



Government of Kenya

National Climate Change Response Strategy



April 2010



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Foreword

The integration of climate information into Government policies is important because climate is a major driving factor for most of the economic activities in Kenya. Climate information has, however, not been easily understandable. The same has not been adequately factored into most of the sectors of the country's economy including Government development policies and plans. The current Government's blue print called 'Vision 2030' is no exception. The purpose of this National Climate Change Response Strategy (NCCRS) is to put in place robust measures needed to address most, if not all, of the challenges posed by climate variability and change.

It is important for me that this Strategy has been developed through a very participatory process conducted countrywide. We have had two national workshops, nine regional workshops as well as workshops with parliamentarians and clusters of stakeholders including the Government, private sector, civil society organisations, development partners, youth groups, women's groups, faith-based organisations, and the media, among others. These workshops were held to gather information on the impacts of climate change as well as on recommended interventions.

It is also important for me that a number of line-ministries have provided their programmes and projects towards sector-wide adaptation to and mitigation against climate change. The Action Plan of this Strategy builds on these programmes and projects, among others, and shows to me the Government's commitment towards tackling climate change.

This document is divided into ten chapters. Chapter One looks at the history of climate change, challenges and international efforts to combat climate change. The remaining chapters give details on evidence and impacts of climate change; strategic focus of the

NCCRS including the linkages between the NCCRS and the Vision 2030; adaptation and mitigation interventions; communication, education and awareness programmes; vulnerability assessments; research, technology development and transfer; policy, legislation and institutional framework; as well as action plan, implementation framework and resource mobilisation plan, respectively.

The recommendations given in this document should be translated into policies that would benefit our communities and trigger the process of active involvement in factoring climate information into all relevant activities. For climate change threats to be appreciated, the document has recommended massive awareness campaigns so that the public can be sensitised and mobilised to adapt to and mitigate against impacts of climate change.

It is important to note that this is the first time this country has developed a document of this kind dedicated to addressing the threats posed by climate change as well as taking advantage of any opportunities that may arise. Future climate change programmes and projects will have to be developed in line with the provisions of this Response Strategy. Consequently, this Strategy is now the key Government climate change agenda guide in the country and will inform nationwide climate change programmes and development activities including the formulation of documents such as the National Climate Change Policy and efforts towards the attainment of Vision 2030. For this reason, the Strategy shall be circulated widely to as many stakeholders as possible to enable extensive reading.



Honourable John Njoroge Michuki, EGH, MP.
Minister for Environment and Mineral Resources

Acknowledgement

Climate change is considered one of the most serious threats to sustainable development globally. Studies have shown that about 90% of all natural disasters afflicting the world are related to severe weather and extreme climate change events. Impacts of the projected climate change are expected in many sectors such as environment, human health, food security, economic activities, natural resources and physical infrastructure. For example, among the key findings of the Fourth Assessment Report (AR4) (IPCC, 2007) are:

- Millions of people globally will be exposed to increased water stress,
- Access to food in many African countries will be severely compromised, and
- Adaptation to climate change will be necessary.

Kenya acknowledges that the change in the Earth's climate and its adverse effects are a common concern of humankind. The Ministry of Environment and Mineral Resources (MEMR) has therefore recognised the need to enhance coordination of climate change activities in the country with a view to ensuring a climate-proof socioeconomic development anchored on a low-carbon path.

The Kenya National Climate Change Response Strategy (NCCRS) is based on outcomes of stakeholder-consultations held all over the country and therefore captures the aspirations of most Kenyans on tackling climate change challenges. The document has also drawn from sectoral climate change response activities and budgeted Action Plans of various line Ministries.

Indeed, the Strategy has come up with modalities of dealing with climate change challenges in the country with a view to ensuring a climate-resilient nation. These include recommendations on relevant policies, institutional framework, awareness creation and mobilisation of resources, among many others.

The Ministry of Environment and Mineral Resources is proud to present this Strategy, the first ever in the country. This is an indication of

the high priority the Ministry has accorded to climate change and its associated impacts. It is my hope that the document will be found useful in delivering the country out of the vicious cycle of poverty exacerbated by the changing climate and its associated severe impacts on livelihoods and economic development.

The preparation and publication of this Strategy have taken efforts of various entities and I would like to acknowledge their efforts. I take this opportunity to thank all those who participated in the production of this Response Strategy: CAMCO as a consulting firm, stakeholders who participated in the consultative workshops, the NCCRS Advisory Committee, the NEMA staff who organised the regional consultative workshops, officers of the Climate Change Secretariat at the Ministry headquarters, all Ministries that contributed concept papers on climate change projects and programmes to be undertaken by their respective Ministries, and the Environment Secretary for coordinating all these inputs and steering the publication of the Strategy.

Development of a document of this kind would be impossible without financial resources. In this regard, my gratitude goes to the Governments of Denmark and Sweden through the Danida/Sida supported Environmental Programme Support (EPS) for providing both technical and financial support for the process. Of course I can't forget the support provided by other development partners in particular the UNDP, UNEP, International Development Research Centre (IDRC), IGAD Climate Prediction and Applications Centre (ICPAC) and members of parliament particularly the Departmental Committee on Land and Natural Resources as well as the Departmental Committee on Agriculture, Livestock and Cooperatives during the awareness campaign workshops.



