenya, Lesotho, Malawi, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Tanzania and Tunisia (UNDP, 2010). The African Adaptation Programme (AAP) a strategic climate change adaptation initiative designed to help in creating more informed climate change adaptation decision-making and more effective implementation of those decisions in each of the 20 participating countries, among which Lesotho. The AAP was launched by the United Nations Development Programme (UNDP) in partnership with United Nations Industrial Development Organization (UNIDO), United Nations Children's Fund (UNICEF) and World Food Program (WFP) in 2008, with funding of US$92 million from the government of Japan. The AAP helps

[9]Burkina Faso, Cameroon, Congo, Ethiopia, Gabon, Ghana, Kenya, Lesotho, Malawi, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Tanzania and Tunisia.

countries develop capacities to identify climate-related risks to their national development priorities and to design and implement holistic climate-resilient adaptation and disaster risk reduction plans to address these risks (UNDP, 2010).

4.5 CLIMATE CHANGE ADAPTATION EFFORTS WITHIN THE SOUTHERN AFRICAN DEVELOPMENT COMMUNITY REGION

In Africa in general and in southern Africa in particular, adaptation is the main priority when it comes to climate change. Most African countries only contribute a very small portion of global emissions of GHGs, so reducing emissions in Africa will have a marginal effect on global warming. Mitigating measures are also associated with very high opportunity costs. More importantly, most countries in Africa are already confronted with adverse impacts of climate change. In the most vulnerable countries, climate change is not only an additional development challenge that slows down economic growth, but it also threatens some of the progress, such as combating HIV/AIDS, made over the last decades. In southern Africa development and climate change adaptation are intertwined, especially in the water sector (SADC, 2011).

GHG emissions from Southern African Development Community (SADC) countries have remained very low over the years, given that GHG emissions are largely associated with energy production and level of economic development. In 2010, the SADC region collectively contributed less than 1,3% of total global emissions. This means any GHG mitigation in the SADC region will be insignificant for global emission reduction goals.

All SADC member states joined an international treaty, the UNFCCC, whose main objective is to stabilise GHG concentrations in the atmosphere. Climate change mitigation considerations are anchored in Article 3 of the UNFCCC. For SADC member states, the priority is to reduce the impacts of global warming and climate change on development and to adapt to and cope with increased climate variability and climate change. The most pressing reality for the SADC region is the vulnerability of member states to climate change, considering differences in their respective economic and technical capacities to tackle adaptation. It is for these reasons that SADC member states signed on to the UNFCCC and its Kyoto Protocol (Lesolle, 2012).

SADC member states are actively developing and implementing national legal frameworks, policies and strategies to address the effects of climate change through various mitigation and

adaptation actions. These states include countries like South Africa, Malawi, Mozambique, Mauritius and Zambia (Viljoen, 2013). South Africa is currently implementing renewable energy feed-in tariffs as well as a National Climate Change Response Strategy; Mauritius has two approved CDM projects (waste to energy project/biogas and a coal-fired electric power plant); Malawi is implementing a National Framework on Climate Change on Adaptation and Zambia is implementing a National Disaster Management Policy and Wildlife Policy (Viljoen, 2013).

The SADC Energy Action Plan was established in terms of the provisions of the SADC Energy Protocol and encompasses a comprehensive action plan for harmonised regional energy activities. The provisions contained in both the Action Plan and the Energy Cooperation Policy and Strategy Document, 1996, were the impetus for drafting the SADC Energy Sector Activity Plan in 1999, which sets out the activities and time frame related to proposed regional energy activity. Activities regulated by the Activity Plan are grouped under four focus areas, namely, energy trading; investment and finance; training and organisational capacity building; and information and experience exchange. The Activity Plan and its related activities ultimately revolve around the objective of increasing levels of access to modern energy sources in the region. It should be noted that the Activity Plan refers specifically to climate change and the concerns and challenges it poses to the SADC energy sector. In the regard, the Activity Plan states that mobilising climate change funding will play an important role in facilitating adaptation of the energy sector to the impacts climate change is set to have (Richards, 2008).

Since SADC has one of the fastest growing populations in the world (Khaketla, 2012), it is challenged by increasing food requirements, which has inevitably presented the region with further challenges, such as uncontrolled deforestation and cultivation of fragile ecosystems, resulting in soil erosion, desertification, biodiversity loss, decline in agricultural productivity and ensuing socio-economic upheavals. The SADC Protocol on Forestry is aimed at promoting sustainable forest management and trade in forest products, consistent with the Forest Principles adopted at the United Nations Conference on Environment and Development and the Proposals for Action of the Intergovernmental Forum on Forests/Intergovernmental Panel on Forests/United Nations Forum on Forests process. For easy alignment with national policies and legislation, the protocol was designed to be compatible with international initiatives, such as the United Nations Convention to Combat Desertification, the convention on Biological Diversity and the UNFCCC,

to which all SADC member countries are signatories. The SADC Protocol on Forestry has been ratified by four of the current 13 member countries, namely, Lesotho, Mauritius, South Africa and Tanzania. At least five more countries must ratify it to obtain the minimum two-thirds majority required for it to enter into force (Khaketla, 2012).

The SADC Climate Change Adaptation Strategy (SADC: 2011) for the water sector is aimed at improving climate resilience in the region through integrated and adapted water resource management, by promoting integrated water resource management as a priority tool to reduce vulnerability, and ensuring that water management systems are well adapted to cope with climate variability (White, 2013).

Lesotho's policy framework will be discussed below.

4.6 LESOTHO'S POLICY FRAMEWORK AND STRATEGIES RELEVANT TO CLIMATE CHANGE

Lesotho is not a significant emitter of CO_2, a fact directly linked to the low level of development and industrialisation of the country. Lesotho has, however, committed itself to tackling the impacts of climate change by ratifying the UNFCCC and the Kyoto Protocol. In 2000, in keeping with its obligations under the International Negotiating Committee for Framework Convention on Climate Change, Lesotho submitted its National Report on Climate Change. In addition, in 2006 NAPA prepared a prioritised list of adaptation projects, including the enhancement of agricultural productivity, irrigation, the introduction of drought-resistant varieties, early warning systems for droughts, water resource development and research and development (Khaketla, 2012; Gwimbi, 2013).

Lesotho is highly dependent on imported fossil fuels for the energy requirements of its transport and other industries. Biomass forms an important energy source in the rural domestic sector, as a result, the government is promoting the use of clean technologies, such as efficient cook-stoves. These technologies reduce GHG emissions and also have positive impacts on the livelihoods of Basotho. Government has also embarked on a programme to promote the use of solar panels to minimise wood consumption through the Lesotho Renewable Energy-Based Rural Electrification programme, especially for communities far away from the national grid (LMS, 2013). Lesotho's electricity supply is already amongst the greenest in the world, with almost all demand being

satisfied by hydropower. Increasing demand for energy means that Lesotho will need to invest in expanding current hydroelectric supply. Other renewable energy sources, including water and wind, have the potential to be particularly important in supplying rural areas that are not connected to the electricity grid (IMF, 2012).

The government of Lesotho, being a state party to the UNFCCC, has undertaken certain mandatory activities pursuant to its obligations under the Convention. These include participation in UNFCCC Processes-Initial Communication – GHG inventories; mitigation and adaptation measures; and the development of NAPAs. The country has also adopted the NAPA as one of the key elements for national poverty reduction. The Lesotho NAPA process was instituted under conditions of extreme challenge, with the nation facing exponentially rising levels of poverty that have depressed livelihoods at their survivalist point. Climate-change-induced poverty remains a major challenge, for now and the foreseeable future. The key objectives of the NAPA process entail identifying communities and livelihoods most vulnerable to climate change, generating a list of activities that would form a core of the NAPA, and communicating the country's immediate and urgent needs and priorities for building a capacity for adaptation to climate change (LMS, 2001).

4.6.1 Policy context of Lesotho

In the late 1970s and early 1980s, Lesotho began to implement policy reforms that, although not directly related to climate change, have been found to affect both mitigation and adaptation strategies. These reforms include the promotion of renewable energies, the introduction of biogas projects, the introduction of an afforestation programme, water development, sanitation improvement, the formulation of new agricultural policies and environmental regulation, as previously stated (LMS, 2001).

The incorporation of environmental concerns in economic development ensured that sustainable development was the guiding principle for the publication of the Brundtland Commission's report. The road to achieving sustainable development for Lesotho started with the United Nations Conference on Environment and Development, and the formulation of the National Environmental Action Plan. Sustainable development has been refined and modified by subsequent documents, such as the National Paper on Environment and Development in Lesotho (1992) (KOL, 1992), the National Action Plan to implement Agenda 21 and the National Environment Policy (1996).

4.6.2 Lesotho National Environmental Policy

The mission statement in the Lesotho National Environmental Policy, developed under the auspices of the National Environmental Secretariat of the Department of Tourism, Environment and Culture, is "to promote and ensure that the present and future development of Lesotho is socio-economically and environmentally sustainable". Elements of this policy relate to toxic and hazardous substances; sanitation and waste management; and air pollution (MoH, 2012). In June 1989 Lesotho published its first National Environmental Action Plan (NEAP), a document laying down the framework for the conservation and sustainable utilisation of Lesotho's natural resources (Machepha, 2010). The NEAP refers to the integration of environmental considerations into the planning and decision-making process for social and economic development and for the implementation of Agenda 21 (UNCCD 2nd National Report, Lesotho). Subsequent to the NEAP, the National Adaptation Plan to implement Agenda 21 was launched in May 1994; this Plan will build on the foundation of the NEAP and will incorporate sectoral priorities and national plans for implementing international conventions on biodiversity, climate change and combat desertification (NFP update-information as of 2004: 2008).

a) National Adaptation Programme of Action

The UNFCCC has recognised the specific needs and special situations of least-developed countries, and consequently COP 7 decided to implement NAPAs to assist least-developed countries to identify priority activities that would respond to their needs to adapt to climate change. The main content of NAPAs is a list of ranked priority adaptation activities and projects, as well as short profiles of each activity or project, designed to facilitate the development of proposals for implementation of the NAPA. The development of NAPAs represents a multi-sectoral approach to climate change, and this approach will ensure that solutions in one sector do not affect other sectors (Khaketla, 2012). To support a work programme to assist least-developed countries carry out the preparation and implementation of NAPAs, the Least Developed Countries Fund was established, and the Nairobi Work Programme was initiated. The objective of the latter is to assist countries, in particular developing countries, to improve their understanding and assessment of impacts, vulnerability and adaptation, and for the developing countries to make informed decisions on practical adaptation actions and measures in response to climate change, on a sound scientific, technical and social basis, taking into account current and future climate change and variability.

Another fund, the Adaptation Fund, was established to finance concrete adaptation projects and programmes in developing countries that are parties to the Kyoto Protocol. The Fund is financed with a share of proceeds from CDM project activities. It has not yet become fully operational (UNDP, 2010).

The Lesotho NAPA process was undertaken under conditions of extreme challenge when the nation is facing exponentially rising levels of poverty that have maintained livelihoods at their survivalist point (LMS, 2001).

b) National Action Programme on Climate Change

Lesotho initiated a project enabling activities for the implementation of UNFCCC with the assistance of UNEP, and obtained funding for this project from the Global Environment Facility, which is a financial mechanism of the UNFCCC jointly implemented by the World Bank, UNDP and UNEP. The main objectives of this project are to assist Lesotho to meet its obligations under the UNFCCC, and to lay down a framework for the formulation and implementation of a National Programme of Action on Climate Change (NAPCC). The development of NAPCC took place in stages that involve multi-disciplinary inputs which are marked by the following clearly identifiable activities: public awareness campaigns, compilation of inventories of GHG emissions, vulnerability assessments, and the assessment of policies and mitigation and adaptation measures. The development of NAPCC has therefore been a process that incorporated findings of activities listed above and, together with the active participation of major stakeholders, undertook in-depth assessments of the level of GHG emissions in Lesotho and vulnerabilities of the country to the impacts of climate change, and mapped out various sectoral mitigation and adaptive options, including reviews of reports of the national study team and consultants. The plan therefore represents real national aspirations and priorities, with sectoral inputs. This was done through broad consultation, as well as through a national conference to which a draft national action plan was presented for in-depth review by major stakeholders, including NGOs and the private sector (MoNR, 2000; National Investment Brief, 2008). Therefore, the NAPCC will form a very important input in the preparation of Lesotho's seventh development (MoNR, 2000).

c) African Adaptation Programme

Lesotho has been identified as one of those countries most vulnerable to climate change worldwide, therefore the AAP seeks to ensure that climate change risks are addressed (UNDP, 2012). Through the support of the AAP, Lesotho acquired complex technological and wide-ranging intellectual capacities necessary to identify and understand its vulnerability to climate change. This enhanced capacity facilitated the undertaking of analyses of the country's vulnerability in the health and energy sectors. Early warning systems have been installed and monitoring of diseases related to climate change was established. The new technology is also being used by the Lesotho Meteorological Service, to provide better weather forecasts and long-term analysis (Phuroe, 2015).

Because of its high elevation Lesotho is heavily influenced by a variety of competing weather systems. The observed and anticipated impacts of climate change are likely to affect agricultural production and livelihoods, as more that 80% of the population in Lesotho are farmers who depend, at least to some extent, on subsistence agriculture for their livelihood. Basotho farmers have been adopting innovations and practices introduced from outside since the arrival of the missionaries in the 19th century, and have used these innovations to improve their agricultural production. However, the lack of access to modern technologies and farming methods, including high-value crops and inorganic fertilizers, continue to hamper the realisation of food security. Lack of modern technologies notwithstanding, climate change effects have contributed to decreased crop yields as a result of the phenomena of poorly developing buds, pest infestation, drought, flooding and hail storms. The available arable land has decreased considerably for farming. Indigenous farming systems, like the Machobone Farming System, has, over the years, become popular among Basotho farmers, because it has proven to respond positively to consumer needs to food variety and security. The Machobone Farming Systemis an integrated organic farming system, which derives inputs from a crop-livestock combination, and involves a rational, labour intensive intercropping system using kraal manure/ash to improve soil fertility. The sustenance of fertility from the soil, which slowly releases nutrients for crops and conserves soil moisture content caused by application of the Machobone Farming System, improves farming techniques which in turn, helps communities to become more resilient to impacts of climate change (Mekbib *et al*., 2011).

