

**CLIMATE CHANGE AND ENVIRONMENTAL SUSTAINABILITY
ACTION PLANS IN AFRICA: A CASE STUDY OF KENYA, (1980-2014)**

BY

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REG. NO: R50/82642/2015

**A PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
OF THE MASTERS OF ARTS IN INTERNATIONAL STUDIES, TO THE INSTITUTE
OF DIPLOMACY AND INTERNATIONAL STUDIES (IDIS), UNIVERSITY OF
NAIROBI**

JULY 2016

DECLARATION

I declare that this project is my original work and has not been presented to any other University

Sign.....

Date.....

Jerome Muthemba Mwanzia

This work has been submitted with my approval as University Supervisor

Sign.....

Date.....

Dr. Shazia Chaudhry

DEDICATION

To my lovely wife Carol and our two beautiful children Joy and Natalie

ACKNOWLEDGEMENTS

I am grateful to the Almighty God for the good health, protection and strength He so generously provided to me during the busy year of studies. I wish to sincerely thank my supervisor, Dr. Shazia Chaudhry for her guidance, insight, patience and advice as I pieced together each line into paragraph and eventually to this final product. I also wish to register my appreciation to the Director and staff members of Institute of Diplomacy and International Studies (IDIS) for their lectures, discussions and engagement during studies.

I am thankful to the Director, Kenya Forest Service Mr Emilio Mugo for according me the opportunity to participate in the course, and Kenya Forest Service for the sponsorship. I also thank the National Defense College (NDC) Commandant Lt General Jackson Waweru and the NDC staff for hosting us and guiding us during the entire period. To my fellow participants at NDC, I appreciate the comradeship, networking and useful discussions that we shared.

My appreciation goes to Kenya Meteorological Department, Ministry of Environment and Natural Resources, Kenya Forest Service, Kenya Agricultural and Livestock Research Institute and Non-Governmental Organizations for their support in gathering research data. I also wish to thank David Chege and Rose Akombo from KFS and Dr Margaret Gichuhi of Jomo Kenyatta University of Science and Technology for the useful advice. Finally, my special thanks go to my wife for taking care of the home during my studies, and to my kids: thanks for giving me space and strength to pursue the course.

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List of Acronyms

AAAA	Addis Ababa Action Agenda
ACCF	African Climate Change Fund
ACPC	African Climate Policy Centre
AfDB	African Development Bank
AMCEN	African Ministerial Conference on the Environment
ASDS	Agricultural Sector Development Strategy
AU	African Union
CBO	Community Based Organization
CCCU	Climate Change Coordination Unit
CDM	Convention on Biodiversity Diversity
CH ₄	Methane
CIGI	Centre for International Governance Innovation
CO ₂	Carbon dioxide
COMESA	Common Market for Eastern and Southern Africa
COP	Conference of Parties
DRC	Democratic Republic of Congo
DRR	Disaster Risk Reduction
EAC	East Africa community
EACCCP	East African Community Climate Change Policy
EALA	East Africa Legislative Assembly
EU	European Union
FAN	Forest Action Network
FAO	Food & Agriculture Organization

GBM	Green Belt Movement
GCCA+	Global Climate Change Alliance
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Green House Gas
H ₂ O	Water Vapour
IFAD	International Fund for Agricultural Development
IGAD	Inter-Governmental Authority on Development
IPCC	Intergovernmental Panel on Climate Change
ISDR	International Strategy for Disaster Reduction
IUCEA	Inter-University Council of East Africa
JKIA	Jomo Kenyatta International Airport
KALRO	Kenya Agricultural & Livestock Research Organization
KFS	Kenya Forest Service
KFWG	Kenya Forest Working Group
KWS	Kenya Wildlife Service
LVBC	Lake Victoria Basin Commission
LVFO	Lake Victoria Fisheries Organization
M&E	Monitoring and Evaluation
MAM	March – April – May
MDG	Millennium Development Goals
MEAs	Multilateral Environment Agreements

MKEPP	Mount Kenya East Pilot Project
N ₂ O	Nitrous Oxide
NAMAs	Nationally Appropriate Mitigation Actions
NAPA	National Adaptation Programmes Action
NAPs	National Adaptation Plans
NCCAP	National Climate Change Action Plan
NCCRS	National Climate Change Response Strategy
NCWK	National Council of Women of Kenya
NDC	Nationally Determined Contribution
NEMA	National Environment Management Authority
NEPAD	New Partnership for Africa's Development
NGOs	Non-Governmental Organizations
NOAA	National Oceanic and Atmospheric Administration
OCD	October – November – December
PES	Payment for Environmental Services
PMU	Programme Management Unit
RECs	Regional Economic Communities
SADC	Southern Africa Development Cooperation
SDG	Sustainable Development Goals
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environmental Development
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Program

UNEP	United Nations Environment Programme
UNFCCC	United Nations Forum Convention on Climate Change
UNICEF	United Nations Children's Fund
USA	United States of Africa
USAID	United States Agency for International Cooperation
WHO	World Health Organization
WMO	World Meteorological Organization

Abstract

Climate change is probably the most important environmental issue facing the world today. Africa specifically, has been adversely affected by climate change, yet little concrete action has been put in place to address the same. In view of the issue, the study examined the status of climate change action plan and environmental sustainability in Africa generally and Kenya in particular. It also sought to understand the relationship between climate change and environmental sustainability, as well as establish the effectiveness of the climate change adaptation options to enhance climate resilience in Africa, with a special focus on Kenya. Further, the study analyzed the role of state and non-state actors in implementation of a regional as well as national climate change action plan for environmental sustainability. To realize this, interviews to key informants were conducted in various ministries, government organizations and Non-Governmental Organizations. Further, secondary data from both physical and on-line libraries were utilized to gather additional information. The study concluded that climate change undermines achievement of environmental sustainability through impacts such as increase in temperatures, variability of rainfall and increased drought and flooding incidences which affect many sectors such as food crop productivity. Conversely, environmental degradation, by virtue of its contribution to greenhouse gas emission through deforestation, land degradation and pollution among others, contributes to climate change, hence the two variables are mutually interlinked. For the case of Kenya, in the period 1980-2014, temperature rise was found to be higher than the global average, while there was increase in annual rainfall over the same period. The country, by virtue of being an agriculture-based economy, has been severely affected by warmer temperatures as well as rainfall variation. The main crop production season of March –April – May has experienced reduced rainfall over the same period. On a positive note the country's second crop planting season of October – November – December has been receiving enhanced rainfall, which portends well for crop production by the counties that use this particular season. On the overall, implementation of climate change action in Africa in general and Kenya in particular, was found to be generally unsatisfactory. Though the policies and legislation are largely in place, key bottlenecks were found to include; inadequate funds, low technical capacity and inadequate expertise by the state and non-state actors charged with responsibilities of implementing climate change action. It is therefore recommended that the continent, the sub-region and Kenya should develop internal capacities on climate change in order to leverage and attract international support under existing international conventions in its efforts to address climate change. Similarly, Kenya should operationalize the institutions created by the Climate Change Act 2016 in order to offer guidance in the quest to make the country climate resilient. Finally, it was recommended that the Ministry of Agriculture and Kenya Agriculture and Livestock Research Institute (KALRO) should consider the viability of the country utilizing more the October – November – December rains for crop production in view of the findings that the rains during that season have increased while the March- April –May rains have reduced.

CHAPTER ONE INTRODUCTION TO THE STUDY

1.0 Introduction

Environmental degradation in the form of industrial pollution, deforestation and land use change has over the years led to increase in greenhouse gas emission leading to climate change. A clear manifestation of this phenomenon on a global scale is reduced rainfall, increased drought, flooding and reduced biodiversity. These have had serious impacts on key economic sectors including agriculture, energy, environment, infrastructure development and human health, and made the vision of achieving global environment sustainability a challenge.

Africa is recognized as one of the most vulnerable regions to climate change despite being one of the least contributors of global emissions.¹ Factors such as poverty, high population growth and dependence on environmental and climate related resources have exacerbated the situation. The most devastating drought to hit the horn of Africa in 60 years has created food shortage that has threatened the lives of 11 million people in the region.² Widespread drought in Sahel as well as massive flood events registered in Mozambique, Kenya and Somalia has translated into loss of lives and massive losses in homes and infrastructure. Other sub-regions are also facing similar challenges.

In Kenya, one of the consequences of climate change is conflict over resource use that has impacted negatively on development. Water scarcity has resulted in sporadic conflict over the resource and grazing grounds by various communities. The decade of the 90s witnessed conversion of forest to other land use systems, mainly agriculture and settlement. A case in point

¹ L. Otter, D.O. Olagi. & I. Niang. *Global Change Process and Impacts in Africa- A Synthesis*. East African Education Publishers. 2007, P 33.

² *Environmental Sustainability: An Evaluation of World Bank Group Support*. The World Bank. Washington DC. 2008, P 53.

is the Mau forest complex that lost about 100,000 ha through encroachment and degazetment.³ This led to destruction of water catchment areas and subsequent reduction of water flow for domestic and agricultural utility

On the overall, this scenario has created a vicious cycle where environmental degradation has led to climate change phenomenon, which in turn has caused further depletion. In order to contribute to global environmental sustainability, it is prudent that sound policies are developed and clear implementation framework instituted at local, national, regional and global arena.

1.1 Statement of the Research Problem

Environmental concerns on our planet are among the most serious challenges affecting people's well-being. Extreme climate events are more severely felt in developing countries such as the Sub-Saharan Africa. They are the hardest hit by environmental destruction yet they have the fewest resources available to adapt to the situation. Basic commodities such as food and water are adversely affected in the region.

Addressing this problem requires concrete actions on climate change adaptation and mitigation which will increase resilience of these countries. In Kenya, the government has acknowledged the problem of climate change and environmental degradation, and has developed the National Climate Change Strategy (2010) and National Climate Change Action Plan. Beyond the policies and plans, little is known to be practically taking place to address this topical problem. Indeed, actions towards addressing this are at best disjointed with no clear implementation framework. The World Bank disclosed that in its Africa programs, the institution has not been able to integrate environmental stewardship centrally and integrally into country

³ *Mau Complex and Marmanet Forests. Environmental and Economic Contributions. Current State and Trends.* UNEP. 2008. <http://www.unep.org/dewa/Portals/67/thickbox/maucomplex.html> accessed on 26th August 2015.

programs.⁴ Similarly, a meeting on Intergovernmental Panel on Climate Change (IPPC) held in Kampala Uganda in November 2011 affirmed that whereas climate change has significant impact on Africa's development agenda, very little has been accomplished in terms of development of a practical action to address climate change.⁵

The study focuses on examining the mechanisms for contributing to sustainable environment in Africa. It investigates the extent to which state and non-state actors in Kenya are implementing effective climate change adaptation measures in order to increase the country's resilience. It further seeks to identify the roles of these actors in combating the effects of climate change as well as effective adaption and mitigation measures to enhance environmental sustainability with socio-economic development in Kenya.

1.2 Research questions

The purpose of the study is to analyze and compare the available climate change adaptation measures geared towards environmental sustainability. In doing so, the study will attempt to answer the following questions.

1. What are the climate change adaption and mitigation measures for achieving environmental sustainability implemented by relevant players in Africa?
2. What roles are the key state and non-state actors playing in addressing climate change and its negative impacts in the region?
3. Are there any other factors that can enhance resilience to climate change and contribute to environmental sustainability?

⁴ *Environmental Sustainability: An Evaluation of World Bank Group Support*. The World Bank. Washington DC. 2008, P 2.

⁵ IPCC, 2011: Summary for Policymakers. In: IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation, O. Edenhofer, et al, (eds), Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

1.3 Objectives of the Research

The broad objective is to examine the status of climate change action plan and environmental sustainability in Africa generally and in Kenya specifically. The specific objectives are to:

1. Understand the relationship between climate change and environmental sustainability in Africa.
2. Establish the effectiveness of the climate change adaptation/mitigation options that can be used to enhance climate change resilience in Africa and particularly in the case of Kenya.
3. Analyze the role of state and non-state actors in the implementation of a regional as well as national climate change action plan for environmental sustainability in Kenya.

1.4 LITERATURE REVIEW

This section reviews literature for global environmental sustainability and climate change related issues as they affect the globe, region and Kenya in particular. It also identifies knowledge gaps in the available body of literature.

1.4.1 What is Environmental Sustainability?

Environmental sustainability is the ability to maintain the qualities that are valued in the physical environment. It is a state in which demands placed on environment can be met without reducing its capacity to allow all people to live well, now and in the future.⁶ This entails measures that ensure environment is not depleted or damaged more than it has already been. As the world faces a myriad of environmental challenges, the need to put in place mechanisms to ensure environmental sustainability has gained urgency. Many of these challenges are attributed to climate change phenomena.

⁶ Growth, Well-being and Environmental Sustainability." *OECD Economic Surveys - Turkey*. Paris: OECD Publishing, 2014. P 12.

The relationship between economic development and environmental degradation were first placed on the international agenda in 1972 at the United Nations Conference on the Human Environment held in Stockholm, Sweden.⁷ The conference's declaration contained 26 principles concerning environment and development, key among them the need to safeguard natural resources, assertion that pollution must not exceed environment's capacity to clean itself and the need for development to support environment. One of the major outcomes of the conference was setting up of United Nations Environment Program (UNEP) in Nairobi to act as a global catalyst for action to protect environment. The body is charged with responsibility to ensure compliance and enforcement of Multilateral Environment Agreements (MEAs).

A historic moment on environmental sustainability was realized during the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro on 3rd – 14th June 1992.⁸ Named the *Earth Summit*, the conference advanced the essence of environmentally sustainable development. It adopted major agreements that were bound to change the traditional approach to development. The message from the conference reflected the complexity of problems facing the world; that both poverty and affluent populations place damaging stress to the environment. The governments recognized the need to re-direct national and international plans and policies to ensure that all economic decisions fully took into account any impact on the environment.⁹ An important achievement of the summit was an agreement on Climate Change Convention which in turn led to Kyoto Protocol. Similarly, the Convention on Biodiversity Diversity (CDM) and United Nations Convention to Combat Desertification

⁷ Declaration of the United Nations Conference on the Human Environment. UNEP <http://www.un.org/geninfo/bp/envirp2.html>. Accessed on 2nd Sept 2015.

⁸ United Nations Conference on Environment and Development (UNCED). United Nations, 1972. <http://www.un.org/geninfo/bp/enviro.html> Accessed on 25th October 2015.

⁹ United Nations Conference on Environment and Development (UNCED). United Nations, 1972. <http://www.un.org/geninfo/bp/enviro.html> accessed on 25th October 2015.

(UNCCD) were opened for signature at the summit.¹⁰ In addition, the summit produced the Forest Principles, which are a set of principles to bring sustainable management of forests worldwide.

Millennium Development Goals (MDGs) were the world's time-bound targets for addressing extreme poverty in its many dimensions.¹¹ Goal seven (7) of MDGs was about ensuring environmental sustainability. In Africa, achieving environmental sustainability is a challenge, especially with the emerging threat of climate change. Though Africa is doing well in limiting CO₂ emissions and ozone-depleting substances, the shrinking forest cover and struggle to meet targets on water and sanitation remains a big challenge.¹² In sub-Saharan Africa, the proportion of land covered by forest shrank from 29.4 per cent in 1990 to 28.1 per cent in 2010. The MDGs ended in 2015 with mixed performance over the spectrum of 8 goals.¹³

Sustainable Development Goals (SDGs) replaced the MDGs in 2015, and seek to address the broader sustainability agenda with a focus on root causes of poverty and the universal need for development that works for all people.¹⁴ With a time frame of 15 years (2015-2030), SDGs' 17 goals also aim at putting the world on an inclusive and sustainable path while meeting the citizens' aspirations for peace, prosperity and preserving the planet. Seven out of these goals are related to environmental sustainability. Goal 6 focuses on universal access to clean water and sanitation, while goal 7 calls for affordable, reliable, sustainable and modern clean energy for all. Goal 11 aims at making cities inclusive, safe, resilient and sustainable given that more than half of the world's population live in urban areas while Goal 12 seeks to ensure sustainable

¹⁰ Ibid.

¹¹ Millennium Development Goals- UN Project. www.unmillenniumproject.org/goals/ accessed on 27th July 2016

¹² *MDG Report 2015: Assessing Progress in Africa towards Millennium Development Goals*. United Nations Economic Commission for Africa, African Union, African Development Bank and United Nations Development Programme. 2015. Addis Ababa, Ethiopia.

¹³ Ibid.

¹⁴ UNDP. *Sustainable Development Goals*. www.undp.org/content/undp/en/home accessed on 27th July 2016.

consumption and production patterns by reducing ecological footprint. Goal 13 is crucial as it calls for urgent action to combat climate change and its impact in order to strengthen the resilience and adaptive capacity of vulnerable regions. Goals 14 and 15 addresses conservation and sustainable use of oceans, seas and marine resources; and sustainable management of forests to combat desertification and halt biodiversity loss respectively.¹⁵

1.4.2 Climate change

Climate change refers to any change in climate over time, either due to natural variability or as a result of human activity.¹⁶ It is acknowledged that though earth's climate has been changing for millions of years, human activity has accelerated climate variability over time. The combination of natural and human induced forces has witnessed an increase in atmospheric concentration of Greenhouse Gas (GHGs) emissions (mainly CO₂, water vapor, methane and nitrous oxide). These can alter the energy balance of earth's climatic system, thus influencing climate change. According to Inter-Governmental Panel on Climate Change (IPCC), the planet is warming at 0.1-0.2° C per decade as a result of increased GHGs that trap the earth's heat.¹⁷ Though the change may appear small, such minute change in climate can lead to disastrous situations that are difficult to reverse. This is evident when overexploitation of resources is combined with even small changes to the climate, thresholds are crossed that lead to surprising changes in the ecosystems that people depend on for food.¹⁸

¹⁵ UNDP. Sustainable Development Goals (SDGs). www.undp.org/content/dam/undp/library accessed on 27th July 2016.

¹⁶ C. Webersik, *Climate Change and Security: A Gathering Storm of Global Challenges*. Praeger. Santa Barbara CA. 2010. P 2

¹⁷ IPCC, 2015: Meeting Report of the Intergovernmental Panel on Climate Change Expert Meeting on Climate Change, Food, and Agriculture [Mastrandrea, M.D., K.J. Mach, V.R. Barros, T.E. Bilir, D.J. Dokken, O. Edenhofer, C.B. Field, T. Hiraishi, S. Kadner, T. Krug, J.C. Minx, R. Pichs- Madruga, G.-K. Plattner, D. Qin, Y. Sokona, T.F. Stocker, M. Tignor (eds.)]. World Meteorological Organization, Geneva, Switzerland, P 68.

¹⁸ T.R McClanahan, J.E. Cinner. *Adapting to a Changing Environment: Confronting the Consequences of Climate Change*. Oxford University Press. New York. 2012. P 2

Cooper (1994) asserts that climate change can be attributed to the industrial revolution which has resulted in the accumulation of GHGs as a result of economic activities based largely on burning of fossil fuels.¹⁹ Webersik (2010) stated that the largest share of anthropogenic GHG emission comes from the energy sector (25.9%), industry (19.4%) and forestry (17.4%).²⁰ Increased levels of GHGs lead to increased temperature, reduced precipitation, storms and glacial melt resulting in sea level rise.

According to IPCC report (2014), anthropogenic GHG emissions have increased since industrial era largely due to population and economic growth. The decade 2000 – 2010 witnessed the highest emissions in history. These have driven the atmospheric concentration of CO₂, methane and nitrous oxide to unprecedented levels in the last 800,000 years, leading to uptake of energy by the climate system.²¹ Some of the consequences include the warming of atmosphere and oceans, diminishing of snow and rise in sea level.

Continued emission of GHG will cause further warming and more changes in climate system.²² This will increase likelihood of severe pervasive and irreversible impacts for people and ecosystems. Limiting climate change would require substantial and sustained reduction in GHG emissions, together with adaptation measures.

¹⁹ R.N. Cooper, *Environment and Resources, Policies of the World Economy*. Donnelley. Washington DC. 1994. P 40

²⁰ C. Webersik, *Climate Change and Security: A gathering Storm of Global Challenges*. Praega. Santa Barbara CA. 2010. P 2

²¹ IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland.