Despite the initiatives taken by Lesotho, the country does not have a long-term national adaptation plan for climate change. Thus, there is an urgent need for financial support to complement the

ongoing processes of policy development and to take the process further, to the development of an adaptation plan and research. Adaptation barriers in Lesotho are the lack of tools and techniques, which may contribute to rural communities and/or farmers not being able to adapt to impacts of climate change. Also, the urgent need for adaptation plans is felt most by rural, low-income subsistence farming households and communities.

4.7 CONCLUSION

Climate change is a global problem and responses require global cooperation, especially to help developing countries adapt to the adverse effects of climate change. Developing countries, particularly the poorest segments of society within these countries, cannot avoid the impacts of climate change because they lack financial support or have limited resources available to counteract the effects of climate change. Furthermore, climate change affects the natural resource base of a country, which, in turn, leads to a decrease in agricultural productivity, placing an additional burden on poorer nations.

Chapter 4 discussed policies and strategies have been designed and implemented to reduce vulnerability caused by the effects of climate change, also in Lesotho. The country has implemented several appropriate measures to assist the country to adapt to the impacts of climate change. However, the success and sustainability of many measures is largely dependent on the availability of donor funding.

Chapter 5 will deal with the methodology used in the study.

CHAPTER 5. RESEARCH METHODOLOGY

5.1 INTRODUCTION

In this chapter, the methodology of the study will be outlined. The following aspects will receive attention: the research design, sampling methods used for the study, the data collection procedures, data processing and analysis.

5.2 RESEARCH DESIGN AND METHODOLOGY

The study followed a mixed-methods approach that consists of both quantitative and qualitative data-gathering techniques. Mixed-methods research is defined as a procedure for collecting and analysing both quantitative and qualitative data in the research process within a single study with the purpose of gaining a more in-depth and holistic understanding of a research problem (Creswell, 2012a; Driscoll *et al*., 2007).

Qualitative research is an approach used for the collection, analysis and interpretation of data on phenomena that are not easily reduced to numbers (Babbie, 2011). Qualitative methodology is increasingly being used in the field of social research as a means to harness and explore the lived experiences of the research participant (Tufford & Newman, 2010). Quantitative research, on the other hand, is an approach used for testing theories by examining the relationship among variables (Creswell, 2012b). The mixing of these two methods in this study helps diversify viewpoints and cast light upon issues of climate change in the context of Lesotho by gathering data from different sources of information (Brennen, 2013; Creswell, 2012b; Weinreich, 2006).

Table 5.1 outlines how the different approaches (qualitative and quantitative) link with the objectives of the study

Table 5.1: Approaches employed to investigate the objectives of the research

OBJECTIVE	APPROACH EMPLOYED	METHOD OF DATA COLLECTION
To assess the impacts of climate change on the population of Lesotho	Quantitative and qualitative	• Literature review • Questionnaires • Focus-group discussions
To explore current national policy framework to address issues of climate change in Lesotho	Qualitative	• Literature review • Key-informant interviews
To identify gaps between the needs of subsistence-based farmers and the current national policy framework for climate change in Lesotho	Quantitative and qualitative	• Questionnaires • Key-informant interviews • Focus-group discussions
To make recommendations to improve the effectiveness of current mitigating and adaptation measures put forth by the Lesotho government in dealing with the impacts of climate change	Interpretation based on the analysis of the data collected	

By achieving the objectives listed in Table 5.1, the overarching aim of the study, which is to explore the resilience of the population of Lesotho with regard to the impacts of climate change, could be achieved effectively.

5.3 SAMPLING

Two populations were included in the study, namely, key informants from institutions and government departments that are actively involved in addressing the issues of climate change in Lesotho (these interviews aimed at achieving the second and third objectives[10]), and households reliant on agriculture for their livelihoods (focus-group discussions and a household survey aimed at answering the first, second and third objectives[11]). The sampling of each of these populations will be discussed in turn.

[10]See Chapter 1, Paragraph 1.5.

[11]See Chapter 1, Paragraph 1.5.

5.3.1 Key informants

To achieve the aim and objectives of the study, it was necessary to include all organisations that are involved in addressing the issue of climate change in Lesotho. In identifying key organisations to approach for interviews, the researcher read literature and consulted with government bodies and NGOs in Lesotho. The sampling technique utilised for selecting the key informants for interviews was purposive sampling, where the institutions to be interviewed were deliberately selected by the researcher based on own knowledge of institutions involved in addressing issues of climate change in Lesotho. Purposive sampling is defined as a type of non-probability sampling, in which the units to be observed are selected on the basis of the researcher's judgement about the units that will be the most representative and appropriate for the purposes of the study (Babbie, 2011). Respondents of organisations that took part in the key-informant interviews suggested other institutions that they thought were relevant for the study. Thus a snowball sampling technique was also employed. Snowball sampling is a technique employed in field research, whereby each person interviewed is asked to suggest additional people for interviewing (Babbie, 2011).

5.3.2 Households reliant on agriculture for their livelihoods

For the purpose of assessing the nature and extent of the impacts of climate change on the livelihoods of Basotho, to assess how resilient rural households are to the impacts of climate change, and what their needs in terms of mitigation and adaptation are, households reliant on agriculture for their livelihoods were identified as another population in this study. For this specific population a multi-stage sampling technique was used. First, an existing demarcation of Lesotho into five different ecological zones – mountains, foothills, southern lowlands, northern lowlands and the Senqu River valley (Figure 5.1) – was obtained.

The foothills are agriculturally highly productive because of the rich volcanic soils, and the mountainous zone is characterised by shrubs, grasslands and marshlands. The northern lowlands contain most of the arable land, the southern lowlands are characterised by flat plains with desert-like characteristics, and the soils of the Senqu River valley are thinly covered due to overgrazing. Trees and shrubs dominate the vegetation in this zone (DMA, 2012).

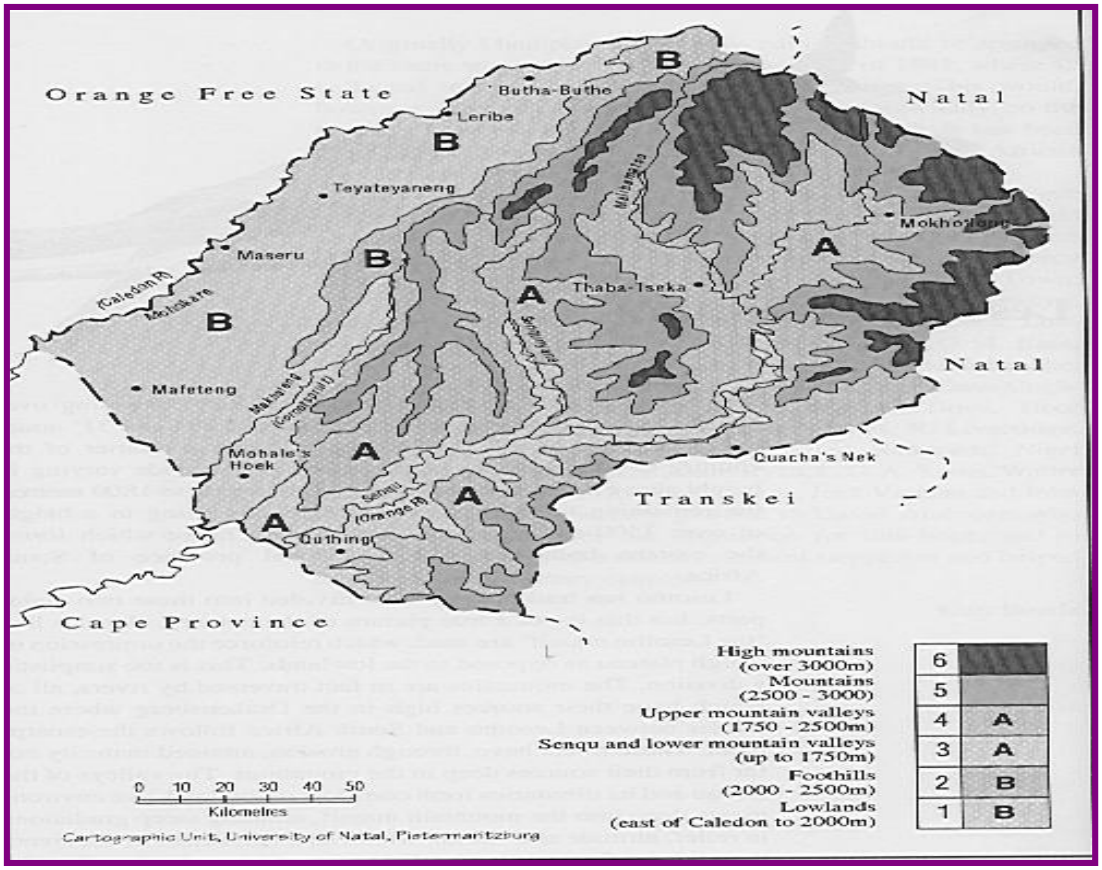


Figure 5. 1: Demarcation of Lesotho into five ecological zones

Source: NUL, 1998.

Thereafter, the second stage was to select an administrative district randomly to represent each ecological zone. All the districts were chosen from the map (Figure 5.1) of Lesotho that shows the districts in the five ecological zones. One district had to be selected for each ecological zone because each zone may experience the impacts of climate change in a different way. The selection of districts in each ecological zone was done through the purposive sampling method. The criterion used for selecting the districts in each ecological zone related to accessibility, mainly because of time and financial constraints.

The third stage involved selecting one village in each district. The villages were purposively selected on the basis of their location within the particular district. What the researcher considered when selecting a village was accessibility (because of time constraints), the size of the village and if the villagers had access to agricultural land, especially fields within the village. The researcher set out to find people who were able and willing to provide information by virtue of their

knowledge and experience. Lastly, using simple random sampling[12], 25 households were selected in each village;[13] this method was used so that every household in the selected districts had the same chance of being selected for the study. Depending on the size of the population of each village, the researcher divided the population by the sample size to obtain the sampling interval. For instance, if there were 100 households in one village, then the researcher and her assistant selected every fourth house from a set point. The outcome of the selection process is depicted in Table 5.2.

Table 5. 2: Selected villages by district by ecological zone

ECOLOGICAL ZONE	DISTRICT	VILLAGE	NUMBER OF HOUSEHOLDS	NUMBER OF HOUSEHOLDS IN THE SAMPLE (*N*)
Mountainous zone	Qacha's Nek	Sehlabathebe	401	25
Senqu-River valley	Quthing	Ha Ntho	118	25
Northern lowlands	Mafeteng	Motsekuoa	190	25
Foothills	Maseru	Thaba Bosiu	117	25
Southern lowlands	Leribe	Ha Maqele	401	25

5.3.3 Focus groups

Focus-group discussions were also conducted with farmers from sampled households in the three villages selected. After the household interviews had been conducted, the researcher contacted the local chiefs to help identify farmers with whom to conduct focus groups. The chiefs were consulted because they had to provide permission for the research team to enter the villages, and chiefs have information about the people who live in their villages. The farmers who were selected to take part in the focus-group discussions were individuals who produced mainly for subsistence, though they did sell their some of their produce to members of their community. Thus, purposive sampling was employed to select participants for the focus-group discussions. The purpose of the focus-group discussions was to give the researcher more in-depth data and build on the data obtained during

[12] A simple random sample is a sample design in which selections are drawn from a population in a way that gives every member and every combination of members an equal chance of being selected (Jensen & Lawrie, 2016).

[13]A village refers to a small human settlement with a few hundred people located in a rural area.

the household interviews. Three groups of about five to 10 members, all farmers, were held; one group (Quthing, Ha Ntho) represented the south, one (Maseru, Thaba Bosiu) represented the central region and another (Leribe, Maputsoe) represented the northern region. These groups comprised both male and female farmers. Focus-group discussions were not held in Qacha's Nek and Mafeteng during the second visit to the villages because, in Qacha's Nek, the researcher failed to get hold of the chief in spite of attempts to communicate with him before arriving at the village, and, in Mafeteng, the researcher arrived at the chief's house but the farmers who had been asked to attend the focus-group discussion did not turn up.

5.3.4 Data collection

Data was collected through various data collection methods, which are discussed below.

a) Literature review

Relevant data was retrieved from secondary and documentary sources for review and analysis, with the view of providing general background, informing the development of the research instruments, enriching the analytical framework and triangulating the findings of the empirical part of the study. This review included policy documents, previous research and any other documents that were deemed relevant for this study, in particular for assessing whether there are specific policies, laws and strategies in place that address issues of climate change mitigation and adaptation with the aim of reducing vulnerability of rural households to effects of climate change in the country.

b) Key-informant interviews

Institutions that work with issues relating to climate change were identified and interviewed using a semi-structured interview schedule.[14] The institutions included in the key-informant interviews are the following:

i. *Department of Meteorological Services in the Ministry of Natural Resources,* as a starting point to obtain information on the effects of climate change on the population of Lesotho, their coping mechanisms and the effectiveness of these mechanisms.

[14]Refer to Appendix A.

ii. *The Ministry of Agriculture and Food Security*, to establish the effects of climate change on the agricultural sector (crops production and livestock rearing); and coping mechanisms and their effectiveness in Lesotho.

iii. *United Nations Development Program (UNDP)*, to establish what the organisation is doing to assist rural households and farmers to adapt to climate change; to find out from the organisations what climate change policies that have been put in place to help rural households adapt to climate change; and to find out which climate change treaties Lesotho has ratified in adapting to climate change.

iv. *CARE Lesotho*, to establish how this international organisation is assisting farmers and rural households to adapt to climate change.

v. *African Adaptation Programme (AAP)*, to establish how the organisation selected households for receiving subsidised seeds and other assistance to farmers to adapt to climate change.

vi. *Disaster Management Authority (DMA)*, the body that coordinates efforts to reduce disaster risks, was approached to determine the extent their effort, and whether their assistance has been successful.

vii. *Lesotho Network of Aids Services Organisation (LENASO)*, to find out the degree to which their interventions implemented in relation to social development have been successful (this organisation is engaged with issues of awareness creation relating to climate change).