²² Ibid.

1.4.3 The Earth's Climate System

The climate system is a complex, interactive system consisting of the atmosphere, land surface, snow and ice, oceans and other bodies of water, and living things.²³ The atmospheric component of the climate system is the most obvious characterization of climate. Climate is usually described in terms of the mean and variability of temperature, precipitation and wind over a period of time, ranging from months to millions of years (the classical period is 30 years and above). The climate system evolves in time under the influence of its own internal dynamics and due to changes in external factors that affect climate (called *forcings*).²⁴ External *forcings* include natural phenomena such as volcanic eruptions and solar variations, as well as human-induced changes in atmospheric composition. Solar radiation powers the climate system. There are three fundamental ways to change the radiation balance of the Earth. These include changing the incoming solar radiation, changing the fraction of solar radiation that is reflected and finally altering the long-wave radiation from Earth back towards space.²⁵ Climate, in turn, responds directly to such changes, as well as indirectly, through a variety of feedback mechanisms.

1.4.4 Green House Gas (GHG) Emissions

A greenhouse gas is any gaseous compound in the atmosphere that is capable of absorbing infrared radiation, thereby trapping and holding heat in the atmosphere.²⁶ This increase of heat in the atmosphere is responsible for the greenhouse gas effect, which ultimately leads to global warming.

The basis of this can be traced to the sun bombarding the earth with enormous amount of radiation, which strikes the atmosphere in the form of visible as well as invisible light (such as

²³ Parry, et al (Eds)., *Climate Change 2007: Impacts, Adaptation and Vulnerability*. UK: Cambridge University Press, 2007. P 14.

²⁴ Ibid.

²⁵ J. Cowie. *Climate: Biological and Human Aspects*. Cambridge University Press, 2007, P 22.

²⁶ M. Lallanilla. *Greenhouse Gas Emissions: Causes & Sources*. Washington DC: Donnelley. 2014.

ultraviolet and infrared). Thereafter approximately 30% of the radiation is reflected back out to space by clouds, ice and other reflective services. The remaining 70% is absorbed by the land, oceans and the atmosphere.²⁷ As they absorb radiation and heat up, the oceans, land and atmosphere release heat in the form of infra-red thermal radiation, which passes out of the atmosphere into space. This exchange of incoming and outgoing radiation that warms earth is often referred to as the 'greenhouse gas effect'.

The two most abundant gases in the atmosphere, nitrogen (comprising of 78% of dry atmosphere) and oxygen (comprising of 21%) exert almost no greenhouse effect.²⁸ The greenhouse gas comes from molecules that are more complex and less common. The most significant greenhouse gases are water vapour (H₂O), carbon dioxide (CO₂), methane CH₄) and nitrous oxide (N₂O). Water vapour is the most important greenhouse gas, followed by carbon dioxide.

While some scientist argue that global warming is a natural process and that there has always been greenhouse gases, the amount of carbon dioxide in the atmosphere has increased tremendously in the recent history. The industrial revolution had a big part to play in the amount of carbon dioxide released in the atmosphere. According to the National Oceanic and Atmospheric Administration (NOAA), the amount of CO₂ has drastically increased to 100 times faster than the increase when the last ice age ended.²⁹

²⁷L Ecola, S. Hassell, M. Toman & M. Wachs . *Integrating U.S. Climate, Energy, and Transportation Policies: Proceedings of Three Workshops*. Rand. Santa Monica, CA. 2009, P 5.

²⁸ IPCC, 2007: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. P 7.

²⁹ . W. F. Ruddiman. *Plows, Plagues, and Petroleum: How Humans Took Control of Climate* .Princeton University Press. Princeton, NJ. 2010. P 34.

The sources of greenhouse gases are varied, and it is important to understand these sources as we endeavor to address the global warming. Carbon dioxide is largely a result of natural processes such as respiration, and from burning of fossil fuels like coal, oil and gas. Another cause of CO₂ release is deforestation. When trees are removed as firewood or to produce goods, they release the carbon that is normally stored for photosynthesis. According to Global Forest Resources Assessment (2010), nearly a billion tons of carbon is released through this process each year.³⁰ Methane, on the other hand is produced through agricultural practices including livestock manure management.

1.4.5 Current and Future Impacts of Climate Change

There are many impacts of climate change which are felt universally such as erratic climate and extreme weather conditions, altered ecosystems and habitats and risks to human health and security.³¹ Some scholars argue that the climate change may lead to unsustainable practices resulting in severe environmental damage. This scenario could lead to resultant struggle for natural resources which can bring about starvation, ethnic tension, wars, increased diseases, emigrations and turmoil. Indeed, in the recent times we have witnessed conflicts where resources interact with politics in the African countries of Zimbabwe, Rwanda, Ethiopia, Kenya's Rift Valley and coast regions and Sudan.³² This is an indication that climate change is a potential source of conflicts in the region and beyond.

Climate change is a major threat to agriculture and as a result, the world's food security is at risk. Farmers all over the world are struggling to keep up with shifting weather patterns and increasingly unpredictable water supplies. They must also contend with unexpected attacks from

³⁰ *Global Resource Forest Assessment 2010*. FAO Forestry Paper No 163. FAO, Rome. 2010 P 54.

³¹ T.R McClanahan, J.E. Cinner. *Adapting to a Changing Environment: Confronting the Consequences of Climate Change*. Oxford University Press. New York. 2012. P 45.

³² Ibid.

weeds, diseases and pests which affect yield. In addition, warmer, polluted air affects human health through airborne diseases and contamination of drinking water. Indeed, a warmer atmosphere increases chemical reaction that forms smog, a well-known lung irritant and a major trigger of asthma attack. With regards to infrastructure, hot weather, flooding and other extreme weather events damage infrastructure, put heavy burden on electrical supplies and generally affects transportation.

According to IPCC (2007) report, by 2020, between 75 and 250 million people in Africa will face water stress due to climate change. In the same period, some countries will have their yields from rain-fed agriculture reduced by up to 50%. This will further adversely affect food security and exacerbate malnutrition. 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 5-10% GDP. By 2080, an increase of 5-8% of arid and semi-arid land is projected under a range of climate scenarios.³³

1.4.6 Climate change adaptation

Climate change adaptation is a response to global warming that seeks to reduce vulnerability of social and biological system to climate change thereby offsetting the effects of global warming.³⁴

It is the principal way of dealing with the impacts of a changing climate that involves taking practical actions to manage risks from climate impacts, protect communities and strengthen the resilience of the economy. Adaptation is especially important in developing countries that are predicted to bear the brunt of global warming. Indeed, it is argued that the adaptive capacity for

³³ IPCC 2007. *Climate Change 2007: Synthesis Report*. Lenny Bernstein, Peter Bosch, Osvaldo Canziani, Zhenlin Chen, Renate Christ, Ogunlade Davidson, William Hare, Saleemul Huq, David Karoly, Vladimir Kattsov, Zbigniew Kundzewicz. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Pg 36

³⁴ D. A. Cole, Climate Change, Adaptation, and Development. *UCLA Journal of Environmental Law and Policy*. Vol. 1 No. 3 (2008). PP 82-102: 88.

humans is unevenly distributed across different regions and populations, and developing countries generally have less capacity to adapt.³⁵

Societies across the world have a long record adapting and reducing their vulnerability to the impacts of weather and climate related events such as floods and drought. Nevertheless, additional adaptation measures will be required at global, regional, national and local levels to reduce the adverse impacts of projected climate change variability. However, adaptation alone is not expected to cope with all projected effects of climate change as most impacts increase in magnitude.³⁶

Some sectors have adaptation measures that are either being implemented or are planned to be implemented. For water sector, the strategies include expanded rain water harvesting, water storage, conservation techniques, desalination, water re-use and irrigation efficiency. On agriculture, adjustment of planting dates, crop variety and improved land management are useful strategies. On infrastructure and settlement, adaptation options include relocation, dune reinforcement, land acquisition and creation of wetlands as buffers against sea level rise and flooding. Options for transport sector include realignment or relocation, design standards and planning for roads, rail and other infrastructure to cope with warming and drainage.³⁷

The economic cost of adaptation to climate change is likely to be very high over the next decades. There was hope when donor countries promised an annual \$100 billion by 2020 through

³⁵ *World Development Report 2010. Development and Climate Change*. The World Bank. Washington DC. 2010. P 56.

³⁶ IPCC 2007. *Climate Change 2007: Synthesis Report*. Lenny Bernstein, Peter Bosch, Osvaldo Canziani, Zhenlin Chen, Renate Christ, Ogunlade Davidson, William Hare, Saleemul Huq, David Karoly, Vladimir Kattsov, Zbigniew Kundzewicz. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. P 56.

³⁷ Green, Donna; Alexander, Lisa; McInnes, Kathy; Church, John; Nicholls, Neville; White, Neil. *An assessment of climate change impacts and adaptation for the Torres Strait Islands, Australia*. 2010. *Climatic Change* **102** (3-4): 405–433.

the Green Climate Fund for developing countries to adapt to climate change.³⁸ However, while the funds were set up at during Conference of Parties (COP) 16 in Cancun, the concrete pledges by developed countries are yet to materialize.

The Kenya National Climate Change Response Strategy (NCCRS) has identified a number of sectoral adaptation needs.³⁹ These measures have to be undertaken through various sectors subject to availability of resources. It recommends broad adaptation and mitigation measures needed to minimize risks associated with climate change. However, the strategy does not offer any specific interventions with details of operationalization of the strategy.

1.4.7 Climate change mitigation

Climate change mitigation refers to efforts to reduce or prevent emission of greenhouse gases. Its goal is to avoid dangerous human interference with climate change system and to “stabilize greenhouse gas levels in a timeframe sufficient to allow ecosystems to adapt naturally to climate change, ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner”⁴⁰ Mitigation can mean using new technologies and renewable energies, making older equipment more efficient, or changing practices or consumer behavior. The measures range from simple technologies such as improved cooking stoves to complex ones such as high tech subway systems.

Some of the key mitigation measures are enumerated, with a focus on forestry, agriculture, industry, buildings, energy and transport systems. An important intervention entails protecting natural carbon sinks like forests and oceans, or creating new sinks through silviculture

³⁸ Benito Müller, *International Adaptation Finance: The Need for an Innovative and Strategic Approach 4* (Oxford Institute for Energy Studies, Working Paper) 2008. P 56.

³⁹ Government of Kenya. *Kenya National Climate Change Response Strategy*. 2010. P 7.

⁴⁰ IPCC 2001, Metz, B.; Davidson, O.; Swart, R.; and Pan, J., ed., *Climate Change 2001: Mitigation, Contribution of Working Group III to the Third Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press. 2001 P 43.

or green agriculture. These will remove greater amounts of carbon dioxide from the atmosphere. Specifically, forestry interventions such as afforestation, reforestation, reduced deforestation and improvement of tree species to increase biomass productivity and carbon sequestration would go a long way in mitigating climate change effects. In agriculture, improved crop and grazing land management to increase soil carbon storage, restoration of cultivated peaty soils and degraded land and improvement of nitrogen fertilizer application techniques to reduce N₂O emissions are some of the mitigation strategies available for farmers. In the energy sector, mitigation strategies include improved supply and distribution efficiency, fuel switching from coal to gas, nuclear power, renewable heat and power such as geothermal, hydropower, solar, wind and bio-energy. Mitigation strategies for transport sector include more fuel efficient vehicles, cleaner diesel vehicles, bio-fuels and non-motorized transport such as walking or cycling. In the industrial front, mitigation measures include more efficient end-use electrical equipment, heat and power recovery, material recycling and substitution and advanced energy efficiency. Finally, mitigation measures on buildings include efficient lighting and day-lighting, more efficient electrical appliances and heating and cooling devices, improved cooking stoves, improved insulation and active and passive solar designs for heating and cooling.⁴¹

In the foregoing, it is noted that no single technology can provide all of the mitigation potential in any sector. The mitigation potential can only be achieved when adequate policies are in place and barriers removed. As is the case with adaptation, mitigation needs a lot of resources to implement the measures. Developing countries will therefore require support from development partners to implement these measures.

⁴¹ IPCC 2007. *Climate Change 2007: Synthesis Report*. Lenny Bernstein, Peter Bosch, Osvaldo Canziani, Zhenlin Chen, Renate Christ, Ogunlade Davidson, William Hare, Saleemul Huq, David Karoly, Vladimir Kattsov, Zbigniew Kundzewicz. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. P 60.

1.4.8 Gaps in the Literature

The Kenya Government has acknowledged existence of climate change and the need to institute appropriate mitigation and adaptation measures to achieve environmental sustainability. This is manifested in the formulation of the National Climate Change Response Strategy and National Climate Change Action Plan to address the adverse effects of these phenomena. However, since the formulation of these policies in 2010, the various sectors in the strategy are yet to practically integrate the actions into their programmes. There appears to be a disconnect between these policies and climate change action plan implementation, and this study will seek to identify the factors affecting effective implementation of the same. The same scenario is reflected in the region and indeed Africa, as alluded in the IPCC held in Kampala Uganda in November 2011. Further, the study seeks to elaborate key sectoral climate change interventions aimed at achieving environmental sustainability.

1.5 Hypotheses

The study tests the following hypothesis

1. Climate change adaptation measures are a pre-requisite to sustainable environment in Africa
2. Poor implementation of climate change action plan results in environmental degradation in the region.
3. Effective environmental and climate change adaptation/mitigation measures have led to sustainable environment in Kenya.

1.6 Justification of the Study

The study recognizes that there has been little progress towards achievement of global environment sustainably. While developing countries still requires rapid growth to reduce poverty over the next decade, the global environment has reached a critical state that could undermine livelihoods, productivity, and economic progress. The study will therefore provide

new information to state and non-state actors to implement climate change actions geared towards achieving the global environmental sustainably.

This study will help policy makers within the concerned ministries to strengthen global environmental sustainably through climate change action in Kenya. The Conference of Parties of the United Nations Framework Convention on Climate Change held in Durban, South Africa in December 2011 pointed at the continued challenges and obstacles regarding climate change resilience in Africa. This study will attempt to contribute to climate change action plan. Finally, the study will contribute to scholarly and academic literature on global environmental sustainably through climate change action in Kenya.

1.7 Theoretical Framework

The study adopted the Environment Security theory which examines threats posed by environmental events and trends to individual, communities or nations.⁴² It is appreciated that environmental issues transcend state borders and therefore have become a focus of international relations in the quest to understand, build consensus on solutions and effectively respond to them. Environmental Security can be defined as the relationship of environmental factors such as water, vegetation and soil that ultimately underpin all socio-economic activities and hence political stability.⁴³ According to the Millennium Project, environmental security is the viability of environment to support life and has three sub-elements.⁴⁴

1. Preventing or restoring damage to the environment
2. Preventing or responding to environmentally caused conflicts, and
3. Protecting the environment due to its inherent moral values.

⁴² Westing, A.H. "An Expanded Concept of International Security" in *Global Resources and International Conflict*, ed. Arthur H. Westing. Oxford: Oxford University Press, 1986 P 34.

⁴³ Norman Meyers. *Environmental Security: What's New and Different? Policy Background*, University of Peace, 2004. www.environmentsecurity.org. accessed on 30th December 2015.

⁴⁴ Gleick, P H. The Implications of Global Climate Changes for International Security. *Climate Change 15* (1989): pp. 303–325, P 322.

It considers the abilities of the individuals, communities or nations to cope with environmental risks, changes or conflicts, or limited natural resources. An example is the climate change, which can be viewed as a threat to the environmental security. This is illustrated by human activities that contributes to greenhouse gas emissions hence impacting regional and global climate regime with adverse effect on agricultural sector. The resultant food shortage has a potential of causing ethnic tensions, civil unrest and conflicts. These conflicts have increasingly been linked to environment in a wide context. Environmental deficiencies provide conditions which render conflicts more likely to occur, with some scholars arguing that environmental scarcity plays a role as an independent variable in violent conflict.⁴⁵ Water deficits, deforestation, soil erosion, desertification, decline in marine resources and other environmental problems have been linked to conflicts. The Ogaden war between Ethiopia and Somalia was caused in large measure by deforestation, soil erosion and increased population, while tensions between Turkey on one hand and Syria and Iraq on the other hand over rivers Tigris and Euphrates have persistent for sometimes.⁴⁶

There is a nexus between environmental security theory and this study on environmental sustainability and climate change action plan in Kenya. According to National Climate Change Response Strategy, the evidence of climate change in Kenya is unmistakable.⁴⁷ The report refers to irregular and unpredictable rainfall, intense floods the increase in temperature experienced in the country as a manifestation of this phenomena. With respect to resource degradation, the destruction of the Mau forest complex is arguably the largest single lose of forest area in the

⁴⁵ Floyd, Rita. *The Environmental Security Debate and Its Significance for Climate Change*. University of Warwick. 2008. P 23.

⁴⁶ Norman Meyers. *Environmental Security: What's New and Different? Policy Background*, University of Peace, 2004. www.environmentsecurity.org. accessed on 30th December 2015.

⁴⁷ *National Climate Change Response Strategy. Executive Brief*. Government of Kenya. 2010, P 9.

country.⁴⁸ This has had ramifications in terms of reduced water flow from the biggest water catchment area in the country. Further, conflicts over natural resources in Kenya are not new, as witnessed in the recent violent conflict between a grazing community and a farming community in Maai Mahiu over water and land resources.⁴⁹ These issues resonates with the environment security theory, especially as this study seeks to investigate the appropriate measures to address adverse effects of climate change in the country.

Related to this argument, some scholars have contended that continuous environmental degradation decrease economic growth, hampers social cohesion, and destabilizes political structure of a nation.⁵⁰ Alteration of environmental regimes reduces economic opportunities for a country by causing displacement of population across international borders hence rising political tensions between neighbouring states. In the international development discourse, projects may aim to improve aspects of environmental security such as food security and water. This is related to the area of focus of this study where Kenya's engagements with its neighbouring countries in addressing these aspects of environmental security will be examined. On a broader perspective, the target for Millennium Development Goal (MDG) 7 about environmental sustainability indicates international priorities for environmental issues. The study will seek to determine the performance of the African continent, sub-region and Kenya in this regard.

⁴⁸ Mau Complex and Marmanet Forests. Environmental and Economic Contributions. Current States and Trends. UNEP, 2008. www.unep.org/pdf/Mau_Complex accessed on 8th February 2016.

⁴⁹ Kisuke Ndiku. *Conflict in Kenya*. Transconclit. www.transconflict.com/gcct/gcct-members/ accessed on 8th Feb 2016.

⁵⁰ Biswan, Ranjan Niloy. Is Environment a Security Threat? Environmental Security beyond Securitization. *International Affairs Review*. Vol. XX, No 1: 2011 P 56.

1.8 METHODOLOGY OF THE RESEARCH

1.8.1 The Study Area

The study will be carried out in Kenya with a focus on state and non-state actors at national level. Specifically, the study will be conducted in Nairobi with interviews conducted in various key ministries, government institutions and Non-Governmental Organizations. It is expected that information on field based programmes will be obtained from the headquarters during the interviews. In addition, data on key parameters of climate change, that is temperature and rainfall, will be sought from Kenya Meteorological Department covering a 34 year period. This will provide the trend over the last half a century.

Kenya has a population of approximately 45 Million with a growth rate of 2.57%. It lies between latitudes of 4° N and 4° S and between longitudes of 34° E and 42° E. It is bordered by Somalia to the east, Uganda to the west, Tanzania to the south, Sudan to the north-west, Ethiopia to the north, and the Indian Ocean to the south-east. The area of both land and sea is approximately 584,000 km². The country has varied climatic and ecological extremes with altitude varying from sea level to more than 5000 m in the highlands. The mean annual rainfall ranges from less than 250 mm in semi-arid and arid areas to over 2000 mm in high potential areas. Soils vary from swampy, alluvial, and black cotton soils along river valleys and plains to the coral types on the coast. The highlands have fertile volcanic soils whereas in the semi-arid regions the soils are shallow and infertile. Such diversity in edaphic and climatic conditions has encouraged the evolution of a wide variation in plant genetic resources.⁵¹

1.8.2 Research design

This study will adopt qualitative design in its conduct and utilize descriptive research designs. Descriptive research design is a scientific method which involves observing and describing the behavior of a subject without influencing it in any way. Many scientific disciplines, especially

⁵¹ Government of Kenya 2010. *Agricultural Sector Development Strategy 2010-2020*.

social science, use this method to obtain a general overview of the subject. It is also employed where testing and measuring large number of samples for more quantitative types of experimentation is impossible. An in-depth study on climate change actions that contribute to environmental sustainability will be done. This method enhances the study helping researcher better understand the interactions of climate change and environment.

1.8.3 Study population

Population of the study will target state actors such as Ministry of Environment & Natural Resources, Ministry of Agriculture, Kenya Forest Service (KFS) well as non-state actors such as Kenya Forest Working Group (KFWG), Forest Action Network (FAN), a Community Based Organization (CBO) and an Non-Governmental Organization (NGO) at the national level. The study collects data on rainfall and temperature from Kenya Meteorological Department.

1.8.4 Instruments for Data Collection

The researcher will rely on both primary and secondary data. Primary data will be obtained through administering interviews to key informants from both from state and non-state actors dealing with sectors affected by climate change. Secondary data will be obtained from published data available from libraries including on-line libraries such as Questia and J-store. This will comprise books, journals and newspaper articles. With technology development, internet sources will form an important source of data in form of latest development in the field.

Considering the time and other resource limitations, the researcher will focus on purposive and snowball sampling methods in order to obtain in-depth information.⁵² Officials of the key ministries dealing with environment and natural resources and agriculture sectors who can give authoritative information will be targeted with the use of interviews and focus group

⁵² F.J. Laurence & C. Oslon., *Political Science Research, a Handbook of Scope and Methods*, (New York: Long Horn 1996). PP 214-336.

discussions targeting the representatives of the institutions. The data collected in the interviews will be analyzed by use of Excel spreadsheet. It will thereafter be presented in graphs, tables and pie charts.

1.8.5 Limitation of the Research

The research will cover the ten institutions based in Nairobi as outlined in section 1.8.3 due to limitation of time and financial constraints.

1.9 Chapter Outline

This study will cover five chapters. The first chapter covers the background of the study and includes the statement of the research problem, objectives, literature review, justification, theoretical framework, hypothesis and research methodology. The application of concepts of environmental sustainability and climate change in Africa will cover chapter two. The role of state and non-state actors in implementation of climate change action in the African region will be covered in chapter three. Chapter four is the analysis of the effectiveness of climate change adaptation measures on environmental sustainability in Kenya. Chapter five gives conclusions on the main findings and provides policy guidelines for future planning and strategic management of climate change mitigation and adaptation programs in Kenya. The chapter will conclude with a summary of key findings and recommendations; and areas for further research.

CHAPTER TWO

CLIMATE CHANGE AND ENVIRONMENTAL SUSTAINABILITY IN AFRICA: AN OVERVIEW

2.0 Introduction

In order to address climate change in the continent, it is important to understand the relationship between climate change and environmental sustainability from a global as well as the African perspective. It is well acknowledge that natural resources underpin economic growth in the developing countries especially in Africa. However, unsustainable utilization of these resources often leads to environmental degradation with adverse effects to the larger population especially the poor in the society. This is further compounded by the impact of climate change, which manifests itself in form of severe drought, flooding and altered climatic regimes, affecting agriculture and food security among other basic needs. Against this background, this chapter examines the inter-relation between climate change and environmental sustainability in the context of African continent, with a focus on the impact of the former on the latter.

2.1 Environmental Sustainability: An introduction to the concept

Environment sustainability refers to maintenance of the integrity of diverse systems in order to uphold their functions and beneficial use for the present and future generations.⁵³ Resource degradation undermines attainment of this with global challenges ranging from air and water pollution to soil erosion, water scarcity, deforestation and loss of biodiversity. These problems are especially severe in developing countries and have adverse impact particularly on the poor. The scale of environmental degradation has taken a new dimension in the current globalized world, where actions of one country often have impact well beyond its borders, and its

⁵³ *Sustainable Development Report on Africa: Managing Land Resources for Sustainable Development*. United Nations Economic Commission for Africa. 2005. P 56

environmental footprints expand in tandem with national economic growth.⁵⁴ Solutions to environmental problems are among the most significant and overarching issues that need to be addressed domestically as well as trans-nationally.

2.1.1 Key Impacts on Environmental Sustainability in Africa

Africa has experienced environmental degradation due to wide range of factors such as deforestation, soil degradation, loss of biodiversity, desertification and pollution. This is discernible through the presence of gullies, sand dunes, degraded forests and grazing lands that are widespread in the continent's landscape. However, the effects of sheet erosion and declining soil fertility are less obvious and are hardly noticed. In this section, we examine some of the issues that undermine environmental sustainability.

Deforestation is rampant in the continent to an extent of threatening one of the continent's most important resources. Forests are the principle source of rural energy, and provide wood, timber, medicinal and other products for both domestic and industrial purposes. They often supply food, animal feed, building materials and act as a source of employment and income for many rural Africans. It is estimated that about 4 million hectares of this resource are either deforested or degraded annually, largely in humid and sub-humid West Africa.⁵⁵ The rate of destruction is alarmingly high in Cameroon, Côte d'voire and Nigeria.⁵⁶ The cause of deforestation is mainly clearing for agriculture, uncontrolled logging, fuel wood, and overgrazing. Ninety per cent (90%) of Africa's population is dependent on wood fuel for domestic heating and cooking and Sub-Saharan Africa utilizes 500 million tons of wood for

⁵⁴ *Environmental Sustainability*, An Evaluation of World Bank Group Support. The World Bank, Washington DC, 2008, P 2.

⁵⁵ FAO. *Land and environmental degradation and desertification in Africa*. .www.fao.org/docrep accessed on 30th May 2016.

⁵⁶ Ibid.

energy per year, making it the highest consumer in the world.⁵⁷ Between 1990 and 2000, Africa's forests and woodlands receded at an average of 0.8 per cent against the global average of 0.2 per cent.⁵⁸

Related to this is the issue of land degradation which forms a major part of environmental degradation. It refers to loss in productivity of the land and its ability to provide qualitative and quantitative goods or services due to natural or human induced changes.⁵⁹ An FAO/UNEP assessment of land degradation in Africa indicates that large areas especially in the countries north of the equator suffer from serious desertification problems, with the desert estimated to be moving at an annual rate of 5 km in the semi-arid areas of Western Africa.⁶⁰ Similarly, Global Assessment of Soil Degradation reported that an estimated 65% of African agricultural land, 31% of pasture land, and 19% of forests and woodland are degraded.⁶¹ This has a direct effect on food production, and the most conspicuous symptoms of the negative impact of land degradation is stagnating and declining yields and increased poverty levels.⁶²

Soil degradation which is mainly a consequence of deforestation is also a serious threat in Africa. It leads to loss of biological and economic activity of the land. Deforestation exposes the soil to high temperatures which break down the organic matter, increasing evaporation and making the soils vulnerable to erosion. The expansion of agriculture which involves cultivation of marginal areas or clearance of important natural habitats such as forests and wetlands are the

⁵⁷ FAO. *Land Degradation and Desertification in Africa*. Rome Italy, 2013. P 15.

⁵⁸ FAO (2005). *State of the World's Forests 2005*. Food and Agriculture Organization of the United Nations, Rome. Italy. p 234.

⁵⁹ Blaikie, P. Brookfield, H, *Land Degradation and Society*. Methuen & Co. Ltd, London. 1987. P 12.

⁶⁰ F. Nachtergaele, R. Biancalani and M. Petri. *Land Degradation. SOLAW Background Thematic Report 3*. FAO. Rome, Italy. 2012 p 12.

⁶¹ Sivakumar, M.K.V., Wills, J.B. *Combating Land Degradation in Sub-Saharan Africa: Summary Proceedings of the International Workshop for a Desert Margins Initiative, 23-25 January 1995*. Nairobi, Kenya & Patancheru, Andhra Pradesh, India. 1995. P 45.

⁶² FAO. *Land Degradation and Desertification in Africa*. Op cit, P 8.

main cause of soil degradation. The loss of natural habitat has reduced vegetation cover and exposed soils to wind and water erosion, with an estimated 25 per cent and 22 per cent of the land in the continent being vulnerable to water and wind erosion respectively.⁶³ FAO further estimates that many areas in the continent are losing over 50 tones of soil per hectare per year, which is equivalent to a loss of 20 billion tones of Nitrogen, 41 billion tones of potassium and 2 billion tones of phosphorous per year.⁶⁴ Similar estimates indicate that the causes of soil degradation in Africa include overgrazing (49%), agricultural mismanagement (28%), deforestation (14%) and overexploitation of vegetation for industrial and domestic use (13%).⁶⁵

The Eastern African region has similarly faced an alarming rate of environmental degradation, which has led to famines, massive economic and social dislocations, and widespread resource-based conflicts. Large parts of the region, which are arid or semi-arid, have faced rapid rates of degradation in the form of deforestation, loss of vegetation and biodiversity, increased soil erosion and desertification.⁶⁶ A UNEP fact-finding mission to East Africa further identified oil pollution, damaged coral reefs, ruined mangrove swamps, pollution from fertilizers and threats to precious marine animals as the major environmental problems facing coastal ecosystem in the region.⁶⁷

Within East Africa, Kenya's dependence on the natural environment is profound. The environment underpins most sectors, including agriculture and horticulture, tourism, wildlife, and energy. Eighty per cent (80%) of all energy comes from wood and rural dependence on

⁶³ UNEP (2006). *Global Environment Outlook 3*. <http://www.grida.no/geo/geo3/english/149.htm> accessed on 29th May 2016.

⁶⁴ FAO. *Soil Fertility Management in Support of Food Security in Sub-Sahara Africa*. Food and Agricultural Organization of United Nations, Rome, Italy. P 74.

⁶⁵ Muchena F.N., et al; *Turning the Tides of Soil Degradation in Africa: Capturing the Reality and Exploring the Opportunities*. Land Use Policy 22 (2005) 23-31. P 24.

⁶⁶ 'Environmental degradation in the Greater Horn of Africa: Some impacts and future implications'. www.unep.org accessed on 30th May 2016.

⁶⁷ *UNEP-sponsored programme for the protection of oceans and coastal areas*. UNEP Regional Seas Reports and Studies No. 135. UNEP, 1991. P 34.

wood is almost total.⁶⁸ Closed canopy forest cover (about 3% for indigenous forests) is the lowest in East Africa, and water supply has become a major constraint to agricultural production. This scenario points to environmental degradation due to pressure from population growth. Other degradation challenges facing the country include, soil erosion, desertification, water shortage and degraded water quality and domestic and industrial pollution.⁶⁹ The driver for this state of affairs can be attributed to the continued high population growth rate which is placing pressure on land beyond its carrying capacity in the continent.

2.1.2 Water Resources and Environmental Sustainability

A significant consequence of land degradation is reduced water from the major catchment basins of the continent. Deforestation and land degradation often destroys critical water catchment areas that are a source of livelihood for many. Forested ecosystems form a unique natural fibrous layer that retains and regulates the flow of groundwater, thereby sustaining water supply for a long period of time.⁷⁰ An estimated 4 million Hectares of forests that are degraded or lost annually due to over-exploitation in Africa are directly linked with decrease of water resources in the continent.⁷¹ One of the greatest causes of poverty, which is mostly overlooked, is lack of access to clean drinking water.⁷² Lack of water adversely affects food productivity, health, shelter and virtually all aspects of life, making it one of the most critical life-supporting systems. In 2014, it was estimated that 40% of Sub-Saharan Africa population was without access to improved source of drinking water from the region.⁷³ Africa is the second driest continent on

⁶⁸ African Development Bank. Appraisal Report: Green Zones Development Support Project. Tunis, Tunisia August 2010. P 4.

⁶⁹ Anderson, David; Grove, Richard H. *Conservation in Africa: Peoples, Policies and Practice*. Cambridge University Press. 2009 p 45.

⁷⁰ FAO. *Managing forests for cleaner water* . www.fao.org/docrep/010/a1598e/ accessed on 27th July 2016

⁷¹ FAO. *Land and environmental degradation and desertification in Africa*. www.fao.org/docrep accessed on 30th May 2016

⁷² The Water Project. www.thewaterproject.org/why-water/poverty accessed on 28th July 2016

⁷³ UN Water. International Decade of Action 'Water for Life' 2005-2015. www.un.org/waterforlifedecade/africa.shtml accessed on 1st August 2016.

earth after Australia, and the United Nations estimates that Sub-Saharan Africa loses 40 billion hours per year collecting water, a task mostly carried out by women.⁷⁴

2.1.3 Population Growth and Environmental Sustainability

The role played by population and environmental sustainability in sustainable development is particularly critical for Africa. The impacts discussed in the previous section are largely related to human activities that lead to changes in land-use and land cover. Africa is currently experiencing the highest population growth rate globally, and is the only continent where population will continue growing beyond the year 2100.⁷⁵ Currently, the continent is estimated to have a population of 1.18 billion (2015 estimates), which is 15 per cent of the world's population and the second most populous continent.⁷⁶ The population is estimated to grow from the current levels to 2.1 billion by 2050, with thirty-one (31) of the fifty one (51) countries in Sub-Saharan Africa projected to at least double their population by 2050.

There is a confluence between population situation in Africa and the contemporary environmental conditions. Agriculture, which provides livelihood to approximately three quarters of the continent's population, is mainly rain-fed. Consequently, the high population in the continent has led to expansion of agricultural land leading to soil erosion and land degradation.⁷⁷ This results in reduced agricultural yields, crop failure and loss of livestock thus endangering rural and pastoral populations. Indeed, the importance of environmental sustainability is reflected in its inclusion in the MDGs and more recently the SDGs.

⁷⁴ UN. *Water for Women*. www.unwater.org accessed on 28th July 2016.

⁷⁵ Clive Mutunga, Eliya Zulu, Roger-Mark De Souza. *Climate Change and Sustainable Development in Africa*. Population Action International. 2012, P 2.

⁷⁶ *Population Pyramids of the World from 1950 to 2100*. <https://populationpyramid.net/africa/2015/> accessed on 9th February 2016.

⁷⁷ Hanny Besada, Nelson Sewankambo. *Climate Change in Africa: Adaptation, Mitigation and Governance Challenges*. The Centre for International Governance and Innovation Special Report. 2009, P 9.

2.2 Climate Change

According to the Intergovernmental Panel on Climate Change (IPCC), climate change is to variation in climate over time, which is attributed by natural variability or as a result of human activity.⁷⁸ Similarly, the United Nations Framework Convention on Climate Change defines climate change as changes in climate, attributed directly or indirectly by human activities which alter the composition of the global atmosphere, in addition to the natural climate variability observed over a certain time period.⁷⁹ Over the last few decades, there has been concerns that human activity may be inadvertently altering the global climate regime through enhanced greenhouse effect, brought about by emission of carbon dioxide and other gases which causes the temperature of the Earth's surface to increase. This is commonly referred to as global warming, which has significant impacts on virtually all facets of the society.

According to the IPCC, the important natural factors affecting climate change revolve around interception of sun's energy by the earth. It is argued that when solar radiation is intercepted by the earth, about a third is reflected back, while the remainder is absorbed by different components such as land, forest, ocean, ice and atmosphere which are part of climate system.⁸⁰ In the long term, the energy absorbed in this process is eventually balanced by the outgoing radiation from the earth and atmosphere.

2.2.1 Climate Change in Africa

There is a consensus among key players such as scientists, policy makers and environmentalists that climate change poses a major challenge to Africa's socio-economic development and human security. It is estimated that millions in Africa are already experiencing the adverse effects of

⁷⁸ IPCC, 2007. *Summary for Policymakers*. In: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution to Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L Parry, et al; (eds)., Cambridge University Press, Cambridge, UK, PP 7-22.

⁷⁹ Handbook on United Nations Framework Convention on Climate Change: Climate Change Secretariat United Nations. Bonn, Germany 1994.

⁸⁰ IPCC, 1990. Climate Change: The IPCC Scientific Assessment 1990. Intergovernmental Panel on Climate Change, J.T. Houghton, Eds., Cambridge University Press, Cambridge, UK, P 6.

climate change resulting in significant economic and human losses.⁸¹ Similarly, the World Bank has pointed out that though all nations are affected by climate change, Africa bears some of the greatest burdens owing to its less privileged and poor population.⁸²

Temperature increase that has been experienced in Africa and beyond has been linked to climate change. Indeed, it is estimated that by 2050, the average temperatures in the continent will increase by 1.5 – 3°C and the upward trend will continue beyond the time frame.⁸³ It is further predicted that warming in the continent is very likely to be larger than the global annual mean warming. Similarly, there are intensified and prolonged droughts in Africa especially in the tropics and sub-tropics since 1970s. It is projected that by 2080, there will be an increase of 5-8% of Arid and Semi-Arid lands in Africa under a range of climate scenarios. Rainfall variability has increased in Africa in the current era of climate change. This is in the form of annual and seasonal trends as well as extreme events of flood and drought.

According to the IPCC, the annual rainfall is likely to decrease in much of Mediterranean Africa and northern Sahara, while the rainfall in southern Africa is likewise projected to decrease. On the contrary, rainfall in East Africa is likely to increase.⁸⁴ This is already manifesting through apparent decline in mean annual rainfall in West Africa, as well as more intense and widespread droughts and flooding incidents in Eastern Africa.

Africa has about 320 coastal cities with an estimated population of over 56 million people, living in low elevation coastal areas. The global average sea level rose at an average rate

⁸¹ Intergovernmental Panel on Climate Change, *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution to Working Group II to the Fourth Assessment Report on Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK, 2007. P 5.

⁸² *Environmental Sustainability*. An Evaluation of World Bank Group Support. World Bank. Washington DC. 2008. P 4.

⁸³ UNEP: *Climate Change in Africa-What is at Stake?* www.unep.org/roa/acmen/docs/ACMEN_Events accessed on 1st Aug 2016.

⁸⁴ Ibid.

of 1.8 mm per year from 1961 to 2003 and at an average rate of about 3.1 mm per year from 1993 to 2003.⁸⁵ It is further reported that sea level rise together with human development are contributing to losses of coastal wetlands and mangrove forest ecosystem. Towards to end of 21st Century, projected sea rise will affect coastal populations and increase the high socio-economic and physical vulnerability of coastal cities in Africa. The sea level rise will probably increase flooding particularly in the coast of eastern Africa.⁸⁶

In terrestrial areas, ecosystems of Africa are critical and contribute significantly to biodiversity and human well-being. It is estimated that by 2080, the proportion of arid and semi-arid lands in the continent is likely to increase by 5-8% thereby destroying part of the existing ecosystems. Similarly, between 25-40% of mammal species in the national parks will become endangered. There is growing evidence that natural mountain ecosystems is altering through complex interactions and feedbacks.⁸⁷

Destruction of water catchment areas and rainfall variability will have a direct effect on availability of water to the populations in Africa. It has been projected that by 2020, between 75-250 million will be exposed to increased water stress in the continent due to climate change, and this figure is projected to rise to 350-600 million Africans by 2050. Further, climate change and variability are likely to impose additional pressures on water accessibility, water availability and water demand in the continent.⁸⁸

2.2.2 Climate Change and Agriculture in Africa

Perhaps the most critical sector in terms of social and economic development in Africa is the agricultural sector. Nearly 60 per cent of Africa's population directly derives their livelihood

⁸⁵ IPCC 2007. Climate Change Synthesis Report 2007. Abdelkader Allali, et al, P 30

⁸⁶ Ibid.

⁸⁷ Ibid.

⁸⁸ Ibid.

from agriculture related activities.⁸⁹ Production scale in the continent ranges from subsistence farming to large scale commercial farming, and contributes to about 50 per cent of Africa's total export value and 21 percent of its total Gross Domestic Product (GDP).⁹⁰ It is instructive that Sub-Saharan Africa overwhelmingly depends on rain-fed agriculture for its productivity, which is climate-dependent hence susceptible to adverse effects of climate change.