Interviews with key informants were conducted by the researcher using an interview schedule and each interview was recorded using a dicta-tape recorder. Because each institution and government sector had a different approach to the issue of climate change and its impacts, the researcher implemented a less restrictive approach to data collection, to allow for in-depth discussion in relation to climate change impacts and policies for mitigation and/or adaptation approaches. Therefore, the measuring instrument used was a semi-structured interview schedule. Interviews took between one hour and one-and-a-half hours to complete and were conducted after data had been collected from households. The focus-group discussions with farmers took place after the key-informant interviews had been conducted. The reason for this sequence was that the researcher derived some of the questions for the key-informant interview schedule from the focus-group discussions as a way of determining whether there were gaps between the needs of farmers and

other stakeholders, and the policy and decision-making framework currently in play in Lesotho. While 10 institutions had been approached initially, seven interviews were conducted, as not all institutions were willing to cooperate.

c) Interviews with households[15]

A survey was conducted at the household level among people engaged in subsistence agricultural production. A structured questionnaire was developed covering the following topics:

i. *Household demographic information* – It was necessary to collect information from the respondents on their status within the household as this would indicate the level of reliability of information provided. Information on age, gender and the age distribution within the households provided an indication of the level of dependency within the households.

ii. *Sources of income for the household* – This information was necessary as it points to the level of vulnerability of such households to impacts of climate change.

iii. *Agricultural information* – Most Basotho, especially in rural areas, rely on subsistence farming to meet their daily food needs. Therefore, it was important to establish whether the selected households had access to arable land, the size of the land, the types of crops cultivated and for how long, size of the harvest and how produce is used.

iv. *Climate change* – The researcher wanted to understand the respondents' point of view about and experience of changing climate patterns, and their understanding of its effects on agricultural production.

v. *Adaptation to climate change* – It was important to understand how farming households adapt to the impacts of climate change on their agricultural activities.

In total, 125 interviews were conducted. The researcher interviewed the households over five days with the aid of three research assistants. By gathering this information, the researcher is able to, from the perspective of the farmers directly affected by changing climate patterns, achieve the overarching aim of the study, which is to determine the overall resilience of the population of Lesotho to the impacts of climate change.

[15] The questionnaire is attached in Appendix B.

d) Focus-group discussions

Focus-group discussions were conducted to obtain more in-depth data on the study question. The data collection instrument used for the focus-group discussions was an unstructured interview schedule, which allowed respondents to lead the researcher into the questions that needed to be answered. Between five and 10 people took part in each focus-group discussion, which were held at the chief's office in three of the villages. All focus-group discussions were recorded with the help of an assistant.

5.4 DATA PROCESSING AND ANALYSIS AND REPORTING

All data collected through the questionnaire survey was entered into a Microsoft Excel spreadsheet and analysed statistically and descriptively. The information collected through the key informant interviews and focus-group discussions was analysed thematically and used to corroborate and complement the quantitative data obtained from the household survey. The data collected was informed by the problem statement and answered the set objectives of the study.

5.5 LIMITATIONS OF THE STUDY

Some challenges were experienced in the execution of the study due to lack of cooperation from some key informants, such as FAO and WFP. It was necessary to interview both these key informants to obtain their opinions and suggestions because they are also stakeholders when it comes to dealing with the impacts of climate change in Lesotho. In spite of several attempts these key informants could not be interviewed.

In spite of the local chiefs having notified farmers in good time about the public gathering that would include a focus-group discussion, some of the farmers decided not to participate. Consequently, a limited number of farmers participated in the focus-group discussions.

Because of the inaccessibility of some of the villages, money and time were constraints.

5.6 DISSEMINATION OF FINDINGS

The dissertation will be one of the primary ways in which the researcher will disseminate the findings. Furthermore, the findings will be disseminated by means of presentations, presenting

copies of the study finding to relevant stakeholders, and submission of articles based on the findings to accredited academic journals.

5.7 ETHICAL CONSIDERATIONS

According to Neuman (2005) any research study should address ethical considerations so that any possible concerns, dilemmas or conflicts that may arise during the execution of the research can be identified and addressed in an ethical manner. The researcher therefore took the time to understand and consider the following ethical matters:

The first ethical consideration was that of anonymity in the case of the questionnaire survey. The farmers who responded remained anonymous and because no names appear on the questionnaires it would not be possible to link a specific questionnaire to a specific respondent.

Respondents were properly informed about the research and the researcher obtained their consent prior to data collection. The consent was obtained from the respondents verbally.

The key informants consented that their names being recorded during the reporting phase of the study, with the exception of one key informant, who did not consent to his name being used.

With the focus-group discussions and household questionnaires, the village chiefs were informed about the research taking place and they gave permission for the data to be collected within the villages.

5.8 CONCLUSION

This chapter provided an overview of the research design, and outlined the methodology and the sampling techniques used. Various data-collection methods were used, namely, a literature reviews, focus-group discussions, household interviews and key-informant interviews. The way the data was processed and analysed was also discussed. In Chapter 6 the findings of the study will be presented.

CHAPTER 6. DISCUSSION OF THE FINDINGS

6.1. INTRODUCTION

In this chapter, the findings of the study are discussed. The first part of the chapter deals with physical description of the country in terms of its location, and its environmental description. This is then followed by a brief description of the socio-economic situation in the country, after which the study results are discussed.

6.2 PHYSICAL AND ENVIRONMENTAL DESCRIPTION OF LESOTHO

6.2.1 Physical description

Lesotho is a landlocked country that is surrounded by the Republic of South Africa and which covers an area of about 30 558 km^2. It is situated approximately between 28°S and 31°S latitude, and longitude 27°E and 30°E (LMS, 2013). The elevation above sea level varies from 1 388 to 1 800 metres above sea level in the lowlands, to 3 482 metres above sea level at Thabana-Ntlenyana in the Maluti Mountain ranges. Mountain ranges run from north to south and form a high plateau in the north, where height varies from 2 700 m to 3 400 m, as depicted in Figure 6.1. Two of the largest rivers in southern Africa, the Orange (Senqu) and the Tugela, have their origins in these mountain ranges (GoL, 2013).

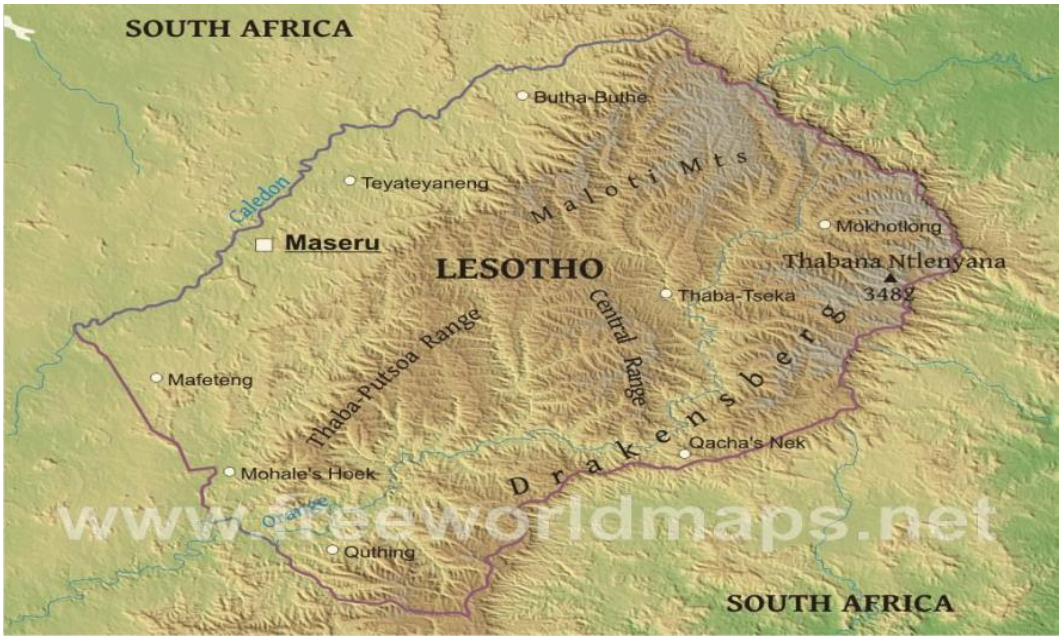


Figure 6. 1: Geographical location of Lesotho

Source: Free World Map, n.d.

Lesotho's geology derives from the Karoo sedimentation that began forming from the carboniferous to the middle era of the Jurassic period (MoNR, 2000). The country is underlain by sediments and basaltic lavas of the Karoo Supergroup. These basaltic lava flows attain a thickness of at least 1 600 m and characterise the mountain region. The basalt capped the underlying sediments during the tectonic evolution of the area in the early part of the Jurassic Period, some 190 million years ago (Marake *et al.*, 1998). The Karoo basin is characterised by the headwaters of the Orange (Senqu) River and its tributaries, which drain in a north-southerly direction; together with an extensive network of mountain wetlands that form an important segment of the southern African region's water sources (MoNR, 2000).

6.2.2 Climate

Lesotho's climate is described as continental and temperate; it is highly influenced by seasonal and geographical variations (Chakela, 1997; LMS, 2001). Temperatures are highly variable on diurnal, monthly and annual time scales. Mean winter temperatures range from 6.3°C in the highlands to 5.1°C in the lowlands; extreme monthly mean winter temperatures can be as low as -10.7°C, while daily winter minimum temperatures can drop to as low as -21°C in the highlands, for example, in areas such as Qacha's Nek. In both the lowlands and highlands, sub-zero daily

minimum temperatures can also be experienced in summer (Moeletsi, 2004). During winter months, the country is vulnerable to frost and heavy snowfall. There is lower rainfall in spring, higher precipitation in winter, and gradually increasing precipitation in autumn, varying from one ecological zone to the next. The average rainfall in Lesotho ranges between 500 and 800 mm per year in the lowlands and over 1 000 mm in the highlands. Lesotho receives about 80% of its total annual precipitation during the summer season from October to April (Calles & Kulander, 1994).

As a result of climate change the country is expected to experience changes in temperature and precipitation patterns, to dryer and warmer conditions. The western and northern lowlands are already experiencing the intensity and frequency of extreme weather events, such as floods and drought, which are expected to increase (Dill, 2011).

6.2.3 Ecological zones

There are four ecological zones in Lesotho: the lowlands, foothills, highlands and the Senqu River Valley; each has distinct characteristics, as shown in Figure 6.2.

The lowlands of Lesotho occupy 17.0% of the total land area, and form a narrow belt along the western border of the country, between 1 388 and 1 800 m above sea level. This region has a relatively flat topography compared to the rest of the country. The foothills occupy 15.0% of the land surface and form a narrow strip between the lowlands and the highlands. These foothills lie between 1 800 and 2 000 m above sea level. The Senqu/Orange River valley runs from the northeast to southwest of the country and it occupies 9.0% of the country's surface area. The highest point of the Senqu River valley is at 2 000 m above sea level, and drops to 1 388 m above sea level where it enters South Africa. The highlands, which comprises the Maluti mountain range, starts at 2 000 m above sea level and elevates to 3 482 m above sea level. The highlands occupy 59.0% of the land area.

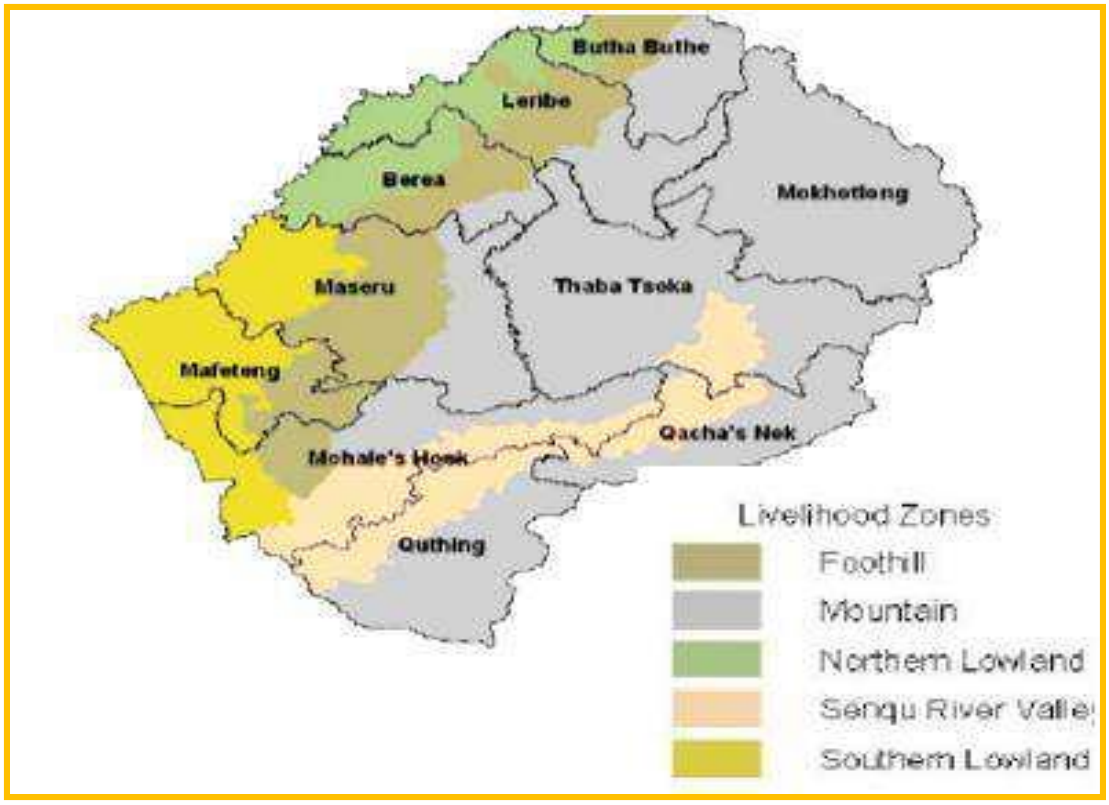


Figure 6. 2: Ecological zones of Lesotho

Source: ECB, 2012.

Table 6.1 shows the agricultural productivity of the different zones. The foothills, which lie in the Leribe, Berea, Maseru and Mafeteng districts, consist of hills and low-lying areas that provide suitable arable land and grazing for livestock. Droughts and livestock diseases are the main environmental hazards that affect the livelihoods of local communities living in the foothills (ECB, 2012). The highlands are found in the following districts: Mokhotlong, Butha-Buthe, Leribe, Berea, Maseru, Mohale's Hoek, Quthing, Qacha's Nek and Thaba Tseka. In the highlands, the vegetation consists mainly of shrubs, some grasslands and marshlands. Crop farming is less productive here due to poor soil quality – the soil is highly erodable (ECB, 2012). The headwaters of the Senqu River and its tributaries are found in the highlands. Poor drainage systems in the highlands are partly attributed to visible deep river valleys, gorges and gullies that adversely affect livelihood generation for local communities (LMS, 2013).

The northern lowlands are in the area in Butha-Buthe, Leribe and Berea. The zone occupies most of the arable land in the country, and it is thus regarded as the grain basket of Lesotho. This zone normally receives very good rainfall, both in terms of timing and quantity, making it highly suitable for crop production (Silici, 2010). The southern lowlands cover quite a large proportion of Maseru, Mafeteng and Mohale's Hoek districts, along the Mohokare and Makhaleng Rivers in the southern part of the country. This zone is characterised by flat plains with desert-like characteristics, such as shrubs and rangelands. There is significant land degradation in the area, partly due to poor conservation practices, that have greatly reduced prime agricultural land in the zone.

The Senqu River Valley covers four districts, namely, Mohale's Hoek, Quthing, Qacha's Nek and Thaba-Tseka. Overall crop production is low here compared to neighbouring zones due to poor soil fertility and unfavourable rainfall patterns. The soils in this zone are relatively thin, with little vegetation cover due to overgrazing (DMA, 2012).

Table 6. 1: Ecological zones of Lesotho

Ecological Region	Area (km^2)	Altitude (metres above sea level)	Characteristics
Lowlands	5 200 (17%)	1 388-1 800	Narrow arable belt along western border with very fragile soils and low rainfall. Low agricultural potential in the southern lowlands, with the northern lowlands being more agriculturally productive.
Foothills	4 533 (15%)	1 800-2 000	Rich volcanic soils with agricultural potential.
Mountains	17 910 (59%)	2 000-3 482	Bare rock outcrops, deep river valleys and gorges suitable mainly for grazing. Agriculture is less productive.
Senqu River Valley	2 732 (9%)	1 000-2,000	Mainly poor soils with low agricultural potential.
Lesotho	30 375 (100%)	1 388-30482	

Source: BoS, 2008; LMS, 2001.

Overall, Lesotho is characterised by a fragile environment, and this fact contributes to severe environmental degradation, mainly in the form of soil erosion. Soil erosion constrains agricultural

production severely and limits the ability of local communities to generate adequate livelihoods. It is estimated that the country now has less than 10.0% arable land left (FAO, 2010). One form of erosion, gully erosion, is depicted in Figure 6.3.

Figure 6. 3: Gully erosion

Source: Molaoa, 2012.

Because of land degradation in Lesotho nearly a quarter of the population is vulnerable to food insecurity (ECB, 2012; UNDP, 2011). The effect of land degradation is exacerbated by the impacts of climate change. Increased frequency of weather hazards, such as drought and floods, as a result of climate change affect agriculture-based livelihoods negatively.

6.2.4 Socio-economic situation of Lesotho

- **Demographic profile**

The total population of Lesotho is 1 942 008, with people aged 0-14 years constituting 32.9% of the total population, indicating that there is a relatively large proportion of the population that is economically dependent. Another 20.0% of the population is aged between 15 and 24 years, while the age group 25-54 years constitutes 36.8% of the population. Around 5.0% of the population is

aged between 55-65 years, while 5.9% of the population is 65 years and above. In 2015, there were 98.01 males per 100 females (World Data Atlas, 2015).

- **Poverty**

About 65.0% of the population of Lesotho live below the poverty line of US$1 per day, and 40.0% of them are classified as ultra-poor[16] (Pederson, 2007). The majority of the people of Lesotho lives in rural areas (82%) and the majority (86%) of the population are at least partly dependent on subsistence agriculture (Ransom, 2015).

One of the factors contributing to ever-increasing poverty levels in Lesotho is the decline in the number of Basotho who are employed in South African mines. Lesotho was, for many years, a preferred source of mine workers for South African mines, and in 1990 around 127 000 Basotho were employed in South African mines. By 2010 the number of mine workers from Lesotho was estimated to be fewer than 43 000 due to retrenchments in the mining sector (Cobbe, 2012; FAO, 2010; Nseera & Bhatia, 2014; Rosenberg & Weisfelder, 2013; Silici 2010). Meanwhile, agricultural output has fallen by 40% in the last 20 years, and few returned migrants have access to good agricultural land (Cobbe, 2012).

Agricultural activities account for 7% of the country's gross domestic product (ILO 2012). National statistics show that in 1999 approximately 68.6% of the labour force was engaged in subsistence agricultural activities, up from 50% in 1997. In 2012, subsistence agriculture continues to be the mainstay of the country's livelihoods, though the number of people engaged in agricultural activities has decreased to 40.6% (ILO 2012).

Another factor compounding the low levels of well-being in Lesotho is the HIV and Aids pandemic. In 2008, 23.2% of the population aged 15-49 years (UNDP, 2011) was infected with HIV. This is one of the highest infection rates in sub-Saharan Africa; Lesotho, in 2011, was ranked second in the world regarding HIV prevalence rate. Lesotho has the distinction of being the only country in southern Africa in which more men than women are HIV positive. This is a result of the relative affluence of former miners, who had often had no choice but to live in single-sex hostels. They could not take their families or partners with them, and they had limited home leave,

[16] According to Msangi (2010) the ultra poor are people living on less than US$0.50 a day.

which distanced them further. Living away from their partners under these circumstances lead to some workers seeking other (multiple) relationships. The high prevalence of poverty in Lesotho, combined with the impacts of HIV and Aids, especially among households residing in rural areas, who mostly engage in subsistence farming, restricts their ability to deal with the challenges posed by climate change (FAO, 2011; UNDP, 2011).

6.3 STUDY FINDINGS

This section discusses the results of the study. It commences with a discussion on the demographic profile of the respondents and their sources of income.

6.3.1 Profile of respondents

As mentioned earlier, the preferred respondents to the survey were household heads, or the spouses of the household head. In the case where the household heads, or their spouses, were not available, the researcher interviewed the oldest member of the family.[17] Female spouses of household heads comprised 81.0% of the respondents. Another 15.0% of the respondents were siblings of the head of the household, and the remaining 4.0% were the parents of the household heads. The high number of female spouses interviewed can be attributed to the fact that many of the male partners are employed elsewhere. In Leribe district, for example, 42 109 of the 298 352 people reportedly work outside the district of Leribe, with almost half (22 905) of those working outside the district residing and working in South Africa (Trillo-Figueroa, 2009).

6.3.2 Household sources of income[18]

As already mentioned, agriculture is predominantly subsistence-based, with the majority of farmers in Lesotho cultivating less than half a hectare of land. It is important to note that remittances from migrant workers who work in South African mines play a critical role in household incomes in Lesotho. Most families supplement their income from remittances through agricultural activities. However, retrenchments in the mining industry in South Africa means

[17] In this study, an adult member of a household is anyone between the ages of 18 and 65 years of age.

[18] Although agriculture could fall within the category of sources of income, it was deliberately omitted, as the following section deals with the matter of agriculture in detail. So, in order to avoid repetition, it was not included here.

diminished disposal income for many households in Lesotho. It is becoming ever more difficult for farmers to purchase agricultural inputs, and this has a negative effect on agricultural production in the country (LGNSP, 2009).

As shown in Table 6.2, in three of the districts (Maseru, Quthing and Qacha's Nek) less than 50% of the respondents indicated that salaries constitute their main source of income. In Leribe 80.0% of households had salaries/wages as the primary source of income, followed by Qacha's Nek, with 76.0%. However, Leribe and Qacha's Nek also had the highest number of respondents who indicated that they had no source of income, compared to the other districts. In Quthing and Maseru the households had more diverse sources of income than other districts, while households Qacha's Nek and Leribe had the least diversity in sources of income. This might mean that the populations in the latter two districts derive adequate income from salaries and wages to support their livelihood.

As mentioned, in Maseru district 48.0% of the households relied on salaries as their main source of income, whereas 32.0% of respondents mentioned their main source of income was an own business. Only 4.0% of the respondents in this district had no source of income. Maseru had the highest percentage (32.0%) of households that relied on businesses as a source of income. This could be because Maseru experiences a large inflow of migration due to opportunities that exist in this district as it is the main city of Lesotho. Some of these opportunities in income-generating activities include street vending and other small business enterprises. In Quthing 28.0% of respondents indicated that their own business is their main source of income. Mafeteng is another district with a significant number of households that derive their main source of income from their own businesses (22.0%). Maro (2011) found street vending of food to be a primary source of income for many households in Mafeteng. However, the results of this study also show that Mafeteng has the largest number of households that rely on pensions and casual employment to provide a primary source of income (16.7% and 16.8% respectively).

Table 6. 2: Main sources of income of households

Districts	Salary/ wage	Income derived from business	Gifts (in kind)	Pension	No sources of income	Casual employ-ment[19]	TOTAL
Quthing	40.0%	28.0%	12.0%	4.0%	4.0%	12.0%	100.0
Qacha's Nek	76.0%	0.0%	0.0%	12.0%	12.0%	0.0%	100.0
Maseru	48.0%	32.0%	4.0%	8.0%	4.0%	4.0%	100.0
Leribe	80.0%	0.0%	0.0%	8.0%	12.0%	0.0%	100..0
Mafeteng	38.9%	22.2%	0.0%	16.7%	5.6%	16.6%	100.01

6.3.3 Agricultural production

As mentioned in Paragraph 6.1, the topography, especially in the mountainous areas, is characterised by thin and highly erodible soils of varying fertility, which makes the country's farmers particularly sensitive to environmental impacts, such as the impacts of climate change. Land degradation has already seriously reduced the productive capacity of Lesotho's croplands and rangelands (FAO, 2011). It is expected that the impacts of climate change will reduce agricultural productive capacity in these areas further. This projection was supported by participants in the focus-group discussions, who stated that loss of biodiversity and evident soil erosion push Basotho farmers into poverty despite the efforts made by the Ministry of Forestry and Land Reclamation to curb environmental problems, such as soil erosion, in the country and to reclaim arable land (Matsipa, 2008). Therefore, in assessing impacts of climate change in Lesotho and to determine how resilient the population is to the impacts of climate change, it was necessary to focus specifically on agricultural production, and to determine how agricultural production is being affected by climate change. Topics to be addressed here include access to any form of agricultural land, crop production and whether the produce is sold.

[19]Casual employment (so-called *piece job*) with a flexible working arrangement, such as herding cattle, garden work or being employed at a construction site for a short period of time.

- **Access to agricultural land**

Most of the respondents in all five districts indicated that their households have access to agricultural land. The districts with the highest number of households without access to agricultural land were Quthing and Leribe, where 19.3% of households did not have access to agricultural land. These two districts were followed by Qacha's Nek (17.6%), Mafeteng (16.0%) and Maseru, with 15.8%. The main reason for not having access to agricultural land was because the household lived in rented accommodation and consequently did not have access to any additional land to use for agricultural production (Figure 6.4).

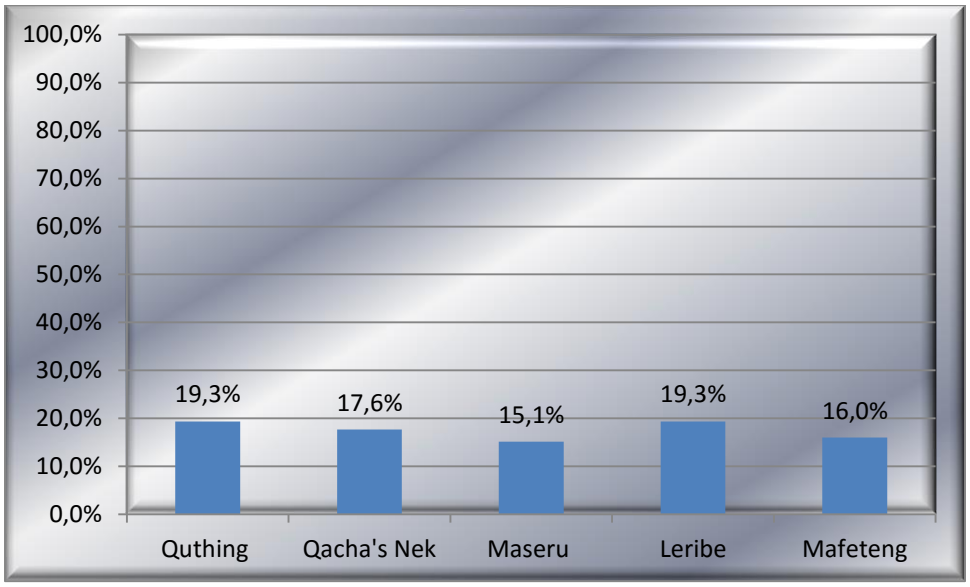


Figure 6. 4: Households without access to agricultural land

Poor households are less likely to have access to land resources and have limited resources to obtain new land. They are less likely to have the financial capital necessary to intensify their agricultural production through the use of new technologies or physical inputs, they cannot invest in new agricultural products and techniques in response to changing markets, and generally do not have the means to access those markets. Finally, poor households are less likely to have the financial and human capital necessary to migrate elsewhere in search of land or employment in response to limited local opportunities (Bremner *et al.*, 2010).

Although most households that were interviewed in the more urban district of Maseru had access to land, land available for agriculture is becoming scarce due to increasing urban growth (Mots'oene, 2014). Furthermore, loss of access to land occurs when people sell their land because of unemployment in Maseru. This threatens the livelihoods of poorer households in particular, as some depend on various forms of cooperation and sharecropping agreements to maintain some form of access to agricultural land (Daemane & Motšoene, 2012; Silici, 2010).

- **Type of land ownership**

In the districts of Qacha's Nek, Leribe and Mafeteng, all the respondents who had access to agricultural land stated that their households owned this agricultural land. In Quthing, access to land is divided between ownership (84.6%), share cropping[20] (11.5%) and rental (3.9%), while in Maseru 81.8% of the households who had access to agricultural land owned agricultural land and the rest of the households either rented land (13.6%), or used land belonging to friends and family (4.6%). Using land that belongs to someone else is part of social capital, by which land owners provide access to land to farmers; farmers, in turn, are expected to provide agricultural inputs in the form of labour (Figure 6.4). Figure 6.5 shows ownership and the size of the land farmed by respondents in the various districts.

[20]Share cropping is where arrangements are made with the land owner to farm on the land by bringing agricultural inputs and share with the land owner the produce according to agreed amounts.