According to World Bank, 96% of total agricultural land is rainfed.⁹¹The impact of maize, which is a staple food to many African countries, could be of concern in eastern, southern and western Africa, while yields in wheat is projected to reduce in northern Africa, a scenario that will result in famine.⁹² The IPCC reports that other areas could experience increased temperatures and rainfall such as Mozambique and Ethiopia, leading to extended growing season and increased agricultural yield. The scenario presented projects that net cereals production will be negative, with Sub Saharan Africa to lose up to 40% of shares of agricultural resources.⁹³

Another effect on agriculture is the sea level rise in various African countries, which could result in sea water intrusion into fresh water sources and supply in the inland, leading to crop failure due to salinity effects. An example is rice farming in Guinea, coconuts and palm oil in Ivory Coast and Benin, shallots in Ghana and cashew nuts, mangoes and coconut in Kenya.⁹⁴The impact of this is worsening of food security situation in Africa. The continent's rural

⁸⁹ Food and Agricultural Organization, *Responding to Agriculture and Food Insecurity Challenges Mobilizing Africa to Implement NEPAD programmes*, Conference of Ministers of Agriculture of the African Union, Maputo, Mozambique 2003 p 12.

⁹⁰ Ibid.

⁹¹ World Bank. *Managing Climate Risks: Integrating Adaptation into World Bank Group Operations*. World Bank Group and Global Environmental Facility Programme. 2006. P 45.

⁹² Warren et al. *Understanding the Regional Impacts of Climate Change. Research Report Prepared for Stern Review on Economics of Climate Change*. Tyndall Centre for Climate Change Research. 2006 p 76.

⁹³ Fischer et al, Climate Change and Agricultural Vulnerability. *International Institute of Applied Systems Analysis. Austria*. 2002. p 56.

⁹⁴ Intergovernmental Panel on Climate Change, *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution to Working Group II to the Fourth Assessment Report on Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, UK,2007. p 35.

population are the poorest and depend entirely on agriculture for income and food. Indeed, it is estimated that 40% of the population in Sub-Saharan Africa is undernourished, and the number could increase by an additional 50 - 240 million by 2080s. ⁹⁵

As for livestock, temperature rise is projected to reduce incomes of large scale farmers who have non-heat tolerant breeds by up to 35%, or USD 20 billion a year compared to 2006. ⁹⁶ On the other hand, increase in rainfall regime would reduce livestock revenue for both small and large scale farms, a state attributed primarily to reduced number of animals. Climate change may also result in an ecosystem shift from savannah to other forms of landscapes, with a potential of emergence of new disease vectors which could lead to losses especially to small-scale livestock farmers. ⁹⁷ This calls for prompt sensitization and technology transfer to farmers on skills and technology on suitable species for the new regime or a shift from livestock to crop production.

With regards to fisheries, salinization of fresh water catchment areas, changes in water flows and coral bleaching are expected to deplete fish species in coastal regions. ⁹⁸ A sea phenomenon where colder nutrient-rich water is driven towards the surface by wind, known as upwelling, will also contribute to decline in fishing stocks. With regards to African lakes, temperature rise and reduction in mean annual rainfall is projected to have negative impact on fish supply, while shallow rivers and wetlands may completely dry out. ⁹⁹

⁹⁵ Rebecca Clements. *The Economic Cost of Climate Change in Africa*. Pan African Climate Justice Alliance. 2009. p 12.

⁹⁶ S.N. Seo, R. Mendelsohn. *Climate Change Impact and Animal Husbandry in Africa: A Ricardian Analysis*. CEEPA Discussion Paper 9, Special Series on Climate Change and Agriculture and Climate Change in Africa. 2006. p 65.

⁹⁷ Ibid.

⁹⁸ Intergovernmental Panel on Climate Change, *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution to Working Group II to the Fourth Assessment Report on Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK, 2007. p 40.

⁹⁹ Food and Agricultural Organization. *Responding to Agriculture and Food Insecurity Challenges Mobilizing Africa to Implement NEPAD Programmes*, Conference of Ministers of Agriculture of the African Union, Maputo, Mozambique, 2003. p 23.

It is projected that 60% of global population growth between 2008 and 2100 will be in the Sub-Saharan Africa. Among other issues, climate change alone poses a critical challenge to food security to the current and future high population in the continent.¹⁰⁰ This is supported by the forecast that production levels of key crops such as maize, rice and wheat are projected to decline from 2050, if the current levels of GHGs are not curbed adequately.¹⁰¹ This also presents severe threat for the continent's ability to respond and cope with expected impacts of climate change.

2.2.3 Impact of Climate Change on Health in Africa

Studies indicate that climate change has a direct correlation with adverse health in Africa. According to the Centre for International Governance Innovation (CIGI), rise in temperature, scarcity of safe drinking water owing to droughts and climate change-induced natural disasters are key contributors to the spread of water-borne and infectious communicable diseases prevalent in the continent.¹⁰² The Centre further states that millions in the continent are currently exposed to malaria, a leading cause of death in Africa as a result of increase in temperature and rains which affects areas that were hitherto malaria-free like Ethiopian and Kenyan highlands.

Similarly, a recent study has established complex links between climate change and the HIV/AIDS epidemic in the continent.¹⁰³ It contends that the response to AIDS will rely on tackling not only the spread of the virus itself but also the effects of climate change such as food and water shortages, growth in poverty and an increase in natural disasters. If these factors are

¹⁰⁰ World Water Assessment Programme. *The United Nations World Water Development Report 3: Water in a Changing World*. UNESCO, Paris and Earthscan London, 2009 p 30.

¹⁰¹ Adger, W.N. et al. 'Human security'. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability*. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Field, C.B., et al (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 755-791.

¹⁰² Hany Besada, Nelson Sewankambo. *Climate Change in Africa: Adaptation, Mitigation and Governance Challenges*. The Centre for International Governance Innovation (CIGI), Ontario, Canada. 2009.p 10.

¹⁰³ UNEP and UNAIDS. *Climate Change and HIV/AIDS: A Joint Position Paper*. United Nations Environment Programme (UNEP), Nairobi, Kenya (2008) P 43.

addressed then AIDS victims will be better placed to cope with the pandemic through healthy lifestyles. The report also argues that strengthening the response to the AIDS epidemic will mean that individuals, communities and societies will have greater social resilience in the face of a range of climate change threats and will be better prepared to deal with their consequences.

Climate change phenomena has further being indirectly linked to negative effects on health in the continent through unsafe water, poor sanitation and ecosystems degradation thereby contributing to malnutrition, diarrheal diseases, cholera and increase in child mortality.¹⁰⁴ Indeed, poor sanitation and water is linked to climate-induced droughts and floods which accounts for over 20 percent of disease in Africa.¹⁰⁵ After malaria, diarrhea is the second leading cause of death for African children.

2.2.4 Climate Change, Forced Migration and Conflict in Africa

Climate change has been linked to the issue of forced migration and conflict in various African regions, largely due to shift in climate, weather extremes and the environmental degradation which has been prevalent in many eco-regions.¹⁰⁶ This has eroded human security and threatened livelihoods resulting in displacement of population and forced migration. Indeed, drying of river basins and drought in eastern and southern Africa as well as rising sea levels and floods in western Africa have prompted migration of large sections of communities in pursuit of alternative livelihoods, such as the internally displaced population in flood-prone plains and the low-lying regions of Niger and Nigeria.¹⁰⁷ These refugees and migrants pose a major challenge for governments with regards to humanitarian assistance as well as sustainable solutions to the

¹⁰⁴ Ibid.

¹⁰⁵ Stern, N. *The Stern Review on the Economics of Climate Change*. London. (2008) P 123.

¹⁰⁶ Commission on Climate Change and Development and the UN International Strategy for Disaster Reduction (ISDR) Secretariat. *Links between Disaster Risk Reduction and Climate Change*. Geneva, Switzerland. 2008. p 38

¹⁰⁷ Ibid.

problem. It also presents national security concerns linked to scrabbling and competition for scarce resources between local populations and the migrants.

With regards to conflict, climate change has a potential to threaten economic and political stability. Given the history of resource, political and ethnic conflicts in the continent, climate change could potentially aggravate border and territorial disputes thus complicating mediation processes and conflict resolution. Potential flashpoints and conflict zones in Africa, such as Democratic Republic of Congo (DRC), Darfur, the Horn of Africa, West Africa and the Sahel all have populations living in unstable and fragile conditions making them susceptible to climate change's effects and the risk of violent conflict.¹⁰⁸

Diminishing arable land and declining water resources are already intensifying competition for those resources, and has created tensions for either displaced populations or migrants searching for improved livelihoods. Similar conflicts also apply to deforestation, soil erosion, desertification, decline in marine fisheries and other environmental issues. Desertification triggers famine, internal displacement and international migrations and has served as a recipe for political instability such as Algeria and Chad, tensions between neighbouring countries (Botswana and Zimbabwe) and armed conflict.¹⁰⁹

Deforestation and improper agricultural practices and population increase led to widespread soil erosion in Ethiopia's highlands. Most of Somalia's rivers emanate from Ethiopian highlands and a conflict arose out of diversion of water by Ethiopians, leading to war between the two neighbours in 1977.¹¹⁰

¹⁰⁸ World Bank. *Making Development Climate Change Resilient: A World Bank Strategy for Sub-Saharan Africa*. Washington DC. (2008) p 40.

¹⁰⁹ Norman Meyers. *Environmental Security: What's New and Different?* Policy Background, University of Peace, 2004, accessed on 30th December 2015.

¹¹⁰ Niloy R Biswas. 'Is Environment a Security Threat? Environmental Security beyond Securitization'. *International Affairs Review*. Vol XX, No 1. 2011 P 6.

2.2.5 Impact of Climate Change on Energy in Africa

The impacts of climate change which includes drought, higher temperatures, changing rainfall patterns, rising sea levels, and increased climate variability have a bearing on the continent's energy production and consumption.¹¹¹ The recent drought which has been linked to climate change in the continent has adversely affected both economic growth and the energy sector. With increase in population and corresponding energy demand, energy security is a priority due to the crucial role it plays in sustainable development. The linkage between drought and energy sector is the fact that water is the source of hydropower, a key source of energy for African countries. It is a paradox that both drought and flooding result in losses in hydro-power potential for electricity generation, with the former affecting due to low volumes of water resulting in low generation, and the latter leading to increased runoff, and consequent siltation, thus reducing the generating capacity.

Indeed, there are several examples in Africa regarding the impacts of climate changes on electricity generation. In Ghana, the water level at the main generating dam of Akosombo fell below the minimum level of 240 feet in 2007, causing a reduction in hydro-power generation that left the authorities with no alternative but to resort to rationing of electricity in the entire country.¹¹² To illustrate the importance of hydropower in Africa, 93% of Zambia's power is hydro-sourced, while 60% of Uganda's power is generated from the same.¹¹³ The situation is the similar for many African countries.

¹¹¹ Intergovernmental Panel on Climate Change. "Climate Change 2001 Impacts, Adaptation, and Vulnerability," *IPCC Third Assessment Report*. Cambridge: Cambridge University Press. (2001) p 45.

¹¹² AFREPREN (2009). *Large Scale Hydropower, Renewable Energy and Adaptation to Climate Change: Climate Change in East Africa and the Horn of Africa*.
<http://www.hbfha.com/downloads/RenewableEnergyandAdaptationtoClimateChangePublication.pdf> accessed on 9th Jan 2016

¹¹³ African Energy Commission. *The AFREC Programme and Plan of Action on Large Hydropower Development in Africa*. 2008 p 34

2.3 Climate Change and Environmental Sustainability in Africa

Discussions in this chapter point out clearly that climate change has led to increase in temperatures and rainfall variability, especially extreme events of floods and droughts. The two are key life support systems as they have direct effect on vegetation growth and sustenance of both flora and fauna. Further, the sea level rise orchestrated by climate change is expected to adversely affect the communities living adjacent to these water bodies. The rise of both the sea level and temperatures triggers a chain of events among them the supply of nutrients, food chains, ocean chemistry, ocean currents and extreme events thereby altering the composition of marine ecosystems.¹¹⁴ All these changes in turn affect distribution, abundance, breeding cycles and migration of marine plants and animals that millions rely for food and income. An example is the mangrove ecosystems which thrives in a narrow range of temperature and salinity regime, and plays a crucial role as a breeding haven for fish and scores of marine organisms in addition to protecting the shore from strong wave action.¹¹⁵

From this discussion, it can be deduced that climate change undermines environmental sustainability through its adverse effects on a wide range of critical life support systems. These systems cover both terrestrial and aquatic environment, and its universality calls for urgent attention. In terms of flora, climate change adversely affects regeneration capacity of vegetation such as forests due to increase in temperature and rainfall variability. According to UNEP, climate change is expected to lead to massive destruction of forests and extinction of many species.¹¹⁶ It is well known that vegetation acts as key carbon sinks, thus making it an important mitigation strategy.

¹¹⁴ WWF. Climate Change Impacts on the Marine Environment. www.wwf.org.au/our_work/saving_the_natural_world accessed on 2nd August 2016

¹¹⁵ Ibid

¹¹⁶ UNEP. 'Climate change and its impact on forests- will forests migrate?' Vital Forest Graphics p 35 www.unep.org/vitalforest/Report/VFG-11 accessed on 21st July 2016.

Examining from the opposite lens, it is widely acknowledged that emissions resulting from human activities are substantially increasing atmospheric concentrations of greenhouse gases. Environmental degradation experienced in Africa in the form of deforestation, land degradation, desertification and air pollution generates carbon dioxide and other gaseous substances into the atmosphere, thereby contributing greenhouse gas into the atmosphere. According to IPCC First Assessment Report, carbon dioxide has been responsible for over half the enhanced greenhouse effect in the past and it is likely to remain so in future.¹¹⁷

In Africa, environmental degradation especially deforestation and land degradation releases carbon dioxide to the atmosphere. Arising from this, it can be deduced that environmental degradation in Africa has a direct effect of increasing greenhouse gas hence enhancing climate change effects. On a global scale, the largest share of anthropogenic GHG emissions are from energy sector with 25.9 % followed by industry at 19.4 % and forestry with 17.4%.¹¹⁸ Environmental footprint expands in tandem with national economic growth, and fossil fuels have catapulted energy sector as the highest emitter of GHG.¹¹⁹

Though Africa is a contributor of GHG, its contribution on a global scale is insignificant due to the low level of industrialization. Comparing *per capita* greenhouse gas emission of an African country to European country, the Europeans emit between 50-100 times more, while Americans emit 100-200 times more.¹²⁰ In 2011, China was the top greenhouse gas emitter with

¹¹⁷ IPCC Scientific Assessment. J.T. Houghton, G.J. Jenkins, J.J. Ephraums. London, UK. University Press, Cambridge. 1990. P xi.

¹¹⁸ C. Webersik, *Climate Change and Security: A gathering Storm of Global Challenges*. Praega. Santa Barbara CA. 2010. P 2.

¹¹⁹ R.N. Cooper, *Environment and Resources, Policies of the World Economy*. Donnelley. Washington DC. 1994. P 40.

¹²⁰ IPCC, 2001. *Climate Change 2001: The Scientific Basis Contribution of Working Group I to Third Assessment Report of IPCC*. Cambridge University Press, Cambridge, The United Kingdom And New York, NY USA, P 231

28% followed by USA and the European Union with 16% and 10% respectively.¹²¹ This lends credence to assertion that Africa is the most vulnerable region to climate change despite being one of the least contributors of global emissions and lacking in resilience and adaptation.¹²²

It can therefore be deduced that the two variables, climate change and environmental sustainability are mutually linked, and a change in one variable inevitably affects the other. The ultimate goal of the current international efforts to address climate change is to achieve environmental sustainability. This is however not easy given the current impacts as well as projected consequences from effects of climate change. Further, international negotiations on climate change action are normally protracted and long. On a positive note, majority of countries are alive to the negative consequences posed by climate change action, and the need to ensure environmental sustainability.

2.4 Conclusion

Environmental sustainability is a state in which demands placed on environment can be met without compromising provision of such goods and services to the present and future generations. However, climate change undermines achievement of this through impacts such as increase in temperatures, variability of rainfall and increased drought and flooding incidences. The sectors affected include agriculture, forestry, energy and health among others. Similarly, climate change has been linked with conflicts and forced migration due to shift in climate, weather extremes and environment degradation.

In addition, the rise in sea levels and sea temperatures continue to trigger a chain of events that will alter the composition of marine ecosystem, harm important components such as coral reefs and mangroves and adversely affect coastal populations. It is from this linkage that

¹²¹ United States Environmental Protection Agency. Global Greenhouse Gas Emissions Data. www.epa.gov/climatechange/ghgemissions accessed on 31st May 2016.

¹²² L. Otter, D.O. Olagi. & I. Niang. *Global Change Process and Impacts in Africa- A Synthesis*. East African Education Publishers. 2007, P 33.

we conclude that climate change adversely affects environmental sustainability. Conversely, environmental degradation has been a contributor to climate change through deforestation, land degradation, loss of biodiversity, desertification and pollution, all of which contribute to GHG emissions. Indeed, on a global scale, the three largest contributors of GHG emissions are energy sector with 25.9 %, industry with 19.4 % and forestry with 17.4%. Environmental degradation in Africa is particularly high due to high population, over-dependence on firewood for energy and unsustainable agricultural practices among other issues. The two variables are therefore mutually linked and this understanding is important in instituting efforts to make African continent more climate-resilient.

CHAPTER 3

ENVIRONMENTAL SUSTAINABILITY AND CLIMATE CHANGE ADAPTATION/MITIGATION MEASURES IN AFRICA

3.0 Introduction

As discussed in previous chapters, there is already evidence that African continent is warming faster than the global average, and this trend is likely to continue. It is projected that temperatures in the continent will increase by a range of 1.4 to 5.8° C in mean service temperature by the turn of this century.¹²³ It is further projected by mid-21st century, an increase in temperature will exceed 2° C. Similarly, climate change in East Africa is projected to increase temperature and precipitation variability. In this sub-region, there are prediction that whereas future precipitation is uncertain, there is likely to be an increase in Eastern Africa and decrease in southern Africa.¹²⁴ This scenario presents worrying prognosis in terms of projected decrease in food crop and livestock in the continent due to increased water stress and incidences of pests, diseases and weeds outbreak. This chapter examines international treaties and agreements as well as the role of institutions including state and non-state actors in implementing adaptation and mitigation actions for environmental sustainability.

3.1 Climate Change and International Treaties

The issue of climate change is probably the most important environmental issue currently in the global agenda. It has been a topical issue in various global and regional forums with a number of treaties and agreements being developed. The early projection of climate change in the global arena was at the United Nations Conference on Environment Development (UNCED) held in Rio de Janeiro in 1992 which led to the United Nations Framework Convention on Climate Change (UNFCCC), an international environmental treaty whose objective is to stabilize

¹²³ Intergovernmental Panel on Climate Change, *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution to Working Group II to the Fourth Assessment Report on Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, UK, 2007. p 56.

¹²⁴ Ibid.

greenhouse gas concentrations in the atmosphere to a level that would prevent dangerous anthropogenic interference with the climate system.¹²⁵ The framework however did not set any binding limits on greenhouse gas emissions or enforcement mechanisms, but rather outlined how specific protocols may be negotiated to set binding limits on greenhouse gases.

Whereas the UN has the overall mandate of UNFCCC, there are specialized bodies mainly within the UN that are charged with the responsibility of implementation of the treaties. United Nations Environmental Programme (UNEP) is a key institution whose functions are shaped by the negotiation process of the UNFCCC. The body works with countries to strengthen their ability to adapt to climate change, move towards low carbon pathway, improve understanding of climate science, and raise public awareness on changing climate.¹²⁶ It focuses on strengthening the ability of developing countries to integrate climate change responses into national development processes.

World Meteorological Organization (WMO) is another specialized UN agency whose role is to coordinate the behavior and state of the Earth's atmosphere, its interaction with land and oceans, the weather and climate it produces and the resulting distribution of various water resources.¹²⁷ The organization provides vital weather and climate information worldwide which includes early and reliable warnings of severe weather and fluctuations in air quality as well as climate variability. This is critical for policy makers, communities and individuals to better prepare for weather and climate events. The institution focuses on the impact of weather, climate and water on agriculture, fisheries, energy, transport, health, sports, insurance, and many socio-

¹²⁵ United Nations Framework Convention on Climate Change. United Nations, New York. 1992. P 34.

¹²⁶ Climate Change. UNEP www.unep.org/gc/gc26/factsheet/pdf accessed on 4th August 2016.

¹²⁷WMO: What we do. www.public.wmo.int/en/our-mandate accessed on 4th August 2016

economic sectors. It further promotes application of meteorological, climatologically, hydrological and oceanographic information in all human activities.¹²⁸

The Intergovernmental Panel on Climate Change (IPCC) is an international body for assessing the science allied to climate change. It was set up in 1988 by both UNEP and WMO to provide policymakers with regular assessment of scientific basis of climate change, its impact, future risks and options for mitigation and adaptation.¹²⁹ Further, the body provides a scientific basis for governments to develop climate-related policies. It is a consortium of leading scientists who have written comprehensive and objective reports that has won them accolades including the prestigious Nobel peace prize of the year 2007.¹³⁰

3.1.1 Conference of Parties of the UNFCCC

After the signing of the UNFCCC treaty, the parties to the convention have been meeting annually since 1995 in forums dubbed Conference of Parties (COP). The COP is the decision making body of the convention with representatives of all states that are parties to the convention.¹³¹ These forums led to the Kyoto Protocol, which set emission targets for developed countries which are binding under international law.¹³² The protocol, which commits state parties to reduce greenhouse gas emissions, was adopted in Kyoto, Japan on 11th December 1997, and entered into force on 16th February 2005.¹³³ It is based on the principle of common but differentiated responsibilities which puts the obligation to reduce emissions to developed countries on the basis that they are historically responsible for the current levels of greenhouse gases in the atmosphere. It set binding emission targets to 37 industrialized countries and the

¹²⁸ Ibid

¹²⁹ IPCC: What is IPCC? www.ipcc.ch/news_and_events accessed on 4th Aug 2016

¹³⁰ The Nobel Peace Prize 2007, IPCC and Al Gore. www.nobelprize.org/nobel_prize/peace accessed on 4th August 2016

¹³¹ Conference of Parties. www.unfccc.int/bodies/body/6383.php accessed on 4th August 2016

¹³² King, D., International Climate Change Negotiations: Key Lessons and Next Step. Oxford University Press. UK. 2011. P 24.

¹³³ Ibid.

European community that add up to an average of five per cent reduction compared to 1990 levels.¹³⁴ It is instructive that the highest emitter of greenhouse gases at the time, the United States of America is not a signatory to the Kyoto protocol.

The 15th session of the Conference of Parties was held at Copenhagen, Denmark in 2009 and served as a meeting of the Parties to the Kyoto Protocol. The conference advanced the negotiations on infrastructure needed for effective global climate change cooperation, including Kyoto Protocol and Clean Development Mechanism (CDM).¹³⁵ It also produced the Copenhagen Accord, which expressed a political intent to constrain carbon and respond to climate change in the short and long term. Another central element of the conference was a promise by developed countries to provide US\$30 billion for the period 2010 – 2012 to developing countries to fund actions to reduce greenhouse gas emissions and to adapt to the inevitable effects of climate change.¹³⁶

The 16th COP session was held in Cancun, Mexico in November 2010 and produced a basis for a comprehensive and far reaching response to climate change in order to reduce carbon emissions and build a system which made all countries accountable to each other for those reductions. The Parties agreed to limit temperature rise to 2° C above pre-industrial levels, and consider lowering that target to 1.5° C in future.¹³⁷ Another key development was establishment of Green Climate Fund (GCF) to provide financing to projects, programmes and policies in the developing countries through a thematic funding window. The conference further produced the

¹³⁴ Making those First Steps Count: An Introduction to the Kyoto Protocol. www.unfccc.int accessed on 24th December 2015.

¹³⁵ Copenhagen Climate Change Conference – December 2009. www.unfccc.int/meetings/copenhagen_dec_2009/ accessed on 24th December 2016

¹³⁶ Ibid

¹³⁷ Cancun Climate Change Conference- November 2010 www.unfccc.int/meetings/cancun_nov_2010/ accessed on 4th August 2016

Cancun Adaptation Framework which included establishment of an Adaptation Committee to promote the implementation of a stronger, cohesive action on adaptation. ¹³⁸

Another key milestone in climate change was realized in the 2015 United Nations Climate Change Conference, COP 21 held in Paris, France between 30th November and 12th December 2015.¹³⁹ The participating parties representing 196 nations negotiated for a global agreement on the reduction of GHG emissions through consensus. A significant result was ratification of a goal earlier set at the Cancun Climate Agreement that set to limit global warming to less than 2 degrees Celsius (°C) compared to pre-industrial levels.¹⁴⁰ Each country that ratified the agreement was required to set a target for emission reduction, known as nationally determined contribution (NDC) which had voluntary amounts. However, there was no mechanism to enforce this commitment, rather, the parties agreed to a ‘name and shame’ system.

Further, governments agreed to meet every five years to set more ambitious targets and track progress towards the long-term goal through a robust transparency and accountability system. Of importance to Africa, the conference agreed to provide enhanced support for adaptation to developing countries.¹⁴¹ Key world leaders led by the United States President Barack Obama attended the conference, underscoring the importance of the issue in the global arena.

3.2 Climate Change and Environmental Sustainability Initiatives in Africa

African Union (AU) has developed a draft strategy on climate change whose vision is to provide the AU, Regional Economic Communities (RECs), Member States and other stakeholders with a reliable source of strategic guidance to enable them effectively address climate change

¹³⁸ Ibid

¹³⁹ Conference of Parties 21st Session. *Adoption of the Paris Agreement*. United Nations, 2015. www.unfccc.int accessed on 24th December 2015.

¹⁴⁰ Ibid.

¹⁴¹ European Commission. *Climate Action-Paris Agreement*. www.ec.europa.eu/clima/policies/international accessed on 8th June 2016.

challenges. The strategy's overarching directive seeks to enhance the adaptive capacities and resilience of member states with a view to minimise their vulnerability; pursue a low carbon pathway dictated by the principles of green economy; sustainable development; and poverty reduction.¹⁴² It will also enable harmonization of regional efforts to combat climate change such as African Ministerial Conference on Environment (ACMEN), the Framework for Southern and Northern Africa Climate Change Programmes and the East African Community Climate Change Policy. The draft strategy proposes specific interventions to address priority areas including adaptation and risk management, Nationally Appropriate Mitigation Actions (NAMAs) as well as some cross-cutting issues. The draft African Climate Change Strategy has four main thematic pillars, namely; Climate Change Governance; promotion of research, education, awareness raising and advocacy; mainstreaming and integrating climate change imperatives in planning, budgeting and development processes; and promotion of regional and International Corporation.¹⁴³

African Union has been actively spearheading the continent's common position on climate change in the global arena. The African Group of Negotiators has been negotiating Africa's interest in the UNFCCC process. Having a common position allows Member States to design robust approaches that would help to effectively address the challenges associated with climate change risks, disasters and sustainable development.¹⁴⁴ Another AU initiative is the African Climate Policy Centre (ACPC) whose primary aim is to generate knowledge on climate change in the continent. It is a joint initiative between the AU, the United Nations Economic Commission for Africa (UNECA) and the African Development Bank (AfDB). Its work

¹⁴² AU. Draft African Union Strategy on Climate Change. Addis Ababa, Ethiopia, 2014. P 3.

¹⁴³ Ibid P 27.

¹⁴⁴ United Nations Economic Commission for Africa. *Climate Change Negotiations*. www.uneca.org/climatechangenegotiations accessed on 29th June 2016

programme is based on three broad activities, namely; knowledge generation, sharing and networking; advocacy and consensus building; and advocacy and technical cooperation.¹⁴⁵

The African Ministerial Conference on the Environment (ACMEN) has been in the forefront in providing advocacy for environmental protection in Africa and to ensure social and economic development at all levels.¹⁴⁶ It provides guidance on key political events related to environment, including Multilateral Environment Agreements (MEAs). AMCEN is credited with leading the process in formulating an action plan for the Environmental Initiative for the New Partnership for Africa's Development (NEPAD). As an affiliate of the AU, ACMEN was a key player in the development of draft African Union Strategy on Climate Change.

3.3 Climate Change Adaptation/Mitigation Costs for Africa

Several studies have been undertaken on projected costs of climate change adaptation and mitigation and they differ in time period, scope as well as methodology. The World Bank study of 2010 used a model where the average temperature reaches about 2° C by 2050 above pre-industrial levels raising to 4° C by 2100 to realize estimates of adaptation costs, which focused on the near to mid-term time frame. The total annual adaptation costs are projected to be US\$ 14-15 billion dollars for Sub-Saharan Africa and about US\$ 2.5 billion for North Africa and Middle East region.¹⁴⁷ The highest adaptation costs in Sub-Saharan Africa are projected to be in water supply, coastal zone protection, infrastructure and agricultural sectors. Similarly, the greatest need for adaptation for the North Africa and Middle Eastern region is in infrastructure, coastal zone protection and adapting to extreme weather events. The study projects that adaptation costs estimates for a 2°C pathway are projected to increase to US\$ 40 billion per annum by 2040,

¹⁴⁵ The African Climate Policy Centre. [www.climdev-africa.org/africa-climate -policy](http://www.climdev-africa.org/africa-climate-policy) accessed on 28th June 2016

¹⁴⁶ UNEP. AMCEN at a Glance. www.unep.org/roa/About_AMCEN accessed on 8th June 2016.

¹⁴⁷ World Bank. The economics of adaptation to climate change - a synthesis report. Washington, D.C., The World Bank Group. Washington DC, 2010. P 36

while a high emission scenario over the same period will witness an increase in adaptation cost upto the range of US\$ 45-70 billion per year.¹⁴⁸

A UNEP report of 2013 gives similar estimates of adaptation costs for Africa, with projections amounting to between US\$ 7-15 billion per year by the year 2020.¹⁴⁹ The report's findings revealed that even where emission gaps are closed and the world gets into a pathway to hold warming to below 2° C by 2050, adaptation costs are forecast to be around US\$35 billion per year. It further provides less encouraging prospects of adaptation costs jumping to US\$ 50 million per annum by 2050, which will be only half way to 2100 under a 3.5 – 4° C warming by the end of the current century.

The UNFCCC has a clear provision in its statutes that commits developed countries to support developing countries' adaptation to climate change impact.¹⁵⁰ In this regards. Global Environmental Facility (GEF) and more recently the Green Climate Fund (GCF) (2010) were designated as the operating entities of the financial mechanism for the convention.¹⁵¹ The GCF set an ambitious target of mobilizing US\$100 billion by 2020 for climate change adaptation especially for the developing countries, however, only US\$ 10 billion had been contributed as at March 2016.¹⁵² From the foregoing, funding for climate change adaptation in Africa has been considerably low and remains a key challenge in realization of climate-resilience continent. Some of the initiatives supporting climate change adaptations are discussed in this section.

3.3.1 The Role of Developed States

International efforts to combat climate change and support for measures aimed at achieving environmental sustainability in Africa has slowly gained momentum in the recent years. The

¹⁴⁸ Ibid

¹⁴⁹ UNEP. *African Adaptation Gap Report: Climate Change Impacts, Adaptation Challenges and Costs for Africa*. UNEP. 2013 p 31

¹⁵⁰ United Nations Framework Convention on Climate Change. UN, New York, 1992. P 23.

¹⁵¹ Green Climate Fund. www.unfccc.int/cooperation_and_support/financial accessed on 28th June 2016

¹⁵² US Supports Green Climate Fund. www.ibtimes.com/us accessed on 28th June 2016

European Union (EU) has been an active participant in this regard, and has rolled out several programmes in developing countries including Africa. It initiated the Global Climate Change Alliance (GCCA+) which seeks to support the most vulnerable nations in order to respond to climate change. The programme provides a platform for dialogue between EU and developing countries most vulnerable to climate change. At national level, the dialogue aims to integrate climate change issues into national development strategies, plans and budgets and seeks to identify and implement concrete actions to help tackle climate change.¹⁵³ On the overall, the EU has supported 50 projects in 38 countries on climate change adaptation and mitigation at a cost of 320 million euros.¹⁵⁴ So far, EU is the largest contributor of Overseas Development Assistance on climate change to developing countries.

The United States through the United States Agency for International Cooperation (USAID) has been engaged on environmental sustainability and climate change projects in Africa and other developing countries. On environmental sustainability, the agency has supported efforts to fight deforestation, protect biodiversity and afforestation programmes in countries such as Kenya, Ethiopia, Liberia and Tanzania.¹⁵⁵ Similar programmes to the region were aimed at mitigating and adapting to effects of climate change so that countries can strengthen their resilience to weather shocks. During the US-Africa Leaders' Summit held in Washington DC on August 2014, the USAID and Rockefeller Foundation announced a US\$100 million Global Resilience Partnership to help protect the lives and livelihoods of African people

¹⁵³ European Commission. Global Climate Change Alliance+. Policy Dialogue. www.gcca.eu/policy-dialogue-and-experience accessed on 8th June 2016.

¹⁵⁴ European Commission. Supporting a Climate for Change. The EU and Developing Countries Working Together. European Union. Luxemburg. 2015 p 3.

¹⁵⁵ USAID. Environment and Climate Change. www.usaid.gov/what-we-do/environment accessed on 8th June 2016

and other vulnerable countries in the world.¹⁵⁶ The partnership will focus on the Sahel, Horn of Africa and South East Asia which are considered highly vulnerable to climate change.

The African Development Bank has initiated African Climate Change Fund (ACCF). Its aim is to support African states to transition to climate resilient and low carbon development. The Bank plans to assist states to access greater amounts of climate financing and support them in tracking climate finance flows from which they benefit. The Fund, which was conceived as a bilateral thematic trust focusing on climate change, has an initial contribution of US\$ 6.1million from Germany.¹⁵⁷ This initiative is still in its infancy and the success of the initiative remains to be seen.

3.4 Environmental Sustainability and Climate Change in East Africa

The East African region is described as predominantly arid and semi-arid lands. Observations of climate change impact in the region from 1900 to 2005 demonstrate increasing temperatures with varying rainfall patterns both spatially and temporally across the region.¹⁵⁸ The past trends of rainfall over a 30 year period indicate that the frequency, severity and intensity of droughts have increased. The drought incidence has increased from seven years to five and currently to almost every other year.¹⁵⁹ Future climate projections indicate that mean temperatures of the region may increase even further. With regards to rainfall, it is likely that the region will experience an increased annual average rainfall. However, these prediction further points at variation in rainfall pattern within region, with southern part of East Africa expected to receive reduced rainfall while the northern part will receive increased rainfall. Ironically, this may not necessarily be a

¹⁵⁶ White House. Fact Sheet: US Engagement on Climate Change and Resilience in Africa. www.whitehouse.gov/the-press-office accessed on 8th June 2016.

¹⁵⁷ *Establishment of African Climate Change Fund*. African Development Bank. Tunis, Tunisia, 2014. P 2

¹⁵⁸ *Assessing Climate Change Vulnerability in East Africa*. A case study on the use of CARE's Climate Change Vulnerability and Capacity Assessment (CVCA) Methodology within the Global Water Initiative East Africa Program CARE USA, http://www.careclimatechange.org/files/adaptation/GWI_CVCA_CS_Sept11.pdf accessed on 11th February 2016.

¹⁵⁹ *Climate Vulnerability and Capacity Analysis Handbook (May 2009)*, CARE International, p 2.

blessing to farmers in the northern part as the rain is projected to fall intensely and over a short period of time, interspaced with long dry spells.¹⁶⁰ It is worth noting that projections for East Africa rainfall are a challenge due to the influence of regional weather by the El Nino Southern Oscillation phenomenon.

3.4.1 Climate Change Action for East Africa

The East African Community (EAC) has taken positive initial steps in its effort to address climate change in the region. It has developed the EAC Climate Change Policy, EAC Climate Change Strategy, EAC Protocol on Environment and Natural Resources and EAC Food Security Action Plan. The EAC comprises of Burundi, Uganda, Kenya, Tanzania and Rwanda and South Sudan. The latter joined the EAC in March 2016.¹⁶¹ The Secretariat of EAC in Arusha, Tanzania is the institution charged with spearheading the climate change response initiative.

3.4.2 EAC Climate Change Policy

In 2009, the East African Community (EAC) Heads of State Summit in Arusha, Tanzania directed the relevant authorities to develop a regional climate change policy and strategies to respond to the vagaries of climate change, including the issue of food insecurity linked to this phenomenon.¹⁶² They noted the adverse effects of climate change that was as a threat to the livelihoods of people in almost all sectors of the economies of EAC region. Of particular concern was food security situation as well as other drivers of economy, hence the need for an integrated, harmonized and multi-sectoral framework for responding to climate change in the region. This was upon realization that being trans-national in nature, climate change is better handled at

¹⁶⁰ Boko, M., I. Niang, A. Nyong, C. Vogel, A. Githeko, M. Medany, B. Osman-Elasha, R. Tabo and P. Yanda, 2007: *Africa. Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge UK, pp 433-467.

¹⁶¹ East African Community. One People, One Destiny www.eac.int/ accessed on 29th June 2016

¹⁶² *East African Community Climate Change Policy*. East African Community Secretariat. Arusha, Tanzania. 2010. p 1.

national, regional and global levels simultaneously. This led to development of the East African Community Climate Change Policy (EACCCP).¹⁶³

The EACCCP's overall objective is to guide member states and other stakeholders in preparing and implementing collective measures to address climate change in the region and assure social and economic development. It prescribes statements and actions that guide climate change adaptation and mitigation in order to reduce vulnerability of the region and enhance adaptive capacity thereby building socio-economic resilience of vulnerable populations and ecosystems. The policy has three pillars; adaptation, mitigation and climate change research which entail monitoring, detection, prediction and attribution. The policy considers the differentiated impacts of climate change on youth, women and men and the role of women in addressing climate change. Gender consideration has therefore been given adequate attention in the policy.¹⁶⁴

The policy outlines urgent and immediate adaptation measures as identified in the National Adaptation Programmes Action (NAPAs), climate change strategies and National Adaptation Plans (NAPs). It classifies adaptation priorities as improvement of early warning systems, strengthening meteorological services, disaster risk management through preparedness, risk reduction, mitigation and reconstruction. Others include increasing of efficient water and energy resources, irrigation, livestock and crop production and reduction of pre- and post-harvest losses in agriculture. Additional adaptation areas include protection of wildlife and fragile biomes such as coastal, wetlands, forestry and marine ecosystems, improvement of land use, tourism, soil protection and reduction of climate sensitive vector and water borne diseases. Similarly, mitigation measures include reforestation, afforestation, promotion of energy efficient

¹⁶³ Ibid

¹⁶⁴ *East African Community Climate Change Policy*. East African Community Secretariat. Arusha, Tanzania. 2010. p 10.

technologies, efficient livestock and crop production, waste management and efficient transport systems.¹⁶⁵

Although the region's contribution to global greenhouse gas emission is negligible, the policy proposes reduction of GHG for sectors with potentially high emissions such as energy, agriculture, transport, waste management and industry. It cautions that such actions should not compromise the regions' social and economic development, but rather position it towards low carbon development pathways. In order to implement this policy, each partner state is encouraged to create an enabling environment through policy, legislative and institutional framework. The EAC secretariat was tasked with initiating follow-up actions and to establish partnership for successful implementation of the policy.

3.4.3 East Africa Climate Change Strategy

In order to operationalize the EACCCP, the EAC developed the East Africa Climate Change Strategy in 2011. The goal of the strategy is to contribute to successful implementation of EAC Climate Change Policy objectives, and a vision of a community with a prosperous population, climate resilient, climate proofed and disaster resilient development in the region.¹⁶⁶ It is intended to enhance a coordinated response to climate change in East Africa in order to achieve sustainable development in line with climate change policy priorities. The strategy provides a short and medium term framework for implementing concrete and elaborate climate change mitigation and adaptation programmes. Of particular significance is the Disaster Risk Reduction (DRR) measures in various sectors including early warning system that are critical in climate change adaptation.