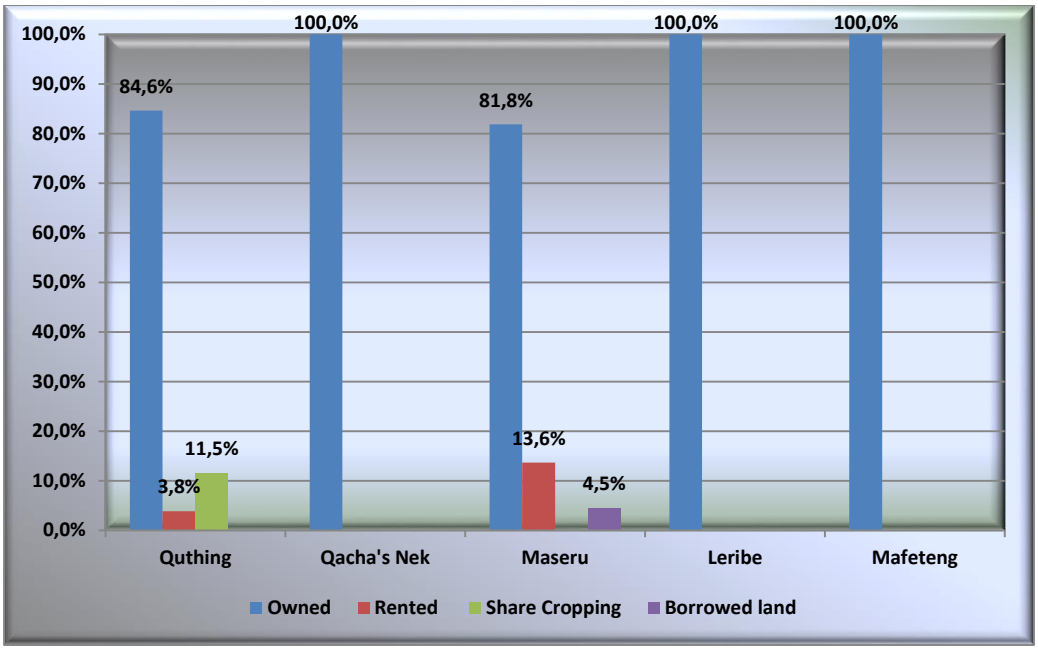


Figure 6. 5: Type of access to agricultural land

- **Size of agricultural land to which households had access**

Respondents were asked to estimate the size of the land their household had access to. The respondents found it difficult to indicate the size of the arable land they had access to. Most of the respondents estimated that they had plots of less than 10 hectares, while a large number had access to backyard plots.

The welfare of rural households varies significantly with the size of agricultural land available to them. The incidence of poverty is greatest among those with no land and those with the smallest plots, users of marginal lands and landless labourers (Saha, 2011). Half of the world's undernourished people, three quarters of Africa's malnourished children and the majority of people living in absolute poverty are living on small farms (Hazell *et al*, 2007).

- **Time farming on current land**

Respondents were asked to indicate the time their household has been farming on their current agricultural land, and 18.3% of respondents said they have been farming on the land for 21 years or longer. Almost a third, 30.4%, of respondents have been farming on their current land for

between 11 and 20 years, while 28.7% of households have been farming on their land for 5 to 10 years. A further 21.7% of respondents indicated that they have been farming on this land for less than 5 years (Figure 6.6). Maseru had the largest proportion of households who have been farming on their current land for less than 5 years (45.0%), while Leribe had the largest proportion of households (29.0%) who have been farming on the same land for over 30 years. Maseru is a more urban area with more migrants, which explains the large number of people who have been farming on a particular plot of land for less than five years. Leribe's large number of households who have been farming for more than 30 years can be indicative of an older population structure and a more rural-based population. Furthermore, Leribe lies in the northern lowlands, which occupy much of the country's arable land.

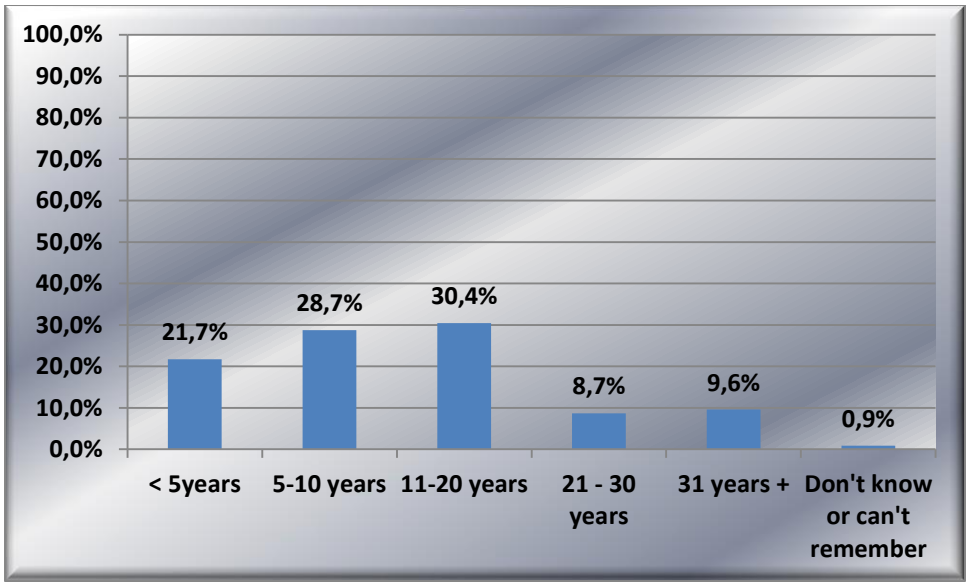


Figure 6. 6: Length of time farming on current agricultural land

- **Household crop production between 2005 and 2010**

Respondents were asked if they had grown crops between the years 2005 and 2010 and most of the respondents indicated that, in this period, crops had been grown in both fields and garden plots. Respondents who did not grow crops gave lack of finances to buy seed and fertilizer as the primary reason for their failure to grow crops in these years. Others gave changing weather patterns as

reason, and some respondents said they were too old to engage in any activities, let alone agricultural activities.

In Leribe, all the respondents said they used their land for crop production between 2005 and2010. Trillo-Figiroa *et al*. (2009) report that some regions of Leribe have deep, permeable soils, with potential for good agricultural production. This could be one of the major reasons why crop production in this district is high. In contrast, Maseru has the highest number of farmers who have been farming on their land for less than five years, and the district also had the lowest number of households that planted crops from 2005 to 2010. While the percentage of households that planted crops in Maseru is significant (81.8%), the district had the lowest number of households that grew crops between 2005 and 2010. This can, in part, be attributed to fact that, in Maseru, households have more opportunities for alternative income-generating activities that are not agriculture-based, as explained in Section 6.2.2.

- **Changes in crop production**

The main cereals grown in Lesotho are maize, wheat and sorghum, for both subsistence and commercial purposes. Lesotho has the largest consumption of maize per capita in the world (174 kg per person per year) and, although maize production has been on the decline in recent years, it remains the country's staple food (FAO, 2007; IITA, 2009). The majority of maize farmers are small-scale farmers with average yields of less than 1 tonne/ha per year. Maize production is more prevalent in the lowland areas, such as Maseru, Mafeteng and Leribe, than in the mountainous areas, such as in Qacha's Nek and Quthing. FAO (2006) indicates the four leading maize growing districts being Leribe, Maseru, Mafeteng and Berea. Most households in this study planted vegetables, such as cabbage, peas, pumpkins and sugar beans, in addition to cereals for household consumption.

Households experienced varying degrees of change in crop production. The two districts with the largest proportion of respondents who have experienced changes in crop production are Quthing and Mafeteng. In both cases 40% of respondents have experienced changes in crop production in the past 10 years. Both of these districts have experienced extensive spells of drought accompanied by desertification in these areas (Mary & Majule, 2009). Figures for Maseru are lower, because most of the farmers interviewed have not been working on their current land for longer than five

years. During the focus group discussions, farmers emphasised that they had experienced long dry spells and therefore had only planted climate-resistant crops in recent years, such as maize (cereal). In other areas, fewer respondents experienced changes in crop production. Households in Qacha's Nek (19.0%), had experienced the least change in the types of crops grown, followed by Leribe with 27.3%. The reasons why these districts experienced the least change in types of crops grown could be because the farming systems in Qacha's Nek district are dominated by livestock. Though some people in the district engage in crop production and could use the manure from the animals as fertilizer for their fields, every bit of dung that is collected is used for fuel purposes (Pederson, 2007). Where major agricultural activities occur in Leribe the land is characterised by rich, black soils or sandy loam and that may be a reason why there is less change in crop production than in the other districts (MoAFS, 2014).

- **Reasons for not engaging in crop production**

Although most of the households did use their land for crop production between 2005 and 2010, those who did not embark on crop production presented a combination reasons that were both socio-economic and environmental in character. During focus-group discussions, participants mentioned drought, which they believe they are experiencing due to changing weather patterns. The effects of changing weather patterns on crop production included small or even no harvests, soil erosion and too much wind, late and heavy rains, hail and snow.

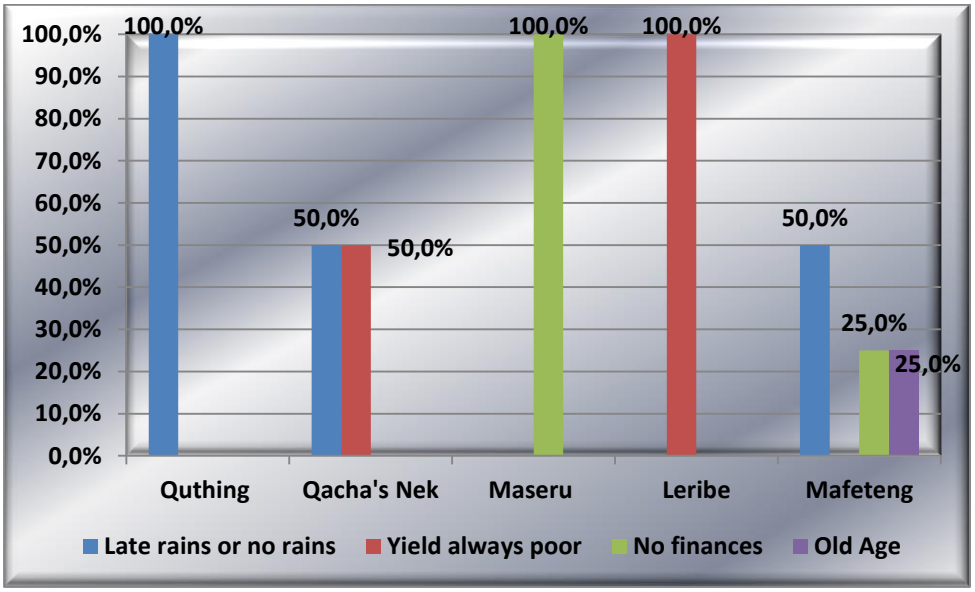


Figure 6. 7: Reasons for not growing crops

Results shown in Figure 6.7 confirm information collected through focus-group discussions, during which all the respondents who did not grow crops in Quthing attributed this to late rains or no rains at all. In Leribe, respondents who did not grow crops mentioned that they have been discouraged by poor yields, while in Maseru the respondents pointed to lack of money to purchase inputs as a factor. Respondents in Mafeteng mentioned three reasons, namely, late rains, no money and that some of the land owners regarded themselves as too old to engage in crop production. When it came to Qacha's Nek, the respondents mentioned late rains and low and poor yields as reasons why they did not grow crops. IRIN (2012) reports that many of the subsistence farmers in Lesotho had struggled to recover from heavy rains over much of the country in December 2010 and January 2011. This had had a devastating impact on crop production and livestock rearing. However, this event was, interestingly, not mentioned by the respondents of the study. One can deduce that factors such as later rains and dry spells affected crop production more significantly than heavy rains do. The case of drought in Lesotho is quite specific and relates to what is described as contingent drought, which occurs as a result of irregular rainfall, when the rain fails to fall over a period of time. Climate variability resulting in drought incidence is not new to Lesotho, considering that some regions are susceptible to low rainfall regimes. These regions are becoming drier at a rapid rate, occasioned by fast depletion of surface water, leading to changes in crop production (Obioha, 2010).

- **Sale of agricultural produce**

During focus-group discussions farmers stated that they have been experiencing weather patterns changing gradually over the years and that this has impacted negatively on their crop yield. Consequently, the produce from their land is not even enough to meet their household food requirements, let alone to sell. Indicative of the impact of changing weather patterns on crop production is that farmers mentioned that they have, in the past, produced enough to sell, but that their crop yields have declined to the extent that they now produce barely enough for household subsistence.

Some participants in the focus-group discussions mentioned that the last time their fields were ploughed was in 2008, and this is because late rains meant the ground was too dry. One of the participants of a focus-group discussion stated that he managed to produce enough to sell through

participation in block farming.[21] However, this was not profitable as there was no market for the produce, even though they do produce enough crops to sell and, in addition, they had no storage facility for grain.

Those respondents who said they sold part of their produce were asked to estimate how much they had received as income from sale of the produce per planting season.[22] As shown in Figure 6.8 the majority of households (63.0%) received income of less than M1 000[23] per month from the sale of their crops per planting season. Only 7.4% of respondents received income of more than M5 000. One reason why most of the respondents earned income of less than M1 000 per planting season could be the fact that, as discussed above, most of the households, especially those in the rural mountainous region, cultivate land of less than 0.5 hectares, which is already very small; difficulties faced by farmers are compounded by social, economic and environmental challenges that affect yields negatively.

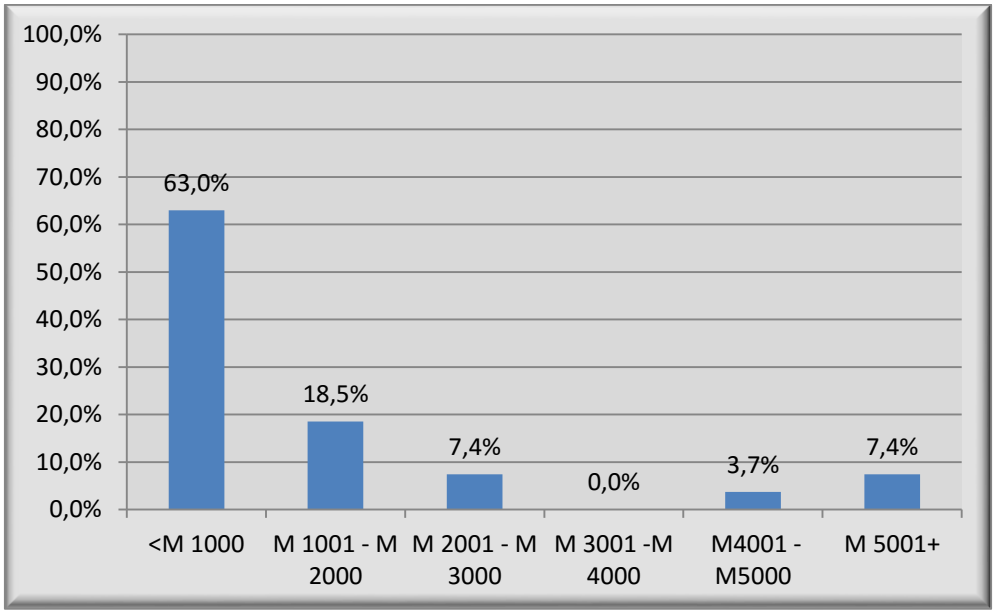


Figure 6. 8: Average income earned from selling agricultural produce per planting season

[21] Block farming is a programme funded by Standard Bank Lesotho, out of a loan fund that was guaranteed by the government of Lesotho. Under this programme the bank lent money to farmers to encourage the commercialisation of agriculture in the country.

[22] In Lesotho there are two main planting seasons, namely, winter and summer cropping seasons.

[23] M1000 is equivalent to US$60.60.

6.3.4 Indications of changing weather patterns

In Lesotho, where the majority of the population is, to a large extent, directly dependent on natural resources for survival, vulnerability to the negative impacts of climate change is high. These impacts directly and indirectly affect human welfare and, at times, sabotage efforts to promote sustainable human development and environmental recovery (Thobei *et al.*, 2014).

At a national level, higher temperatures, lower rainfall, more frequent droughts and rainstorms, and stronger winds, are identified as climate hazards that have an impact on the capacity of soils to support Lesotho's agro-ecological and socio-economic well-being (FAO, 2011; Maro, 2011). These impacts are on food security and livelihoods in the whole of Lesotho, but the southern lowlands and mountains of Lesotho were identified as the zones most vulnerable to the impacts of climate change (FAO, 2011).

Changing weather patterns are influenced by a number of factors, such as: i) the degree of exposure to climate stressors, and ii) the underlying sensitivity of the natural and social systems. Exposure includes climate variability both within and between years, the frequency, magnitude and duration of extreme climate events, such as droughts, floods, frost, hail, storm winds, heat waves, cold snaps, and long-term climate changes (rising temperatures, changing rainfall regimes).

More than 95.0% of the respondents in the districts of Quthing, Maseru, Leribe and Mafeteng indicated that they have observed changing weather patterns, while 72.0% of the respondents in Qacha's Nek attested to the same. The indications of changing weather patterns as identified during the focus-group discussions included increase in the intensity of windstorms, rain storms, floods, droughts, wild fires and changes in seasons i.e. delayed onset of summer.

Respondents observed that drought is one of the key issues with regard to climate-related impacts on agriculture, as indicated in Figure 6.9, and this, in turn, negatively affects crop production. In Quthing, 31.1% of the respondents indicated that drought is one of the primary impacts on crop production. Similarly, 26.2% of the respondents in Maseru and Mafeteng identified drought as one of the key impacts on crop production. These findings are in line with the global climate change models that predict lower precipitation under climate change, which would result in reduced surface and subsurface runoff and therefore increasing water stress levels (LMS, 2001).

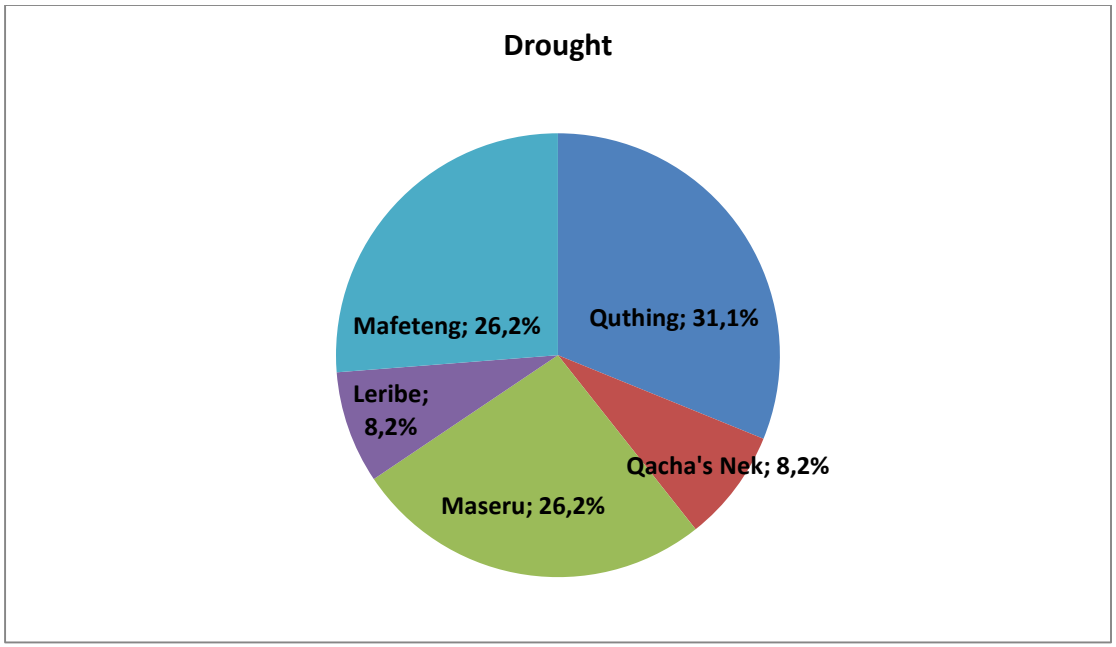


Figure 6. 9: Percentage of respondents indicating drought as influencing their farming

Water scarcity is a worrying occurrence that emanates from the increased prevalence and intensity of droughts. Global climate change models predict a gloomy picture for the water sector in Lesotho (LMS, 2001). Lower precipitation under climate change is likely to result in reduced availability of fresh water. This situation means that a condition of water stress could be reached earlier than predicted. Predicted climate change scenarios for the water sector in Lesotho indicate a reduction in surface and subsurface runoff owing to anticipated lower precipitation (Gwimbi *et al*., 2013). During focus-group discussions in the Senqu River valley in Quthing, farmers from Qacha's Nek and Quthing reported that water for irrigation purposes poses a challenge, and makes it difficult for them to continue with large-scale agricultural production. Farmers emphasised that they needed assistance from government to improve water accessibility.

During the focus group discussions, the participants were asked about the factors that, in their view, contribute to changing weather patterns. Some mentioned that Basotho are no longer adhering to cultural practices, such as burying the dead during the morning hours, burying them in the afternoon instead. Others said the fact that women do not cover their heads during burials and funeral services is another factor leading to changes in weather patterns. Others said that, these days, people weed their fields during daytime, while this used to be done from before sunset into very early hours of the morning, ending before 7:00. In any African country culture and beliefs

have a direct role to play in providing a people-centred approach to development (Brijball, 2012). However, adherence to traditional socio-cultural beliefs and practices present a persistent challenge to adaptation. While changing socio-economic and environmental conditions may constrain existing community coping mechanisms, cultural beliefs and the kind of knowledge that is trustworthy may lead to questioning of scientific findings. Although local knowledge or cultural practices can be effective for progressively adapting to climate change, such knowledge or beliefs may have limited utility when cultures are confronted with rapid change (Adger *et al.*, 2014). For instance, Basotho were able to use a combination of strategies when confronted with drought, but as drought became more prolonged and intense, such strategies become less effective, leading to food insecurity. This may be an indication of why rural households might not be resilient to adapting to the impacts of climate change, but would rather hold on to traditional explanations for why they suffer from the impacts of climate change.

The environmental changes that result from climate change as listed above, coupled with high poverty levels, mean that households have very few reserves to fall back on in times of extreme events or shocks, such as droughts and extreme snow events. This makes households very vulnerable to any changes in conditions that affect their ability to grow crops, keep livestock or access natural resources (Lewis *et al.*, 2011).

6.3.5 Conservation techniques employed

In light of their experiences with droughts and water scarcity respondents were asked whether they were familiar with and used any water and soil conservation techniques. From the data gathered it appears that, overall, households are not familiar with soil conservation techniques. Overall, only 20% of respondents indicated that they were familiar with specific soil conservation techniques. The lack of knowledge on soil conservation techniques point towards a heightened vulnerability to the impacts of climate change amongst the population. As mentioned earlier, climate change is likely to cause Lesotho's citizens to experience drier climate conditions in the future. The socio-economic resilience of the Lesotho population may be severely challenged if they are unable to adapt to these changing conditions through, among others, employing strategies to conserve soil moisture and fertility.

It transpires from the data that respondents mostly obtained their knowledge of and skills related to soil conservation from other community members. A relatively low percentage of respondents from Leribe (5.9%) said they were taught soil conservation techniques by CARE,[24] although this institution did not train farmers in any other district (Table 6.3).

Formal institutions (government or civil society organisations), it transpired, are not really involved in imparting knowledge on soil conservation techniques. Reasons for this situation could be that the government of Lesotho does not presently have appropriate policies and sector-specific strategies in place to adapt to the anticipated impact of climate change and, therefore, it does not invest in the implementation of adaptation measures at a local level (UNDP, 2015). For instance, ongoing initiatives related to addressing ecosystem degradation currently do not take into account climate-change-related risks and adaptation needs. Furthermore, the capacity of Lesotho's line ministries and various socio-economic sectors to plan and implement appropriate climate change adaptation interventions is hindered by the limited availability of technical skills, up-to-date climate information and best-practice examples to inform the design of locally appropriate adaptation measures (UNDP, 2015). The past few years have also seen a major decline in the share of agriculture in the overall national budget. The reduced funding for agricultural programmes seriously compromises the delivery services to farming communities, which is critical for transferring technical knowledge and innovation to rural farming households who have limited access to knowledge resources (LUNDAP, 2012).

Respondents who indicated that they were familiar with soil and water conservation techniques were then asked to mention the conservation techniques they were familiar with. As shown in Table 6.3, the majority of these respondents (30.1%) mentioned keyhole gardens, crop rotation (15.7%), conservation agriculture that uses minimum tillage (14.6%), water harvesting (12.0%), trenching (8.4%), cultivating (6.0%) and backyard garden plots (1.2%).

[24]This is an international NGO that operates in Lesotho and works with communities and local organisations in South Africa and Lesotho to implement programmes in the areas of healthcare and HIV/Aids, economic empowerment, democratic governance and food security

Table 6. 3: Types of soil conservation techniques known and used by respondents

Responses	Percentage of respondents familiar with technique	Percentage of respondents using the technique
Keyhole gardening	30.1%	24.4%
Conservation agriculture	14.6%	10.3%
Water harvest	12.0%	11.5%
Crop rotation	15.7%	16.7%
Cultivating	6.0%	6.4%
Trenches	8.4%	6.4%
Other	13.2%	6.4%
None	0	17.9%
Total	100.0%	100.0%

Keyhole gardens have been promoted by CARE among farmers in Qacha's Nek, Quthing and Leribe who are vulnerable to hunger and food insecurity, as a way of improving household resilience to external environmental shocks, such as drought. The raised beds surrounded by stones and a built-up layer of organic material have the dual purpose of adding nutrients to the soil as well as retaining moisture (CRS, 2008).

The respondents were also asked to indicate which methods they apply and, as shown in Table 6.3, 24.4% of the respondents familiar with soil conservation techniques stated that they applied the keyhole technique, followed by those who applied crop rotation techniques (16.7%). Another 11.5% stated that they applied water harvesting and 10.3% of the respondents applied conservation agriculture techniques. Cultivating trenches and other methods were used by 6.4% of respondents, and the remaining 17.9% used none of the methods because they may not have been aware, or they lacked knowledge on these techniques, or were unable to apply these techniques due to factors such as being too old to carry out the conservation techniques themselves, as some are labour intensive.

Also, as can be seen from Table 6.3, although respondents may know about the soil conservation techniques, it does not necessarily translate into them using these techniques. This could be because of lack of availability of local or improved seeds, a well or water, and therefore, together with the effects of climate change, its limits their agricultural activity.

6.3.6 Adaptation to climate change

- **Government's role**

Respondents were asked whether there was anything that the government of Lesotho could do in relation to adaptation to climate change, especially for agricultural production, and 23.2% of the respondents said the government should donate inorganic fertilizers to farmers because it would help them produce better yields. Another 20.0% of respondents said the government can improve farmers' accessibility to water, while 15.2% of respondents said the government should ensure that farmers have proper machinery for farming. Other respondents stated that government should present workshops to train farmers on adapting to climate change, so that their produce is not affected (11.8%).

Although the Ministry of Agriculture has partnered with various government departments and international NGOs to help farmers to minimise vulnerability to climate change in rural communities, this task is not without challenges. Nevertheless, the contribution of the Ministry has helped farmers, especially with the introduction of conservation agriculture and the introduction of subsidies and new strategies, such as block farming. In spite of these interventions, which are meant to achieve food security through technologies that assist farmers to adapt to climate change, more resources are needed within the agricultural sector to ensure that adaptation measures are implemented. Some respondents mentioned reforestation and provision of animals as a way government could assist them, and others mentioned that there was absolutely nothing that government can do, because all government has done is to make empty promises.

Government has provided limited assistance to farmers with regard to adaptation to the impacts of climate change. However, government has to negotiate the challenges posed by meeting the diverse needs of farmers (i.e. fertilizers, farming equipment, training) with limited financial and human resources.

- **Institutional response to climate change**

A representative of the Ministry of Agriculture and Food Security (Anonymous, 2012)[25] pointed out that the Ministry's ability to provide an adequate response to climate change is constrained by limited research capacity and severe budgetary constraints. He pointed out, further, that the dissemination of new agricultural technologies that address the impacts of climate change has generally suffered from weak institutional linkages, particularly research-extension linkages, as well as from financial limitations on the part of farmers. Other pervasive constraints included inefficient marketing systems, lack of credit facilities, poor distribution networks, low investments in production and low educational levels on the part of the intended beneficiaries (Mhlanga, 2004).

During the focus group discussions, one of the constraints that increase their vulnerability to climate change and mentioned by farmers was lack of information and education to understand the dynamics of climate change better. Providing farmers with the necessary education to enable them to adapt to the impacts of climate change better is thus a need expressed by farmers. Given the lack of financial and scientific capacity in government, it appears that there is a gap between the needs of farmers and the ability of government to meet these needs. However, most of the respondents from Qacha's Nek (71.4%) stated that they had been visited by staff of the Ministry of Agriculture, to talk to them about climate change, whereas a small percentage of respondents from Quthing (9.1%), Leribe (5.9%) and Mafeteng (6.7%) had been visited. Therefore, it is evident that there is some commitment from government to assist farmers in adapting to the impacts of climate change, in spite of the capacity constraints mentioned.