The strategy has identified six broad strategic objectives. First is to enhance climate change adaptation through adaptation planning, building socio-economic resilience, disaster risk

¹⁶⁵ Ibid

¹⁶⁶ *East African Community Climate Change Strategy, 2011*. EAC Secretariat, Arusha, Tanzania. 2011 p 11

reduction and vulnerability reduction. The second objective seeks to enhance sustainable development measures through elaborate climate change mitigation measures. This will entail promotion of green economy and embracing a low carbon development pathways by partner states. Third is to strengthen climate change knowledge through research, detection, monitoring and prediction. Forth is to enhance climate change education and public awareness through trainings, communication, knowledge and information management. This will entail social empowerment with a particular focus on gender considerations. Fifth is to build climate change response capacity through technology transfer, institutional strengthening, building partnerships, resource mobilization and stakeholder involvement. Last strategic objective is to ensure sustainable financing mechanism for implementation of climate change action. The strategy outlines specific actions for each sectoral objective of the EAC Climate Change Policy, and prioritizes the proposed action based on opportunities available and capacity to implement.¹⁶⁷

In order to strengthen EAC's capacity to implement these climate change actions, the Strategy proposes establishment of a Climate Change Coordination Unit (CCCU) at the EAC Secretariat. The Unit is intended to coordinate and oversee effective implementation of projects and programmes emanating from the Strategy and Master Plan. It will work in close collaboration with other EAC organs such as Lake Victoria Basin Commission (LVBC), Inter-University Council of East Africa (IUCEA), Lake Victoria Fisheries Organization (LVFO) and East Africa Legislative Assembly (EALA). In addition, the Strategy proposes establishment of a Climate Change Programme Management Unit (PMU) at the EAC headquarters which is charged with management and implementation of climate change programmes and projects. With regard to resource mobilization, the Strategy identifies the EAC Climate Change Fund as a

¹⁶⁷ *East African Community Climate Change Strategy, 2011*. EAC Secretariat, Arusha, Tanzania. 2011 p 34

critical component to marshal financial resources from various existing and emerging sources of climate change finance. The EAC shall be responsible for coordinating, tracking and overseeing the implementation of the strategic plan in collaboration with partner states. The Secretariat will develop a monitoring and evaluation framework with clear indicators and milestones for efficient implementation of climate change projects and programmes in the region.

3.4.4 IGAD Climate Change Strategy

The Inter-Governmental Authority on Development (IGAD) region which comprises of eight member countries in eastern Africa has been identified as one of the most vulnerable regions in the world to climate variability and change and is already experiencing the adverse impacts of the current El Niño in terms of drought and floods. In response, IGAD has taken several initiatives including a regional climate change strategy, Drought and Disaster Resilience and Sustainability Initiative and establishing centers of excellence such as the IGAD Climate Change Prediction and Application Centre (ICPAC). The mission of ICPAC is to foster a sub-regional and national capacity for climate information, prediction, early warning and other related application as a contribution to sustainable development in the sub-region.¹⁶⁸

3.4.5 Programme on Climate Change Adaptation and Mitigation in COMESA-EAC-SADC

The next three sections look at various actors in climate change action in the region. The Programme on Climate Change Adaptation and Mitigation in COMESA-EAC-SADC region is an initiative aimed at building successful mitigation and adaptation actions across Eastern and Southern Africa.¹⁶⁹ The overall objective of the programme is to address the impact of climate change in the COMESA-EAC-SADC region through successful mitigation and adaptation

¹⁶⁸ *IGAD Climate Prediction and Application Centre (ICPAC)* www.preventionweb.net/organizations accessed on 3rd March 2016

¹⁶⁹ *Programme on Climate Change Adaptation and Mitigation in the COMESA-EAC-SADC Region* <http://www.gcca.eu/intra-acp/programme-on-climate-change-adaptation-and-mitigation> accessed on 25th February 2016

actions for economic and social resilience for present and future generations. The programme will enable Member States to increase their investments in carbon efficient and climate resilient agriculture and in the related areas of forestry, land use and energy practices. It is funded by the European Union (EU), the European Development Fund and European Commission at a budget of Euros 316.5 million, making it is one of the largest climate initiatives in the world. The programme targets smallholder farmers who constitute the largest population in the region in scaling up and mainstreaming climate smart agriculture and sustainable land management practices. The programme has so far benefited 367,900 households against a target of 700,000 households.

3.4.6 IFAD Climate Change Response Project in Eastern Africa

International Fund for Agricultural Development (IFAD) predicts that climate change could result in net reductions of 10% of maize, sorghum, sugar cane, millet and wheat in Eastern African region. ¹⁷⁰ The institute projects an equally gloomy picture for livestock and water availability which is likely to worsen as a result of climate change. In response, the institute has collaborated with governments and communities in the region to introduce appropriate adaptation technologies that reduce vulnerability of poor communities in the rural areas to climate variability. As a result, three separate programmes have been developed for Kenya, Eritrea, and the three East African countries of Uganda, Tanzania and Kenya.

In Kenya, the Mount Kenya East Pilot Project (MKEPP) for Natural Resource Management was commissioned to strengthen the resilience of poor communities' farming systems in the face of climate variability. ¹⁷¹ The project has introduced a wide range of adaptive measures such as improved water resource management through water resource users

¹⁷⁰ *Addressing Climate Change in East and Central Africa*. Project Report. Rome, Italy. IFAD 2011. P 1

¹⁷¹ Ibid

associations, appropriate agricultural practices such as agroforestry and river bank protection, energy-efficient cooking stoves and conservation charcoal kilns and the rehabilitation of degraded land through reforestation including hilltops tree planting.

In Eritrea, IFAD has supported the Gash Barka Livestock and Agricultural Development Project whose main focus is soil and water conservation in the country. The agricultural development project has introduced soil and water conservation technologies, such as earth bunds and terracing to halt land degradation and increase the availability of water for crop irrigation. It also introduced micro-catchment technology to reduce rainwater run-off and increase soil infiltration. Furthermore, the project has constructed two medium-scale spate irrigation schemes covering about 1,100 hectares which has benefited 1,000 farmers.

In East African region, the Programme for Pro-Poor Rewards for Environmental Services in Africa supported by IFAD is a unique initiative that recognizes that poor rural people have a potential of being important players in natural resource management and carbon sequestration initiative and can benefit many community members. The programme, which is in Kenya, Uganda and Tanzania, works with poor communities and potential ecosystem service beneficiaries to put in place schemes to either pay or reward communities for providing these services, including improved land-use practices, reforestation and river bank restoration.

3.4.7 Lake Victoria Environmental Management Project

The Lake Victoria Environmental Management Project covers the five East African Community countries of Burundi, Kenya, Rwanda, Tanzania and Uganda whose objective is to improve the collaborative management of trans-boundary resources of the Lake Victoria Basin (LVB) among the Partner States.¹⁷² It also aims at improving environmental management of targeted pollution

¹⁷² *Lake Victoria Environmental Management Project (LVEMP II)*. East African Community. <http://lvemp.eac.int/> accessed on 25th February 2016

hotspots and selected degraded catchments for the benefit of communities who depend in natural resources for livelihood. The project has embarked on reducing littoral environmental stresses within the lake through implementation of preventive and mitigation measures. It is also implementing non-point pollution mitigation measures such as reforestation and riverbank protection in the larger LVB. The project is funded by the World Bank and it is expected to enhance climate change resilience in participating localities.

3.5 Conclusion

The efforts to combat effects of climate change in Africa have both positive and negative aspects. The positive outlook is exemplified by the fact that the leadership and bureaucrats in the continent have acknowledged the problem posed by climate change, and have consequently instituted measures to address the issue. In this connection, the regional and sub-regional entities have developed policies and legislation to guide the process of climate change adaptation and mitigation in order to attain environmental sustainability. These are the AU, EAC, and IGAD who have laid the necessary framework to combat the adverse effects of climate change and ensure environmental sustainability. Further, they have strategies and actionable plans to operationalize the statutes. Similarly there is supporting international framework such as the UNFCCC, COP and GCF.

However, implementation of climate change action in the continent is generally unsatisfactory. The existing mechanisms and resources designed to mitigate climate change in Africa has been directed towards limiting future emissions as opposed to addressing the continent's vulnerability and lack of resilience to the impacts of climate change on its population and economies.¹⁷³ The key bottleneck in climate change adaptation and mitigation remain

¹⁷³ Franklyn Lisk. *Overview: The Current Climate Change in Africa, in: Climate Change in Africa: Adaptation, Mitigation and Governance Challenges*. Hany Besada, Nelson Sewankambo. CIGI, 2009, p 8.

inadequate funding, technical capacity and expertise. The funding level within the GFC and other related avenues is grossly inadequate, while technical capacity in the continent remains low. It is therefore incumbent upon the international community to honor financial commitments under the GCF. Further, Africa should invest in capacity development and outreach programmes in order to raise awareness and harness a critical mass of scientists who are able to find home-grown solutions, articulate and negotiate Africa's position.

In East Africa, climate change is undermining environmental sustainability through loss of biodiversity, reduced food production, increase in invasive tree and plant species, effects on wildlife populations and rise of sea levels that has affected critical coastal ecosystems and communities. The adaptation and mitigation measures therefore need to be up-scaled for the sake of present and future generations.

CHAPTER FOUR

AN ANALYSIS OF CLIMATE CHANGE AND ENVIRONMENTAL SUSTAINABILITY ACTION PLANS IN KENYA (1980 – 2014)

4.0 Introduction

This chapter seeks to analyze data emanating from research findings and discussions with various stakeholders. It relies on both primary and secondary data generated from personal interviews and literature respectively. The focus is on climate change and environmental sustainability action plans in Kenya, with special emphasis on the policies, statutes, governance and state of implementation of climate change adaptation and mitigation measures to sustain the environmental conditions. Further the role played by both state and non-state actors in climate change action plan is examined.

4.1 Climate change and Temperature Variations in Kenya

It is important to begin by examining temperature variations in Kenya over the last three and a half (3 ½) decades in order to gauge climate change situation in the country. To achieve this, data was obtained from Kenya Meteorological Department covering 15 weather stations spread over the country over a 34-year period from 1980 to 2014. The sites were Kakamega, Kisumu and Kisii stations in Western region; Lodwar, Nakuru and Narok in Rift Valley region; Kabete and JKIA in Nairobi area and Moyale, Garissa and Marsabit representing North Eastern region. More data was obtained for Mombasa and Lamu to represent Coast region and Nyeri and Embu representing Central and Eastern regions respectively. The geographic spread of the stations was deliberately chosen in order to provide a fair representation of the country's weather situation.

From the sampled stations, the temperature trend for the country has evidently been on an upward trajectory. The results obtained from the consolidated average of all the 15 stations indicate that there has been a temperature increase of approximately 1 °C over the period of 1980 – 2014 as indicated in Figure 1 below. According to IPCC, there was a mean global temperature

rise of 0.85 °C over a period of 1880 – 2012.¹⁷⁴ Assuming that the average temperatures used in this study are a true reflection of the climate variability for the entire country, then it can be deduced that the average temperature increase for the country over 1980-2014 period is higher than the global temperature rise for 132 year period from 1880 to 2012. This is consistent with the opinion by IPCC that there are plenty of variations in climate change depending on various factors such as topography and location. The report further indicated that there is an accelerated increase in temperatures over the last few years as compared to the earlier period. This was supported by the fact that the period from 1983-2012 was likely the warmest 30 year period of the last 1400 year.¹⁷⁵

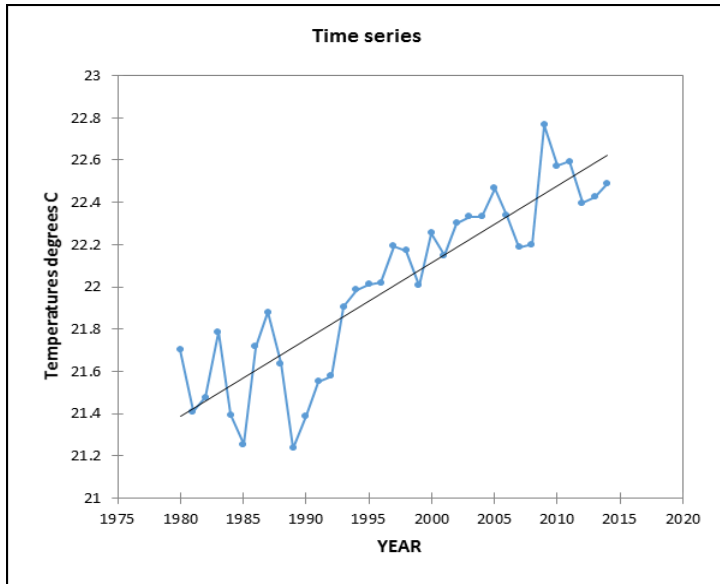


Figure 1. The average temperature trend from 15 stations in Kenya depicting an increase in temperature over 3.5 decades. (Source: Kenya Meterological Dept).

Similarly, it has been reported that 2015 has surpassed 2014 as the warmest year on record due to combined influence of global warming and an exceptionally strong El Nino

¹⁷⁴Climate Change 2014: Synthesis Report .Summary for Policy Makers. IPCC 2014. www.ipcc.ch/pdf/assessment-report/ar5/syr accessed on 5th August 2016.

¹⁷⁵ Ibid

event.¹⁷⁶ Individual stations exhibited a general increase in temperature over the period, albeit at different levels. Some stations such as Nyeri had a relatively higher increase of approximately 1.3^o C while other stations such as Embu and Lodwar showed a modest increase of 0.4^o C over the same period. Nyeri, Kakamega and Narok showed mid-range increase of about 0.9^o C over the 34 year time series as indicated in the graphs below.

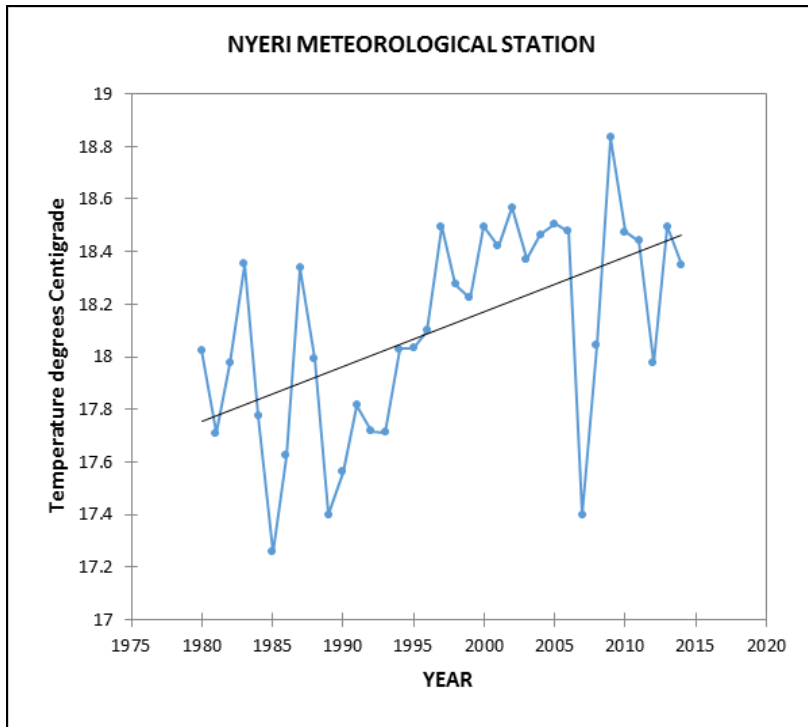


Figure 2. Temperature variation for Nyeri over a period of 1980 – 2014. (Source: Kenya Meteorological Dept).

¹⁷⁶ WMO. New Report Confirm 2015 hottest year on record. www.public.wmo.int/en/media/news accessed on 5th August 2016

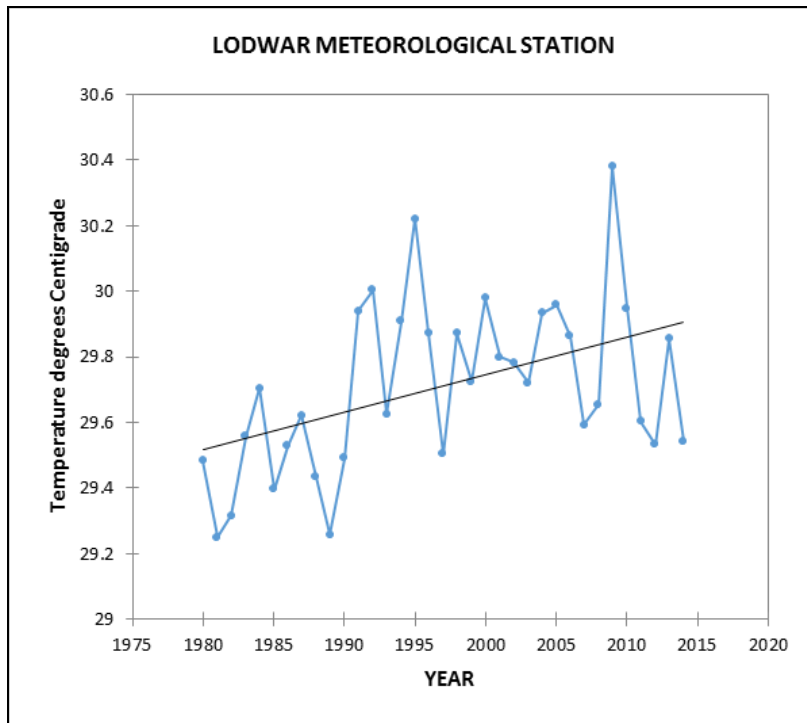


Figure 3. Temperature variation for Lodwar over a period of 1980 – 2014. (Source: Kenya Meteorological Dept).

4.2 Rainfall Pattern

Apart from temperature, rainfall is a key life support system which is affected by climate change. For this study, rainfall data was collected from the same 15 stations that temperature data was sourced. Thereafter individual stations as well as consolidate rainfall data were analysed to determine the trend over a 34 year period from 1980 to 2014. As was the case with temperature, the sites represented various rainfall zones ranging from the arid lands such as Lodwar and Moyale; areas with moderate rainfall like Embu and Mombasa and humid areas such as Kisii, Nyeri and Kakamega in order to have an objective representation of the situation in the country.

Kenya has a bi-modal crop production season and it is important to examine the rainfall pattern within the planting period. This is critical for two main reasons; firstly, Kenya’s

agriculture is predominantly rainfed and secondly, the country is food insecure.¹⁷⁷ In the foregoing, the data was treated in three specific time scales; the overall rainfall per station per year, the March –April – May (MAM) planting season (commonly referred as long rains) and finally the October-November- December (OND) planting season.

The overall averaged rainfall data for the 15 stations spread around the country was consolidated and a trend established. It indicated that on the overall, there has been a modest increase in precipitation over the period of 1980-2016 in the country. Figure 4 below shows that there has been an increase by approximately 50 mm of rains over the period under consideration. This is consistent with the projection that Eastern Africa region is likely to receive increased precipitation over time in the current era of climate change.¹⁷⁸ Whereas this may appear to be a welcome development for the country's food productivity, it is important to examine the trend within the main planting seasons.

¹⁷⁷ Republic of Kenya. *Agricultural Sector Development Strategy 2010-2020*. Government of Kenya 2010 p 3

¹⁷⁸ Christensen, J.H., et al., 2007, Regional climate projections, chap. 11., in Solomon, S., et al; (eds), *Climate Change 2007—The Physical Science Basis: Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, U.K., p. 849–940

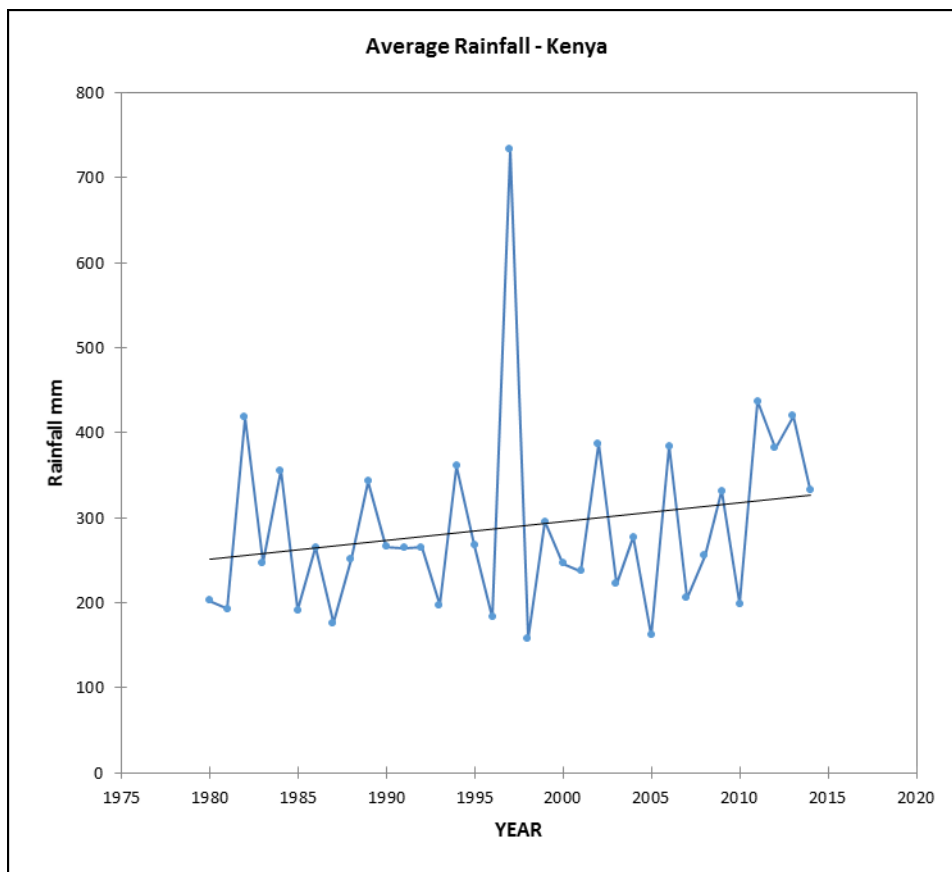


Figure 4. Average annual rainfall for Kenya for the period 1980 – 2014. (Source: Kenya Meteorological Dept)

The main planting season for the country is the March – April – May season. The rainfall within this period is critical for the nation as it strives to be food secure. According to data analysed for this period, there is a significant decrease in rainfall. Figure 5 below indicates that there is a net reduction of rainfall over this period by about 60 mm over the period under consideration. This has serious implications on agricultural productivity in the country, as this is the major planting season for the country. The net reduction of rainfall in the main planting season has potential to adversely affect crop production in the country’s major crop growing areas. The United States Agency for International Development’s (USAID) Early Warning

System Network (FEWSNETS) corroborated this when it reported that long rains in Central Kenya has declined by more than 100 mm between 1970 and 2010.¹⁷⁹

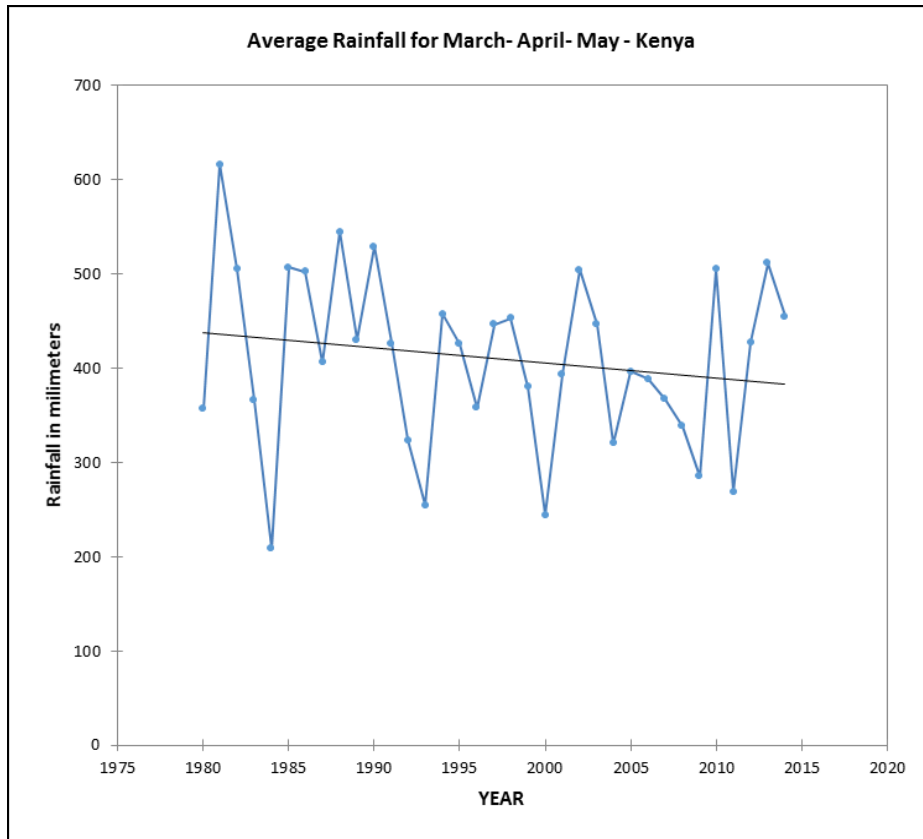


Figure 5. Average rainfall for March-April-May for Kenya for the period 1980 – 2014. (Source: Kenya Meteorological Dept.)

The other important season is the October – November –December period, commonly referred to as the short rains and is used by farmers in Eastern and Coastal regions of Kenya for crop production. Figure 6 below indicates that there has been an increase in the overall rainfall in the period under consideration. This indeed is important for farmers in the eastern and coastal regions whose main planting season is done on this period.

¹⁷⁹ USAID. A Climate Trend Analysis of Kenya- August 2010. FEWSNET. www.pubs.usgs.gov accessed on 11th July 2016

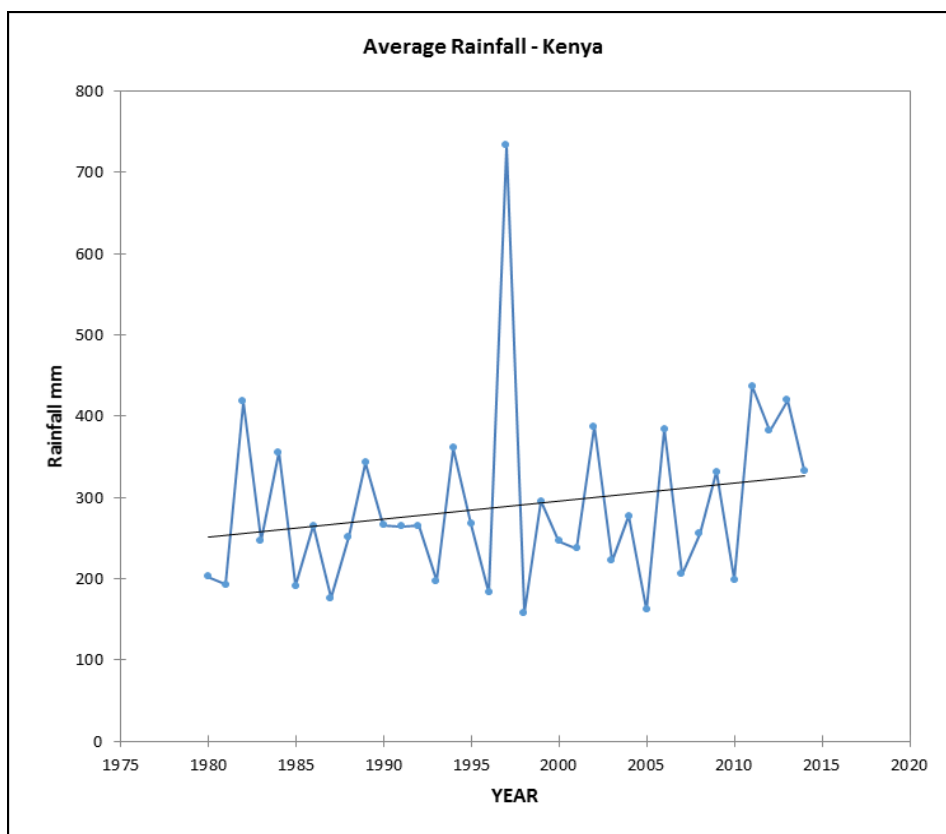


Figure 6. Average rainfall for October – November -December for Kenya for the period 1980 – 2014. (Source: Kenya Meteorological Dept)

It is clear from this analysis that Kenya has been affected negatively by the decline in rainfall during the country’s main crop planting season of March-April-May. However, the increased rainfall during the October – November – December rainfall offers an opportunity for the counties/regions that depends on that season for crop production. The bigger problem nevertheless lies in the apparent increase in drought incidences in the country. In the last 20 years, the country has had six serious drought incidences, an indication that the frequency of

drought could be on the rise.¹⁸⁰ Indeed, the La-Nina related drought of 1999/2001 was thought to be the worst in the country in the recent times.¹⁸¹

4.3 Kenya's National Climate Change and Environmental sustainability Action Plans

Kenya was among the first countries in Africa to develop national plans to address climate change.¹⁸² The National Climate Change Response Strategy (NCCRS) which is implemented through the National Climate Change Action Plan (NCCAP) illustrates that climate change ranks high in the national policy agenda. These documents have laid a foundation for climate change action in several sectors key among them agriculture and natural resources. This section evaluates these documents and their applicability in country's environmental sustainability. It also identifies both state and non-state actors involved in climate change and environmental sustainability programmes in the country.

4.3.1 National Climate Change Response Strategy

The purpose of the National Climate Change Response Strategy is to put in place robust measures for addressing challenges posed by climate variability and climate change in Kenya.¹⁸³

The development of the strategy was upon realization that despite the unmistakable effect of climate change in the country manifested through increase in temperatures and rainfall irregularities, there was a lacuna in terms of policy to address the adverse effects of climate change. The government policy documents prior to development of the strategy such as Vision 2030 did not have an explicit provision for climate change. Climate variability has had negative consequences in economic development of the country, as evidenced by the 1999/2000 *La Nina* droughts which left 4.7 million Kenyans facing starvation and the spread of vector-borne

¹⁸⁰ Mbogo. E, Inganga F, Maina J.M. Drought Conditions and Management Strategies in Kenya. www.ais.unwater.org accessed on 12th July 2016 p 2

¹⁸¹ Nganga J.K. Climate Change Impacts, Vulnerability and Adaptation Assessment in East Africa. UNFCCC African Region Workshop on Adaptation. Accra, Ghana 2006. P 1.

¹⁸² Immaculate Maina, Andrew Newsham, Micheal Okoti. *Agriculture and Climate Change in Kenya: Climate Chaos, Policy Dilemmas*. Future Agricultures. Working Paper No 070. 2013. p 3

¹⁸³ *National Climate Change Response Strategy*. The Government of Kenya. 2010. p 5

diseases like malaria to areas which were hitherto not endemic to such diseases.¹⁸⁴ Similarly, the country has experienced climate change-related migration of its citizens like the continuous movement of pastoralist communities of northern Kenya ravaged by both droughts and floods.¹⁸⁵ The objectives of the Strategy are to enhance the country's understanding of climate change regime by taking in to account the negotiation process, international agreements, processes and policies and elaborate on the country's positions in order to maximize beneficial effects of climate change. It also seeks to recommend robust adaptation and mitigation measures required to minimize risks associated with climate change and maximize on opportunities. More importantly, the Strategy seeks to recommend a favorable and enabling policy, institutional and legal framework to combat climate change in the country.¹⁸⁶

In order to cushion important sectors against impacts of climate change, the Strategy has identified sectoral mitigation and adaptation needs. Adaptation actions include promoting and producing drought tolerant, pest and disease resistant crop varieties that mature early as well as promotion of orphan crops such as cassava, pigeon pea, sorghum and sweet potato. To minimize losses of harvested crops, the Strategy proposes post-harvest processing, storage as well as value addition. In the livestock sector, breeding of animals from different agro-ecological zones that adapt favourably to climate variation will be promoted, and provision of special livestock insurance scheme to transfer and spread the risk attributed to climate change.¹⁸⁷

With regards to mitigation, the Strategy advocates for promotion of energy efficient and renewable energy technologies like geothermal, solar, wind, biomass, small hydro plants and low carbon public transport system. Other measures include afforestation and reforestation with an

¹⁸⁴ Ibid.

¹⁸⁵ Hanny Besada, Nelson Sewankambo. *Climate Change in Africa: Adaptation, Mitigation and Governance Challenges*. The Centre for International Governance and Innovation Special Report. 2009, p 9.

¹⁸⁶ *National Climate Change Response Strategy*. The Government of Kenya. 2010. p 88.

¹⁸⁷ Ibid.

emphasis on the five water towers of Cherangani, Mau, Mt Kenya, Mt Elgon and Abadares ecosystems. These efforts will also accord communities an opportunity to engage on carbon trading for enhanced income generation. Further, the Strategy calls for enhanced awareness campaigns, education and simplified communication models that can easily be understood. It is instructive that the Strategy is complementary and consistent with existing government development and economic plans, principally the blue print Vision 2030.¹⁸⁸

4.3.2 National Climate Change Action Plan 2013-2017

The National Climate Change Action Plan (NCCAP) was primarily developed to facilitate implementation of National Climate Change Response Strategy thereby equipping the country to take necessary action in response to climate variation challenge. The Action Plan focuses on climate resilience, low carbon, development pathway, adaptation analysis and priority actions, mitigation measures, technology requirements, capacity development and climate change financial mechanism.¹⁸⁹ The Action Plan acknowledges the importance of agriculture in the economy, which directly contributes 26% of the country's GDP, and an additional 25% indirectly.¹⁹⁰ The sector also accounts for 65% of informal employment in rural areas. The predominantly rain-fed agriculture practiced in the country is vulnerable to climate change making it food insecure. The Action Plan therefore focuses on this sector together with other vulnerable sectors to guide in prioritization of suitable actions to address climate change effects.

The Action Plan posits that despite the agricultural sector being sensitive to climate change, it is also a large and growing GHG emitter responsible for 30% of Kenya's emission. It identifies climate-smart agricultural practices that reduce climate variability and emissions such

¹⁸⁸ *National Climate Change Response Strategy*. The Government of Kenya. 2010. p 67

¹⁸⁹ *National Climate Change Action Plan 2013-2017*. The Government of Kenya. 2012 p 7

¹⁹⁰ *Agricultural Sector Development Strategy, 2010-2020*. The Government of Kenya, 2010 p xii

as Agroforestry which also offer climate resilience benefits such as improved soil quality, improved water retention capacity in the soil and reduce soil erosion.

Other beneficial low carbon activities include conservation tillage and limiting the use of fire in cropland and range management. In addition, promotion of drought tolerant crops, water harvesting, boosting of strategic food reserves and mainstreaming climate change into agricultural extension service will enhance food security situation in the country. With regards to livestock, low climate resilience actions will entail improved management of grazing systems, livestock diversification and breeding of animals to improve their ability to adapt to climate change and produce lower emissions. Insurance schemes for livestock and price stabilization schemes will shield livestock farmers from risks related to climate variability.¹⁹¹

The Kenya's constitution sets a benchmark of 10% tree cover which the country should work to attain and maintain.¹⁹² Increased tree cover has important benefits in terms of climate resilience and low carbon, due to their action of preventing flooding and landslides as well as reduced erosion and sediment discharge into rivers. Trees also have a central role of carbon sequestration by acting as carbon sinks.¹⁹³ The Action Plan identifies restoration of degraded forest areas, reforestation and actions to reduce deforestation as important mitigation actions. In addition, adaptation actions such as improving coastal zone management through rehabilitation of vital coastal ecosystems will improve climate resilience. Water management is another important area in addressing recurrent drought situation. In this connection, the Action Plan identifies water catchment protection as a priority safety measure. It also identifies key

¹⁹¹ *National Climate Change Action Plan 2013-2017*. The Government of Kenya. 2012 p 45

¹⁹² *The Constitution of Kenya 2010*. Article 69 (b). The Government of Kenya 2010.

¹⁹³ *Forest Management and Climate Change: A Literature Review*. Forest and Climate Change Working Paper 10. Food and Agricultural Organization. 2012. p ix

adaptation measures such as enhanced irrigation and drainage to increase agriculture and livestock production, increased domestic water supply, effective trans-boundary water resource management and flood mitigation schemes.¹⁹⁴

The Action Plan has a comprehensive outlay of adaptation and mitigation measures, as well as financing implementation of the plan. It also outlines the enabling policy, legislative and institutional framework and capacity development arrangement. The Action Plan is expected to inform policy decisions in all sectors of the economy. A wide range of actors ranging from Government agencies, civil society and private sector are expected to contribute to implementation of the Action Plan. It is however important to track implementation of the Action Plan through an elaborate Monitoring and Evaluation (M&E) framework.

4.3.3 Climate Change Act 2016

The Climate Change Act 2016 was enacted on the 13th May 2016 when the President signed the bill to complete the legislation process.¹⁹⁵ This is a significant development as it is the first time a climate change law has been established by an African country. The Act establishes important institutions, such as the National Climate Council which is chaired by the President with the Deputy President being the vice-chairperson. The Council will provide an overarching national climate coordination mechanism, and among the key responsibilities is to ensure mainstreaming of climate change actions by the national and county governments. Similarly, the Act establishes the Climate Change Directorate which will be directly responsible for climate change in the country. The Directorate shall provide analytical support on climate change to various sector

¹⁹⁴ *National Climate Change Action Plan 2013-2017*. The Government of Kenya. 2012 p 59

¹⁹⁵ Njagi, D. At last, Kenya Signs Bill into Climate Change Law. UNFCCC. Climate Change Information Portal. www.meas.nema.go.ke/unfccc/174-2/ accessed on 12th July 2016

ministries, agencies and county governments; and establish and manage a national registry for appropriate mitigation actions by public and private entities.¹⁹⁶

An important component of the Act is the Monitoring of Compliance function which has been vested on the National Environmental Management Authority (NEMA). In order to entrench awareness on climate change, the Kenya Institute of Curriculum Development has been tasked to integrate climate change in the national education curricula. On funding, the Act establishes a Climate Change Fund to provide financing mechanism for priority climate change actions and interventions.¹⁹⁷

4.4 Role of State and Non-State Actors

This section examines the role currently played by the State and Non-State Actors in environmental sustainability and climate change action in Kenya with a view to identify the gaps and weaknesses in the quest to address environmental issues. Prior to 2013, the government showed commitment by establishing a climate change committee at the national level chaired by the then Prime Minister whose function was to coordinate mainstreaming of climate change adaptation in the country. This however became obsolete on abolition of Prime Minister's position under the new constitution. The focus will therefore be on the current role of state and non-state actors on environmental sustainability and climate change action in the country.

4.4.1 National Climate Change Secretariat

The Ministry of Environment and Natural Resources has a Climate Change Secretariat which is tasked with coordinating implementation of the climate change action plan and operationalise the National Climate Change Response Strategy.¹⁹⁸ It is noted that climate change action is spread across different government ministries and agencies of the government, and the Secretariat's role

¹⁹⁶ Republic of Kenya. *The Climate Change Act 2016*. Kenya Gazette Supplement No 68 (Acts No. 11). May 2016.

¹⁹⁷ Ibid

¹⁹⁸ Interview with Mr Peter Omenye- Climate Change Secretariat on 13th June 2016.

is to coordinate climate change action in all of them. Under the newly enacted Climate Change Act 2016, it is envisaged that the Secretariat will be replaced by the Climate Change Directorate.

The Secretariat is yet to be fully constituted and has only some skeleton staff. Recruitment exercise of key staff has been unsuccessful due to capacity gap of the applicants, and this has affected its work. Another key challenge facing the Secretariat is inadequate funding that has slowed down implementation of its activities. One of the requirement outlined in the NCCAP is for all ministries and agencies of the government to develop Action Plans for climate change action which should be submitted to the Secretariat for coordination purpose. However, as at the time of the interview, only the Kenya Civil Aviation Authority had developed and submitted one to the Secretariat.

4.4.2 Ministry of Environment, and Natural Resources

The Ministry of Environment, and Natural Resources is the lead agency in environmental sustainability and climate change action in Kenya. Its mandate is to conserve, protect and manage environment and natural resources in the country for socio-economic development.¹⁹⁹

The Ministry has the Climate Change Secretariat which is charged with coordinating climate change action in all government ministries. It provides the guiding policy in the field of environment and natural resources. The ministry has undergone transformation in order to address the rampant environmental degradation challenges that afflicted the country in the 80's and 90's.