The respondents also indicated that the only NGO that has attempted to provide some education and assistance has been CARE. When asked whether the information provided by CARE was beneficial, one of the key informants had this to say: "Their visit was not useful because we already knew about conservation agriculture, especially keyhole gardens from a volunteer from overseas, in Quthing". This indicated that there might have been a gap between the needs of farmers and the assistance provided by NGOs. Mr Moletsane (Personal interview 5/10/2012) of the Disaster Management Authority indicated that challenges are experienced in relation to coordination

[25]Personal communication, 10/10/2012.

between relevant stakeholders to capacitate farmers to become climate change competent; and that participation, especially from other government departments, is poor.

A representative of the Ministry of Agriculture and Food Security stated that the major focus of the Ministry is to ensure that it is fulfilling its mandate to address matters of food security (Personal interview9/10/2012). This representative claimed that the Ministry is fulfilling its mandate through programmes related to food security that are being driven at both household and national levels. Nevertheless, NGOs such as CARE are involved with issues relating to adaptation to climate change, such as promoting conservation agriculture. The representative of CARE, Mr Makhetha (Personal interview 17/10/12) stated that the organisation provides training for farmers in organic compost systems, and donates seeds to farmers. In this way NGO initiatives augment efforts by the Ministry of Agriculture and Food Security to help farmers to adapt to climate change. The CARE representative also stated that more could be done to mitigate and adapt to climate change.

6.3.7 Initiatives for improving effectiveness of mitigating and adaptation measures for climate change

Various stakeholders who are involved in climate change adaptation and mitigation were interviewed. The Meteorological Services Department[26] of Lesotho provides information on climate in the country, while the UNDP's mandate is to support the government of Lesotho in supporting local communities to adapt to climate change. The AAP investigates mitigation measures for the health and the energy sectors. The Disaster Management Authority coordinates efforts to reduce disasters, and Lesotho Network of AIDS Services Organisations (LENASO) raises awareness on matters related to climate change.

The Department of Meteorology is mandated to report on the state of the climate, and during key-informant interviews Ms Malehloa Jockey (Personal interview5/10/12) declared that Lesotho's emissions are extremely small compared to its neighbour and other countries of the world, although the effects of these emissions are nevertheless felt in the country. A representative of the Meteorological Services mentioned that one of the challenges they are experiencing regarding climate change is providing adequate capacity to carry out adaptation and mitigation measures

[26] This is also referred to as Department of Meteorology, or Meteorological Services.

against climate change. When carrying out their assessment and analysis of the country's vulnerability to climate change, the Meteorological Services also made recommendations to government on adaptation measures, but because of inadequate expertise, implementation of such measures remain low.

The representative of the Department of Meteorology further stipulated that government initiatives to deal with the effects of climate change have been positive. The Ministry of Finance included climate change in their national plans, and government has also collaborated with organisations such as the UNDP, FAO, UNICEF, WFP and IFAD to address climate-change-related matters.

The UNDP's mandate is to support the government of Lesotho in assisting local communities to adapt to the impacts of climate change. Mr Peshoane (Personal interview 24/09/2012) of the UNDP stated that the organisation is fulfilling its expected role because it was implementing interventions that were related to climate change in Lesotho. However, their organisation is experiencing challenges doing so, because climate change is a relatively new phenomenon for Lesotho and consequently it is not easy to integrate interventions into national development plans; other challenges relate to climate change being a cross-cutting issue. Nevertheless, UNDP had implemented the Lesotho Renewable Energy Based Rural Electrification Project (LREBRE), under which 1,500 households have benefitted from the installation of solar systems. Solar is a low-greenhouse-gas technology, meaning that a project of this nature needs to be rolled out to the rest of the country in order to mitigate the impacts of climate change by promoting and increasing green economy initiatives that will improve the environment. Furthermore, solar energy is clean and unlimited, and can help subsistence farmers to pump water for irrigation for producing crops. Capturing the sun's energy for light, heat, hot water and electricity can assist households to become self-sufficient in terms of energy generation, help reduce pollution and provide energy for farming activities, such as drying crops and powering water pumps. This can make farming more economical and efficient. Mr Peshoane (Personal interview 24/09/2012) further recommended that the government of Lesotho continue ensuring that topics related to climate change are included in national development plans.

UNDP, with funding from the government of Japan, launched the AAP programme, which uses an innovative approach to climate change adaptation. Under this programme, UNDP has assisted

20 African countries to implement integrated and comprehensive adaptation actions and resilience plans. This project will ensure that national development processes incorporate climate change risks and opportunities to secure development gains under a changing climate. UNDP helps countries establish an enabling environment and develop the capacity required to design, finance, implement and monitor long-term and cost-effective adaptation policies and plans. Mr Maseru (Personal interview 24/09/2012) of AAP mentioned that government initiatives include the running of two projects, one of which is the AAP, funded by the Japanese government, which is called the Japan International Cooperation Agency (JICA).

According to Mr Maseru (Personal interview 5/10/2012), AAP is fulfilling its mandate to some extent, as it has implemented pilot projects addressing adaptation to climate change. One of these projects relates to establishing climate change platforms, which are now being tested by a community-based organisation, Bonds Community Recreation Association, that is funded by small grants under the Global Environment Facility. In the Thetsane area community members and schoolchildren are being capacitated on issues of climate change and adaptation measures through the sharing of information. Mr Maseru stipulated that climate change has had a severe impact on Lesotho, as heat waves have brought about drought and this has affected agricultural production. AAP intends to buy machinery for the health sector that deals with diseases brought about by climate change, such as malaria, and to train healthcare staff. Furthermore, the government has assisted farmers by subsidising seeds and providing fertilizers. However, financial assistance to farmers has always been problematic.

The Lesotho government is committed to ensuring that its nation is resilient regarding climate change. This was confirmed by Mr Peshoane (Personal interview 24/09/2012), who reported that the government has ratified the following climate change conventions: the UNFCCC, Kyoto Protocol and the treaties that propagate for measures to mitigate against and adapt to climate change. What remains as a challenge, according to Mr Peshoane, is a need for expertise in dealing with climate change. Science and technology is one of the key building blocks of a successful economy in the current and future global economic order. Countries that have built strong technological foundations for development have found that such investment in technology results in longer-term economic sustainability, creation of opportunities to develop new products, creation of an appropriate environment for sound decision-making, and the creation of an appropriate

framework for environmental rehabilitation (Mhlanga, 2004). The reforestation programme that serves to provide a carbon sink, which is being implemented by the Ministry of Forest and Land Reclamation, is a good mitigation measure, as the country is bare of vegetation. Promotion of energy-efficient technologies, like solar, is a positive development, as it provides cleaner energy that does not contribute to global warming.

The Disaster Management Authority deals with disaster risk reduction by coordinating efforts to reduce disaster risk. In discussing disaster risk, Mr Moletsane (Personal interview 5/10/2012) said disaster-risk-reduction measures include prevention, mitigation, recovery, response and preparedness. The view of the Disaster Management Authority is that climate change has had real negative impacts on the country, for instance, extreme rain events and changes in the seasons. The impacts are more visible in the agricultural sector, and production is normally affected negatively. The Disaster Management Authority reports that the water and health sectors are experiencing negative impacts too, caused by diminishing water supplies due to evaporation, and the emergence of new diseases, of which some are lung-related. So, as part of adaptation measures, the Disaster Management Authority assists affected sectors in dealing with impacts of climate change through annual visits to communities that have been affected by climate change. The Lesotho Vulnerability Assessment Committee, which is coordinated and housed by the Disaster Management Authority, conducts vulnerability assessments when shocks or hazards are experienced, and suggests mitigation measures to counter such shocks. As part of adaptation measures, the Disaster Management Authority also encourages people to use heaped roofs, so that, when hazards like winds or heavy snowfall occur, the roofs do not collapse. The Ministry of Agriculture encourages people to engage in conservation farming, such as minimum tillage, so as to conserve water in the soil. By diversifying livelihoods, new opportunities can be explored for coping with climate change effects (Personal interview9/10/2012).

Another organisation that was reached through key-informant interviews, is LENASO. This body is mandated to strengthen community systems and linkages with health services in all ten districts of the country by district coordinators who work in clinics Mr Makoa (Personal interview 17/10/12). LENASO is also engaged in creating awareness about climate change. The organisation has support groups and 162 affiliates that help implement interventions for social development. Their major challenge is sponsorship funding, due to the fact that LENASO is a local NGO.

According to Mr Makoa (Personal interview17/10/12), government has tried to assist farmers to deal with problems caused by climate change through training and donations of seeds. LENASO has also worked with the Red Cross, and asked them to donate seeds to farmers.

Organisations that were interviewed are under the impression that they assist the population in preparing for the impacts of climate change, though it is quite evident that the focus of many of the organisations' strategies are geared towards reducing emissions rather than adapting to climate change. From the survey and focus-group discussions, it transpires that very few of the organisations have actually done anything at community level; farmers and other community members declare that initiatives by government and NGOs have done little to assist them to adapt to climate change. This means the government of Lesotho must adopt a much more robust approach to issues of climate change in terms of building capacity and competencies through providing information. What institutions are doing to assist farmers with climate change adaptation is clearly not sufficient, because the farmers have their own needs regarding finding ways to adapt to climate change when it comes to agriculture.

6.4 CONCLUSION

To conclude, respondents acknowledge that weather patterns have changed and are still changing. Many of the farmers continue to cultivate crops, although their yields have been poor due to factors such as drought and floods. The majority of the population in Lesotho relies on rain-fed agriculture and due to the adverse effects of climate change and socio-economic factors, rural households in Lesotho remain vulnerable to climate change. Interventions by government and NGOs attempt to build resilience in Lesotho, but due to resource constraints, especially for government, organisations are unable to achieve their targets for adapting to climate change, and therefore, the population remains vulnerable to the impacts of climate change.

Organisations that are involved in mitigation of and adaptation to the impacts of climate change have had some positive results. However, some of these organisations cannot reach all parts of the country, because of limitations related to funds and human capacity. Although some of the respondents mentioned that organisations such as CARE and LENASO trained communities in conservation agriculture, respondents stated that not everyone had been invited to the training – only a few households were able to attend the training sessions. This means that there remains a

gap between farmers' needs and what organisations are doing. The gap is caused by a lack of financial support and inadequate information dissemination to farmers and other stakeholders, as well as inadequate financial capacity to help farmers adapt to climate change

The conclusions of the study are therefore dealt with in more detail in Chapter 7.

CHAPTER 7. CONCLUSIONS AND RECOMMENDATIONS

7.1 INTRODUCTION

The overall aim of the study was to take stock of Lesotho's preparedness for dealing with the impacts of climate change in Lesotho (see Paragraph 1.5). It is concluded that farmers are faced with both biophysical and socio-economic problems, which are aggravated by poor coordination and lack of institutional and technical capacity on the side of the government and organisations involved in climate change adaptation in Lesotho. The first part of this chapter will deal with the main conclusions that were reached in the study. Thereafter, the recommendations based on the conclusions will be presented.

7.2 MAIN CONCLUSIONS OF THE STUDY

7.2.1 The impacts of climate change on the population of Lesotho

Developing countries, and particularly the poorest segments of society within these countries, are vulnerable to the impacts of climate change in that they either lack financial support or have limited resources available to adapt to or mitigate the impacts.

Based on the results, it is evident that there is a general view among respondents that weather patterns are changing and that this has an impact on their socio-economic well-being; most importantly, changes in weather patterns are affecting their ability to produce crops. Respondents indicated that their crop yields have diminished over time and, in some cases, though they had been able to sell their produce in the past, they are not able to do so currently. Indications of changing climate patterns that were observed by respondents included worsening and prolonged periods of drought, as well as windstorms and late rains. Furthermore, respondents indicated that, due to changes in weather patterns, i.e. late rains and droughts, they had to change the types of crops that they grow. These environmental changes lead to in poor crop production and thereby exacerbate poverty and threaten food security. For these reasons, climate change appears to affect, and will continue to affect, the population of Lesotho, especially rural households that are dependent on rain-fed agriculture for their livelihoods.

The population of Lesotho is able to adapt to the impacts of climate change by employing mechanisms such as soil conservation techniques, switching to drought resistant crops and employing water saving techniques. However, these mechanisms are dependent on the transfer of knowledge by government and other institutions working in the field of climate change, as well as on the population having access to the necessary resources to do so. Acquiring the necessary resources to enable adaptation is challenging for households that can produce barely enough food for subsistence.

It can be concluded, therefore, that although the population of Lesotho displays some resilience to the impacts of climate change, they remain very vulnerable to these impacts.

7.2.2 Existing policies to address issues of climate change in Lesotho

Lesotho does not display a clearly formulated strategy to deal with the impacts of climate change. Climate change is acknowledged as a factor constraining socio-economic development and adaptation and mitigation strategies are incorporated in Lesotho's policy framework. The government of Lesotho has also collaborated with a range of organisations to deal with the impacts of climate change in the country. One government initiative is the AAP, which is funded by the Japanese government.[27] Other organisations that have funded climate change mitigation and adaptation initiatives in Lesotho include UNDP, FAO, UNICEF and WFP.

Lesotho is already burdened with the challenges of unemployment, poverty and weak economic growth. It appears that there is, at least in theory, policy in place to deal with the impacts of climate change in Lesotho. However, as is the case with many resource-poor nations, the government is experiencing challenges in the implementation of the policy framework. Although the Ministry of Agriculture does partner with various organisations in efforts to assist rural communities to adapt to climate change, the challenges faced by the Lesotho government include inadequate resources for implementing projects, lack of data and information awareness, especially as it applies to emerging technologies, and insufficient human and institutional capabilities.

[27] See Chapter 6 Paragraph 6.2.6.

7.2.3 Gaps between the existing policy framework and the needs of subsistence-based farmers

The government of Lesotho has partnered with various institutions to try and curb climate change impacts. However, during the key-informant interviews with the MoAFS, the representative highlighted that they are not able to carry out all their responsibilities due to budget constraints and limited research capacity.[28] Focus-group discussions brought to light that farmers remain vulnerable to climate change because information is not being disseminated to them.

A policy response to climate change is an important factor that mediates local-level vulnerability, so lack of support from government institutions to smallholder farmers are constraining their efforts to operate as successful farmers. ***Poor distribution networks, low investments in agricultural production by government and low educational levels of farmers*** form the basis for gaps between the policy framework and needs of subsistence-based farmers. Though government has programmes in place to assist farmers to adapt to climate change and build their resilience, government is unable to assist farmers' in meeting their needs because of budget constraints. Therefore, it is clear from the study that government institutions have little involvement with farmers at grassroots level, since the farmers have their own needs, such as seeds and fertilizers. What farmers expect from government differs from what government is doing. This discrepancy results in a gap between the decisions made at a policy level and the needs of subsistence-based farmers.