With regards to actual implementation, the Kenya Forest Service is the implementing arm of the Ministry on matters of forest conservation and management, a key ingredient of achieving

¹⁹⁹ Ministry of Environment and Natural Resources. http://www.environment.go.ke/?page_id=2 accessed on 25th February 2016.

environmental sustainability.²⁰⁰ One of the main activities of the Service is coordination of afforestation and reforestation programme in the country, which is a main mitigation measure for climate change.²⁰¹ Its core function include sustainable management of natural forest, increase productivity of industrial plantations, promotion of farm forestry and commercial tree planting and efficient utilization of forest produce. The Service has developed a National Strategy to Increase Forest Cover 2015-2020 which is the blue print for meeting the constitutional requirement of attaining and maintain the country's tree cover to at least 10% of the land area as stipulated in the country's constitution.²⁰² KFS is also in charge of 'REDD Plus Readiness Plan', a programme that spearheads the country's effort to reduce emissions from deforestation and forest degradation, as well as foster conservation, sustainable management of forests and enhancement of carbon stocks.²⁰³

Other agencies within the ministry include the National Environmental Management Authority (NEMA) which is designated to approve Clean Development Mechanism (CDM) projects, and the Kenya Meteorological Department (KMD) whose role is to research, predict and disseminate climate change information as well as issue early warning of extreme weather events.²⁰⁴ Similarly, Department of Resource Survey and Remote Sensing is charged with continuous monitoring of natural resources in Kenya. These agencies have clear mandates and are supervised and coordinated by the Ministry of Environment and Natural Resources.

²⁰⁰ Interview with Rose Akombo- Kenya Forest Service on 20th June 2016.

²⁰¹ *Kenya Forest Service - Service Charter*. KFS Nairobi, Kenya 2008 p 2.

²⁰² *National Strategy to Increase Forest Cover 2015-2020*. Kenya Forest Service Nairobi, Kenya. 2014 p 23.

²⁰³ Personal with Alfred Gichu- Kenya Forest Service, 22nd June 2016.

²⁰⁴ Interview with Christine Mahonga- KMD on 12th June 2016

4.4.3 Ministry of Agriculture

The Ministry of Agriculture is an important state actor in climate change action in the country. Its main focus is to modernize agriculture and ensure attainment of a food secure Kenya.²⁰⁵ It has three departments; the State Department for Agriculture whose task is to formulate policies on agriculture including land consolidation for agricultural benefit; the State Department for Livestock which handles policies on livestock, veterinary and bee keeping and the State Department for Fisheries is tasked with policies that enhance the development of the fisheries industry. The Ministry therefore provides policy guidelines and enabling environment for stakeholders to propel the sector into greater heights.

With regards to climate change, the Ministry has developed the Agricultural Sector Development Strategy (ASDS) 2010 to 2020 to guide the entire sector on measures that fit within climate change adaptation and mitigation efforts.²⁰⁶ Though the intentions of the strategy was to help the country achieve food security, nevertheless they also help in its quest to be climate resilience. Among the measures outlined are promotion of irrigation farming, Improving agribusiness and market access and strengthening research, extension and training. The government has invested heavily in Galana-Kulalu irrigation project through the National Irrigation Board which aims at putting 1,210,000 acres under irrigation.²⁰⁷

The ASDS further provides for improvement of livestock productivity, strengthening of livestock extension services, control of livestock pests and diseases and improvement of animal health and quality assurance. Further measures outlined in the sector include improving market access for livestock and livestock products and establishing disease-free zones. In addition, the

²⁰⁵ *Ministry of Agriculture, Livestock & Fisheries* <http://www.kenyans.co.ke/government/ministry-agriculturelivestock-fisheries> accessed on 24th February 2016

²⁰⁶ *Agricultural Sector Development Strategy, 2010-2020*. The Government of Kenya, 2010. p 22

²⁰⁷ *Galana/ Kulalu Ranch Irrigation Project- Green Revolution* <http://www.nib.or.ke/research-centre/84-nib/127-galana-kulalu-ranchirrigation-project-green-revolution.html> accessed on 24th February 2016

Strategy outlines key intervention on fisheries sector which includes developing marine capture fisheries, developing inland capture fisheries, development of aquaculture and promoting fish safety, quality assurance, value addition and marketing. It is appreciated that marine fishing in Kenya is currently underexploited despite the huge potential market of the products.

4.4.4 Kenya Agricultural and Livestock Research Organization (KALRO)

Kenya Agricultural and Livestock Research Organization (KALRO) is charged with prioritizing and coordinating agricultural research in Kenya in line with the national policy on agriculture.²⁰⁸

It provides the technical information regarding crop and livestock varieties that are tolerant or resistant to pests and diseases, drought and have improved nutritional value as well as vaccines against priority livestock diseases. The organization advises on growing of crops well adapted to local conditions with disease and pest resistance as well as drought tolerance varieties which are key element in responding to food security and climate change. The Institute also undertakes research of dairy technology in Naivasha. The dairy industry in Kenya is a major income earner for a large proportion of the population in productive areas. The mandate of the institute is to develop appropriate sustainable innovations and cost effective technologies that will enhance productivity, thus improving quality of life, equity and wealth. Among the innovation developed by this institution is the Agro Weather tool which is web and mobile-phone based agro-weather tool that incorporates climate-information and best-bet agronomic management recommendations for farmers.²⁰⁹

4.4.5 Non-Governmental Organizations (NGOs)

A number of non-governmental organizations have been active participants in implementation of climate change action in agricultural sector. Most have focused on building resilience of

²⁰⁸ Kenya Agriculture and Livestock Research Institute (KALRO) http://www.kalro.org/about_us accessed on 24th February 2016

²⁰⁹ Dairy Research Institute. Kenya Agricultural and Livestock Research Institute <http://www.kalro.org/dairy/?q=homepage> accessed on 24th February 2016

communities through promotion of agricultural practices such as drought resistant crop varieties, as well as improved management of livestock and water resources. In line with this, International NGOs such as CARE, and international research bodies such as the World Agroforestry and ILRI are involved with a number of adaptation actions. These include the Payment for Environmental Services (PES) pilot project in Lake Naivasha basin and the Index Based Livestock Insurance project in Marsabit.²¹⁰ However, in terms of conservation of agriculture, there is no clear funding in the Kenya to help promote this important initiative despite being mentioned in the NCCAP as work under research.

The Green Belt Movement (GBM) is an environmental organization aimed at empowering communities, especially women, to conserve the environment and improve livelihoods. GBM was founded by the late Professor Wangari Maathai in the year 1977 under the auspices of the National Council of Women of Kenya (NCWK) in order to respond to the needs of rural Kenyan women after their water streams started to dry up, their food supply became less secure, and they had to walk a long distance to fetch firewood for fuel.²¹¹

It is instructive that Professor Wangari Maathai won a Nobel Peace Prize on account of her work on environmental conservation through the Green Belt Movement. GBM has a climate change programme that aims at strengthening the understanding and capacity of rural communities to take action against climate change. It encourages women to work together to grow seedlings and plant trees to bind the soil, store rainwater, provide firewood and food, and receive a small monetary token for their work. In 2014, GBM planted a total of 438,129 trees

²¹⁰ Brooks, S., Thompson, J., Odame, H., Kibaara, B., Nderitu, S., Karin, K. & Millstone, E.. *Environmental Change and Maize Innovation in Kenya: Exploring Pathways In and Out of Maize*. Brighton: STEPS Centre, IDS 2009 p 34

²¹¹ The Green Belt Movement. <http://www.greenbeltmovement.org/> accessed on 25th December 2016

seedlings with communities around Kenya, while at the same time launching a programme of adopting clean and renewable fuels and technologies.²¹²

4.4.6 Other Government Agencies

The ministry of finance has a critical role in resource mobilization for environmental conservation and climate change action plan. To attain this, the Ministry has established a Climate Finance Unit (CFU) which is tasked with climate change policy financing and investment and enhancing public – private participation in carbon projects.²¹³ Similarly, the Ministry of Planning, National Development and Vision 2030 are mandated to mainstream climate change in development plans. However, the Ministry of planning has acknowledged that not much has been done in terms of actual implementation due to challenges of resources.²¹⁴

4.4.7 Green Zones Development Support Project

The project was funded by African Development Bank with the objective of promoting forest regeneration and conservation for environment protection.²¹⁵ It also aimed at improving community livelihood and incomes, especially women living adjacent to forests. Key project interventions included climate change resilience actions such as rehabilitation of degraded areas, reforestation, afforestation, community participation in conservation activities, promotion of green energy and capacity building. The project established 309,404 Ha of forest within the forest reserves and community landscapes, translating to 0.54% increment in the country's forest cover.²¹⁶ The project also promoted green energy initiative through use of biogas, energy efficient stoves and solar energy. In addition, agroforestry practices were promoted through

²¹² *The Green Belt Movement Annual Report 2014*. Nairobi, Kenya. GBM 2014 p 3

²¹³ Nzau, V, M. *Mainstreaming Climate Change Resilience into Development Planning in Kenya*. Climate Change Country Report, GoK and IIED, Nairobi, Kenya. 2013 p 7

²¹⁴ Interview with James Kirigwi, Ministry of Develution and Planning, 26th Oct 2015

²¹⁵ *Green Zones Development Support Project: Appraisal Report*. African Development Bank, Tunis, Tunisia. 2005 p 7.

²¹⁶ *Impact Study on Green Zones Development Support Project, Forest Conservation Component*. African Development Bank, Nairobi, Kenya 2015 p 51

planting of 11,000 hectares of various configurations of intercropping trees and food crops. It is important to note that this project, which was conceptualized in 2005, was primarily for environmental conservation and not climate change. Nevertheless the project contributed to climate change mitigation in the country, and with a vigorous capacity building programme for communities, these initiatives are bound to produce a multiplier effect as the country grapples with climate change effects.

4.5 Conclusion

The rainfall and temperature data used in the study suggests that climate change has indeed affected the country and we are starting to experience the consequences of the same. The scenario indicates that there has been an increase in temperature by approximately 1° C between 1980 and 2014, and a corresponding decrease in rainfall by about 60 mm in the main planting season of March – April – May. The combination of these two signals serious consequences on crop productivity, and calls for robust climate change adaptation strategies and actions. This comes at a time when the country is food insecure and population continues to rise.

On implementation, the study concludes that whereas there is political will to combat climate change as well as environmental degradation in the country, little is being done in terms of practical action to address the same. The political will is exemplified by the legislation, strategy and action plan for responding to climate change as well as institutional arrangement to implement the task. However, Kenya is yet to develop a specific broad based climate change policy to act as the overall guide the climate change action plan. The Climate Change Act 2006 was enacted before the policy, whereas the reverse should have been the case as per the normal government procedures and protocol. Furthermore, the Climate Change Secretariat is yet to be fully constituted and its work is not visible. Indeed, enquiries revealed that there are capacity

challenges within the government for climate change experts who can run the Secretariat.²¹⁷ In terms of implementation by state and non-state actors, programmes specifically developed for climate change adaptation and mitigation are grossly inadequate despite the gravity of climate change consequences. The study revealed that there are very few pure climate change programmes in place, rather, what we have are programmes with significant climate component, such as afforestation and renewable energy.

Environmental Security Theory considers ability of individuals, communities and nations to cope with environmental risks. From the three elements of environmental security, namely prevention or restoring damage to the environment; preventing or responding to environmentally caused conflicts and protecting environment due to inherent moral values, it can be deduced from this study that the country is yet to achieve desired results, especially in climate change action and reversing environmental degradation. According to KFS, Kenya loses 0.3% of its forests per annum, while Uganda and Tanzania loses 0.9% and 1% respectively annually.²¹⁸

The missing link between the existing climate change framework and actual implementation can be attributed to inadequate financial resources, weak technical capacity and lack of policy. The existing programmes with significant climate components are largely funded through normal sectoral allocation by the government and their impact may not significantly address climate change action and move the country towards environmental sustainability. This is exemplified by information obtained from Kenya Agricultural and Livestock Research Institute (KALRO) which indicated that the institution is grossly under-funded, thereby seriously affecting research on drought tolerant food crops and other climate resilience initiatives.²¹⁹ Similarly, the freeze on employment has curtailed the institute's capacity development and

²¹⁷ Interview with Mr Peter Omenye- Climate Change Secretariat on 13th June 2016.

²¹⁸ Source: Presentation by Prof Donald Ogwen, KFS to NDC on 26th November 2015

²¹⁹ Focus group Discussions during study visit to KALRO by National Defence College on 26th November 2015

succession plans in the institution. There is therefore a need to address these issues if climate change and environmental degradation were to be addressed adequately.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

There is little doubt that the world is experiencing the effects of climate change, which are projected to get more severe as temperatures increase. A clear manifestation of this phenomenon on a global scale is reduced rainfall, increased drought, flooding, heat waves, cold waves and reduced biodiversity. These have had serious impacts on key economic sectors including agriculture, energy, environment, infrastructure development and human health, and made the vision of achieving global environment sustainability a challenge. On human health, it is argued that these extreme weather variations may increase the severity of the diseases worldwide.

Various reports (IPCC 4th Assessment Report, World Bank 2006) point out that despite the universal impact of climate change, Africa bears some of the greatest burdens owing to its less privileged and poor population. This is regardless of the fact that it is one of the least contributors of greenhouse gases. The variable rainfall pattern combined with increased temperature have adversely affected agricultural sector, which is one the main economic activity in the continent. It is estimated that 60 per cent of its inhabitants directly derive their livelihood from this sector that also contributes about 50 per cent of Africa's total export value. More significantly, the continent remains food insecure with approximately one out of four persons in Sub-Saharan Africa classified as undernourished.²²⁰ Other sectors affected by climate change in Africa are health, infrastructure, energy and it has also been linked to forced migration and conflict in the continent.

The East Africa sub-region faces similar predicament in terms of climate variability. It is particularly vulnerable to climate change due to its status as a predominantly arid and semi-arid

²²⁰ FAO & UN. Regional Overview of Food Insecurity- Africa. Accra, Ghana. 2015 P 1

area. Rainfall pattern over a 30-year period point at a worrying trend where frequency, severity and intensity of droughts has been on an increase. According to IPCC 4th Assessment Report, the drought incidences in the sub-region have increased from seven years to five to almost every other year. The sectors most affected include agriculture, livestock, energy and infrastructure.

In Kenya, about 84 per cent of land is arid or semi-arid making it unsuitable for rain-fed farming. This situation poses a challenge in food production as the country is predominantly reliant on rain-fed agriculture. Climate change exacerbates the situation in the country which remains food insecure. In addition, Kenya is the least endowed in terms of forestry resources in East Africa. Forests are critical in both climate change mitigation and adaptation strategy. Despite conservation efforts by the Ministry of Environment and Natural Resources, Kenya Forest Service and other stakeholders, the country is losing forests at a rate of 0.3% per annum which is however less than the annual loss of 0.9% and 1% experienced by Uganda and Tanzania respectively.²²¹ The high rate of deforestation that has occurred in the Kenya and the sub-region has negative effect on climate change.²²²

5.2 Key Findings

The broad objective of the study was to examine the status of environmental sustainability and climate change action plan in Africa, with a particular focus on Kenya. The specific objectives sought to understand the relationship between climate change and environmental sustainability in Africa, and establish the effectiveness of adaptation measures that can enhance climate resilience in Africa in general and Kenya in particular. Further, the role of state and non-state actors in implementation of regional as well as national climate change action as well as environmental sustainability were analyzed.

²²¹ Source: Presentation by Prof Donald Ogweno, KFS to NDC on 26th November 2015

²²² FAO 2010: Global Forest Resource Assessment 2010. Main Report. *FAO Forestry Paper*. Food and Agricultural Organization. Rome Italy. P 34

In Africa, climate change in form of rainfall and temperature variation adversely affects forest regeneration and vegetation growth which are key mitigation strategies. Similarly, sea level rise and sea temperature increase have adverse effects on the rich sea ecosystem as well as the coastal populations. Climate change therefore, undermines attainment of environmental sustainability. On the flip side, environmental degradation in form of deforestation, land degradation, desertification and air pollution generates greenhouse gases into the atmosphere. According to FAO, Africa's forest and woodland receded by 0.8% between 1990 and 2000 against a global average of 0.2% loss.²²³ Environmental degradation in Africa therefore contributes to global warming hence enhances climate change. These two variables, are therefore mutually linked, with change in each variable affecting the other. In order to address climate change, Africa and indeed the world must work towards attainment of environmental sustainability through implementation of mitigation as well as adaptation actions.

Implementation of climate change action in Africa was deemed to be unsatisfactory, as existing mechanisms are geared towards mitigation as opposed to addressing the continent's vulnerability to the impact of climate change. African Development Bank posits that the continent's GDP is shrinking by 3% annually due to negative impact of climate change.²²⁴ Perhaps the greatest impediment to implementation of climate change action and attaining environmental sustainability in the continent is inadequate funds. UNEP estimates that between USD 7 billion and USD 15 billion per year is required to meet Africa's adaptation challenges.²²⁵ However, funds have not been forthcoming for this to be actualized, despite a USD 100 billion

²²³ FAO (2005). *State of the World's Forests 2005*. Food and Agriculture Organization of the United Nations, Rome. Italy. p 234.

²²⁴ African Development Bank Group. *Establishment of the African Climate Change Fund*. AfDB. 2014. p 1.

²²⁵ UNEP. *African Adaptation Gap Report: Climate Change Impacts, Adaptation Challenges and Costs for Africa*. UNEP. 2013 p 31

pledge by developed countries during COP 15 in 2009. African Development Bank has set the pace by initiating African Climate Fund with initial modest funding of USD 6 million, which can pilot some adaptation actions.²²⁶

In Kenya, the study concluded that between 1980 and 2014, the temperatures have increased by approximately 1°C while rains in the main crop production period of March-April – May have decreased by about 60 mm. However, the overall rain received per year has increased, same as the second rainy season of October – November – December. The combination of increased temperature and decrease in rain during the main crop production season signals serious consequences for crop productivity in the country. In terms of addressing the adverse effects of climate change, the country has demonstrated political will to combat climate change through enactment of legislation, development of strategy and action plan as well as establishment of institutional framework. However, little is being done in terms of practical implementation of climate change action. The existing impediments include inadequate financial resources, weak technical capacity and lack of climate change policy.

5.3 Recommendations

According to Nicolas Stern, the cost of action on climate change far outweighs the cost of inaction, as the former confines the annual loss on GDP to 1% while the latter will potentially lead losses of between 5-20% of GDP.²²⁷ It is therefore imperative that the region, sub-region and Kenya take concrete and practical action to address the climate change. Africa should develop internal capacity on climate change in order to understand and subsequently articulate its

²²⁶ African Development Bank Group. *Establishment of the African Climate Change Fund*. AfDB. 2014. p 2

²²⁷ Stern, N. (2006). "Summary of Conclusions". Executive Summary. *Stern Review Report on the Economics of Climate Change*. HM Treasury. P ii.

position in the international arena. This will also enable the continent leverage itself and attract opportunities to address climate change effects.

Kenya should move with speed to operationalize the institutions created the Climate Change Act 2016, such as the National Climate Council and the Climate Change Directorate, in order to offer guidance in the quest to make the country climate resilient. Similarly, the government should consider an internal mechanism of raising funds for climate change, such as establishment of a climate levy to enable implementation of critical adaptation programmes. These funds can be supplemented by external funds. Further, the government should as a matter of policy ensure that all sectoral programmes have a significant climate component. This includes embracing clean energy, energy efficient technology and drought tolerant crops.

This study found that the crop production season of October-November- December (OND) has more reliable rains than the traditional March – April- May season. The Ministry for Agriculture and KALRO should therefore consider viability of shifting more efforts to the OND season for higher productivity. Similarly, the two institutions should link research results with actual implementation by introducing crop varieties that can prevail in the current climatic patterns. Finally, the country should invest on capacity development on climate change in order to be better equipped to handle climate change issues locally.

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Appendix 1

Primary Data

1. Peter Omenye Climate Change Secretariat
2. Rose Akombo Kenya Forest Service
3. Sheila Shefo Climate Change Secretariat
4. Christine Mahonga Kenya Meteorological Department
5. Christopher Ng'etich Kenya Meteorological Department
6. Ephraim Muchiri Ministry of Environment and Natural Resources
7. Chris Mutyota Forest Action Network
8. Lucy Waruingi African Conservation Network