Civil society organisations (CSO), such as CARE, teach villagers and farmers about conservation farming techniques, although not on a large scale, due to budget constraints. Also, the Meteorological Services mentioned that some of the challenges they are experiencing regarding climate change include inadequate capacity to carry out the adaptation and mitigation measures against climate change. When carrying out their assessment and analysis of the country's vulnerability to climate change, Meteorological services also make recommendations on adaptation measures, but because of inadequate expertise, implementations of such measures remain a challenge.

[28] See Chapter 6 Paragraph 6.2.5.2.

While the government of Lesotho has extended some aid to farmers in the form of subsidies for agricultural inputs, productivity has declined because of increasing climate variability impacts, particularly on agricultural livelihoods, and this has reduced the coping and adaptive capacities of resource-poor farmers..

7.3 RECOMMENDATIONS

7.3.1 Promote grassroots participation of local communities in planning for climate change adaptation

Decisions influencing adaptation to climate change should take the needs of farmers on the ground level into consideration, because this is where detailed knowledge about local natural and human conditions is located. Through this approach farmers can develop initiatives for climate change adaptation to enhance the resilience of the local community to the impacts of climate change. The focus should be on local communities building their climate change competencies with the aid of appropriate assistance from government and other institutions.

In this regard, government should promote grassroots organisations and open avenues for direct participation by local communities in planning for climate change adaptation.

Doing so will help improve capacity to mobilise local resources, improvements in community, organisational and management capability, possibilities for local initiatives and implementation of projects, increased provision of skills and information and increased local influence on national policies. Farmers can receive more support from both NGOs and government in terms of training, information and knowledge, and other fundamental resources they need for their farming systems. This will enable full involvement by communities, assisting them to understand programmes that are designed to help them. Development CSOs play a central role in supporting poverty reduction among vulnerable households and communities at the grassroots level. The experiences of these groups in adapting to variations in climate are crucial for informing climate change adaptation plans, which need to build on existing coping mechanisms; their experiences will help others understand how climate change is likely to affect other shocks and stresses on community level. Development agencies can use such knowledge to inform policy-making and planning (IDS, 2006).

7.3.2 The Lesotho government needs to thoroughly evaluate the initiatives currently in place, to determine if they enhance the ability of the population to adapt to the impacts of climate change, and then build out those initiatives

These initiatives include (a) the AAP, which considers ways that people can adapt to climate change, specifically in the health and energy sectors, and adaptation mechanisms like establishing climate change information platforms, and (b) early warning systems, which started in 2012. The latter project investigates the development of policies for climate change and it is being supported by the EU, which donated €4 million to fund climate change projects in Lesotho. The outputs of these initiatives need to be communicated to local communities in general.

Building resilience and enabling adaptation to the inevitable impacts of climate change is key. Several international instruments exist to support adaptation planning, among which the Adaptation Fund, which finances concrete adaptation projects and programmes in developing countries that are particularly vulnerable to climate change (UN, 2014). So, funds should help already existing infrastructures to deliver facilities that will enhance Lesotho's existing research into climate change. These investments will underpin the country's response to climate change and will provide an integrated national platform.

7.3.3 The Ministry of Water, Energy and Meteorological Services, in partnership with CSOs, need to embark on a robust information dissemination programme to impart knowledge on the findings of technological research on climate change causes and effects and adaptation mechanisms, in order to build the competencies of local communities on issues of climate change

Local climate change adaptation platforms, as mentioned above, are critical for mitigating and adapting to climate change by reducing vulnerability among Lesotho's local communities. Implementation of such programmes requires that development agencies need to collaborate, especially scientists and practitioners, but also to enhance local adaptation capacity, which includes the ability to draw on climate data. It is essential that these institutions design their activities around local needs and not around the funding or reporting requirements of the international climate-change community (Ziervogel *et al*., 2008). Education is seen as an agent of social and economic development and therefore it will help farmers to understand their

environment better in order to construct relevant strategic plans and/or polices. Therefore, the government of Lesotho must partner with educational institutions to expand the current capacity of the government.

7.3.4 Both international and domestic investors will be required to mobilise, so as to invest and promote adaptation strategies among rural communities

There is a need for research technologies that will increase the adaptability and resilience of social and ecological systems that are confronted by climate change. Strengthening technical capacity by strengthening the country's capacity to implement early-warning systems for rural populations will assist in the integration of climate change issues into development planning, by promoting tools and methodologies for the analysis of vulnerability and the development of innovative adaptation solutions.

Key national institutions dealing with climate change are faced with a shortage of skilled staff. Support from bilateral and multilateral institutions will help build the capacity of local experts on issues of climate change. This is why Lesotho should continue to strengthen the link with multilateral and bilateral institutions to facilitate capacity building and technology transfer in various areas of climate change policies, science and technologies.

7.4 CONCLUSION

The nature of climate-change adaptation demands that efforts to support African agriculture in the face of climate change should incorporate a set of multidisciplinary stakeholders, comprising science experts, agricultural practitioners and technicians, local communities/civil societies, donors and policy makers. A key challenge involves extending the capacity that currently exists in the agro-meteorological disciplines so as also to include agro-climatic competency. This is an aspect to be considered by the Lesotho government.

In summary, the results of the study lead to the conclusion that climate change is a major threat to Lesotho and will continue to be a threat if not properly addressed at all levels of society in a way that will enable the population to adapt to the impacts thereof.

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APPENDICES

APPENDIX A: HOUSEHOLD QUESTIONNAIRE

District | Research Assistant | Date | Question. #

The impact of climate change on the population of Lesotho
Household questionnaire

A. GENERAL INFORMATION OF THE RESPONDENT

A1. Village:												
A2. Relationship to HH												
A3. Gender	Male						Female					
A4. Age :	15-20		21-30		31-40		41-50		51-60		+60	
A5. Size of the household (No. of members)	Children (0-17 yrs)						Adults (>18 yrs)					

B. AGRICULTURAL PRODUCTION

a. What is the main source of income for the household? (***Mohloli o moholo oa chelate ke o fe bakeng sa lelapa?***

b. Do you have access to agricultural land? ***(o na le mobu oa temo?)***

1. Yes ☐ 2. No ☐

c. If yes, on what basis? ***(Kea mofuta ofe?)***

Owned		Rented		Share cropping		Borrowed land	

d. What is the size of your agricultural land (ha/acres)? **(*Ts'imo ea hao eboholo bo bokae?*)**

_____

e. For how long have you been farming on this land? ***(Ke nako e kae le Lema tsimong e?)***

<5 years		5-10years		11-20years	

f. Have any crops been grown on this land since 2005? ***(Na le na le lijalotseo le li hlahisitseng lirapeng/masimongaa ho tloha 2005?)***

1. Yes ☐ 2. No (skip to g) ☐

	Gardens		**Fields**	
	Yes	**No**	**Yes**	**No**
2005				
2006				
2007				
2008				
2009				

2010				
2011				

g. If 'no', why not?(skip to m)***(Hae bahosa hlahisoa lijalo, lebaka ke le fe?)***

_____
_____
_____
_____

h. If 'yes', in the past five years what were the three predominant crops grown? ***(Ha e ba karabo ke e, ke life lijalo tse tharo tsehlahisoang khafetsa (ha ngata) lilemong tsehlano tsefetileng, 'me hobaneng tsona?).***

_____
_____
_____
_____

i. Has there been any change of crops grown on your land over the past 10 years? please explain the reasons (***naho kile hoaba le phetoho ea lijalo li lemong tse leshome tse fetileng? Hlalosa mabaka***).

1. Yes ☐ 2. No ☐

_____
_____
_____
_____

j. What is the average yield produced per crop grown/per harvest season and what types of crops have been grown (No. of bags/bundles/heads. ***(Kakaretso ea kotulo e fumanoang mofuteng e hlahisoang e kae?)***

	Gardens	**Type**		**Fields**	**Type**
Crop 1			Crop 1		
Crop 2			Crop 2		
Crop 3			Crop 3		

k. Do you sell your agricultural produce? (***na le rekisa lijalo tseo le li hlahisitseng***?)

1. Yes ☐ 2. No ☐

l. If yes, What is the most ever received income from the sale of crops that you have sold?(***Hae ba karabo ke ee, chelete e ngata eo o ileng oa e fumana thekisong ea lihlahisoa ke e kae?***).

_____
_____
_____
_____

m. In your view, are there any signs that weather patterns are changing? (***Ho ea kauena, na hona le phetoho ea maemo a leholimo?***)

1. Yes ☐ 2. No (Skip to section C) ☐

n. If yes, what are the signs of weather patterns in your community or in Lesotho as a whole? ***(Hae ba karabo ke ee, lipontšo tsa phetoho ea maemo a leholimo ke life motseng oa ha eno kappa Lesotho ka kakaretso?).***

_____
_____
_____
_____

Weather patterns	***Experiences of Changes of weather patterns in the last 10 years***								
	Extent			***Number of times***			***Severity***		
windstorms	*high*	*Moderate*	*Low*	*0-5*	*6-10*	*10+*	*Very*	*moderate*	*less*
Flood									
Drought									
Storms									
Shifts in season									
Fires									
Other (specify)									

o. Would you say these weather patterns have affected agricultural production in your community?

1. Yes ☐ 2. No ☐

p. If yes, substantiate. (***Ho ea ka uena, na phetoho ea maemo a leholimo e amme kotulo sechabeng?)***

_____
_____
_____
_____

q. What did you do to adapt to the changing weather patterns to overcome the negative effects on agriculture? ***(na hona le seo o ileng oa se etsa ho fenya mathata a bakoang ke phetoho ea leholimo*)*.**_____
_____
_____
_____
_____

r. What more can be done by government and the farmers to overcome the negative effects of weather patterns on agricultural production? (***Ho ka etsoaeng ho fenya litla-morao tse bosula tsa phetoho ea maemo a leholimo kotulong?***).

_____
_____

C. POLICIES OF CLIMATE CHANGE

s. Has someone from government been here to discuss the effects of changing weather patterns on agricultural production? (***na o kile hoa eba le motho ea tsoang 'musong hotla bua le oena ka litla-morao tse bakoang ke phetoho ea leholimo***).

1. Yes ☐ 2. No ☐

t. If so, what was the nature of the discussion? (***Haeba karabo ke ee, le buile joang teng***)?

_____

_____

_____

u. Was the information you received from the government representative useful in any way?
Yes/ no (***likeletso le melaetsa o e fumaneng 'musong e la ka o tsoela molemo***).
Elaborate.

_____

_____

_____

v. Are there any soil conservation agricultural techniques that you know of? ***(Na ho na le mekhoa ea temo e baballang mobu le metsi eo u e tsebang?)***

1. Yes ☐ 2. No ☐

w. If 'yes', please name these techniques

_____

_____

_____

_____

x. Which techniques do you apply, and why? ***(Haeba karabo ke e, u sebelisa mekhoa efe?)***

_____

_____

_____

y. Who taught you these soil conservation agricultural methods? ***(Ke mang ea le rutileng mekhoa ee ea temo?)***

_____

_____

_____

_____

z. In your view, how can one adapt changing weather patterns so that agricultural production is not negatively affected? (***Litla-morao tsebosula tsa phetoho ea maemo a leholimo sechabeng li ka fokotsoa joang?).***

_____

_____

_____

Thank you for your time!

APPENDIX B: FOCUS-GROUP DISCUSSIONS

District _____ Researcher _____ Date _____

Focus Group Discussions:

Climate change impacts on rural livelihoods

1. How have weather patterns changed over the past 10 years?

_____
_____
_____
_____
_____
_____
_____
_____

2. How has the changing weather patterns affected production?

_____
_____
_____
_____
_____
_____
_____

3. Is there communication between farmers and the policy implementers when formulating policies for changing weather patterns?

_____
_____
_____
_____
_____

4. What has been done to assist farmers in the agricultural sector to try and adapt to changing weather patterns?

_____
_____
_____
_____
_____
_____
_____
_____

5. Has the farmer assistance been effective in any way?

_____
_____
_____
_____
_____

_____
_____

6. What can be done to assist farmers in the agricultural sector in adapting to changing weather patterns?

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Thank you for your time!!!

APPENDIX C: KEY INFORMATIONS QUESTIONNAIRE

Key informants Interview:

The impact of climate change on the population of Lesotho

Name of organization:_____

Name of respondent:_____

Sector within which your organization operates : _____

Contact numbers: _____

A. CLIMATE CHANGE

a) What is your organization's mandate in terms of climate change?

_____
_____
_____
_____

b) Do you think your organization is fulfilling its mandate/ its expected role regarding issues of climate change? Substantiate.

_____
_____
_____
_____
_____

c) Has your organization experienced any challenges in trying to fulfill their mandate? If so, what is the nature of these challenges?

_____
_____
_____
_____
_____

d) In your view, in what ways do you think climate change has impacted on Lesotho?

_____
_____
_____
_____
_____

e) Which sectors have been negatively affected by climate change and why?

_____
_____
_____

_____
_____

f) In what ways have you been involved in assisting these sectors in dealing with the impacts of climate change?

_____
_____
_____
_____
_____

g) Do you think your contribution has helped these sectors? If so, please elaborate.

_____
_____
_____
_____
_____

B. POLICIES AND EFFECTIVENESS

h) Are you aware of any mitigation measures that have been adopted to counter negative impacts of climate change? Please mention them.

_____
_____
_____
_____
_____

i) What in your view is government doing to try and assist in dealing with climate change effects?

_____
_____
_____
_____

j) Has government initiative been positive in any way in dealing with effects of climate change? Elaborate.

_____
_____
_____
_____

k) What initiatives has government taken in assisting farmers to accommodate climate change effects?

_____
_____
_____
_____

l) Have those initiatives by government brought any positive changes in agricultural productivity?

_____
_____
_____
_____

m) What challenges did government experience in trying to assist farmers in adapting to climate change effects?

_____
_____
_____
_____

n) Which organizations, to your knowledge have funded climate change mitigation and adaptation initiatives in Lesotho?

_____
_____
_____
_____

o) Please state the positive impacts emanating from those mitigation and adaptation initiatives in Lesotho.

_____
_____
_____
_____

p) Are you aware of any climate change conventions that Lesotho participated in over the past years? Please state them below.

_____
_____
_____
_____
_____

q) Has Lesotho ratified any of the climate change treaties you have mentioned from your point of view? Please elaborate.

_____
_____
_____
_____

r) What more do you think can be done to mitigate against climate change in Lesotho?

_____
_____
_____
_____

Thank you for your time!!!