Lawrence Lenayapa
Permanent Secretary
Ministry of Environment and Mineral Resources

Executive Summary

It is universally accepted that climate change is one of the greatest challenges facing humanity this century. In Kenya, this phenomenon is already unmistakable and intensifying at an alarming rate as is evident from countrywide temperature increases and rainfall irregularity and intensification.

These climate-driven changes affect resources critical for economic development of Kenya. An example is the 1999/2000 La Niña droughts, which left approximately 4.7 million Kenyans facing starvation. In addition, increased average temperatures have led to the spread of vector-borne diseases like malaria to areas where the disease is not known to be endemic.

Global Greenhouse Gas (GHG) emissions are continuing unabated and in the future, the impacts of climate change are likely to worsen an already precarious situation. If Kenya takes no action to reduce or minimise expected impacts of current and future climate change, the costs of potential damage to the economy could be enormous. A recent study has estimated that the direct costs of climate change damage in Kenya will potentially amount to between one and two billion US Dollars annually by the year 2030 and considerably greater if indirect costs are included.

Climate change also presents opportunities for developing countries like Kenya, which can avoid the high-emission path that developed countries have pursued to attain their present high economic status. The 'carbon market,' where it is possible to trade carbon credits, presents an opportunity for developing countries to raise additional revenues for GHG emission reducing projects that also contribute to sustainable development. There are two types of carbon markets and both are relevant to Kenya. The two markets are: (i) the Clean Development

Mechanism (CDM) compliance market under the Kyoto Protocol and (ii) Voluntary Carbon Markets (VCM), which emerged to fulfil the demand from organisations and businesses that wish to offset their carbon emissions voluntarily. It should be noted that presently, most developing countries in Africa have not benefited from carbon markets because of their complexity, trading conditions, investments and general lack of capacity and knowledge in developing countries. Therefore, for Kenya to benefit from these markets, intense capacity building particularly at the community level will be required.

The National Climate Change Response Strategy

In response to the challenges and opportunities posed by climate change, Kenya has developed this National Climate Change Response Strategy. The vision of the Strategy is for a prosperous and climate change resilient Kenya. The mission is to strengthen and focus nationwide actions towards climate change adaptation and GHG emission mitigation. This will be achieved by ensuring commitment and engagement of all stakeholders while taking into account the vulnerable nature of Kenya's natural resources and society. The objectives are to:

- enhance understanding of the global climate change regime: the negotiation process, international agreements, policies and processes and most importantly the positions Kenya needs to take in order to maximise beneficial effects of climate change,
- assess the evidence and impacts of climate change in Kenya,
- recommend robust adaptation and mitigation measures needed to minimise risks associated with climate change while maximising opportunities,

- enhance understanding of climate change and its impacts nationally and in local regions,
- recommend vulnerability assessment, impact monitoring and capacity building framework needs as a response to climate change,
- recommend research and technological needs to respond to climate change impacts, and avenues for transferring existing technologies,
- recommend a conducive and enabling policy, legal and institutional framework to combat climate change, and
- provide a concerted action plan coupled with resource mobilisation plan and robust monitoring and evaluation plan to combat climate change.

Based on the above objectives the following sections summarise the Strategy's contents and related recommendations as proposed by stakeholders that have participated in the process of developing this Strategy.

1. Understanding the international climate change regime

The main purpose of Chapter 1 of the Strategy is to enhance understanding of climate change in a global context. Discussion in this chapter focuses on the climate change negotiation process and outcomes, international agreements and policies, and most importantly the positions Kenya needs to adopt in order to maximise benefits. To achieve this, the Strategy has provided a synopsis of climate change as an international environmental and developmental challenge. This begins with when climate change was first widely recognised as a global problem in the 1980s where it was mentioned in the Brundtland Report published in 1987 and proceeds through to the formation of the Intergovernmental Panel on Climate Change (IPCC) in 1989. This was then followed by the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, which concluded with agreements establishing

the United Nations Framework Convention on Climate Change (UNFCCC).

Since then, there have been a series of Conference of the Parties (COPs) to the UNFCCC. Two main outcomes of these COP meetings have been the Kyoto Protocol (COP 3 of 1997) and the Marrakesh Accords (COP 7 of 2001), which contains the detailed rules for the implementation of the Kyoto Protocol.

Key issues that have continued to shape the global climate change regime are also explained in this chapter of the Strategy. These include mitigation, adaptation, finance, technology development and transfer, governance as well as the role of land-use and land-use change and forestry (LULUCF) in climate change mitigation especially in developing countries.

2. Assessment of evidence and impacts of climate change in Kenya

The Kenya Meteorological Department (KMD) has provided data of temperature and rainfall changes in Kenya over the last fifty years.

From the early 1960s, Kenya has generally experienced increasing temperatures over vast areas. Over inland areas, the trends in both minimum (night-time/early morning) and maximum (daytime) temperatures depict a **general warming** through time. However, the increase in the minimum temperatures is steeper than in maximum temperatures. The combined effect of a steeper increase in minimum temperatures and a less steep increase in maximum temperatures is a lower daily (diurnal) temperature range.

In general, annual highest rainfall events indicate that the 24-hour intense rainfall amounts observed in the recent years are relatively lower than those in the early 1960s; essentially, these values have **been reducing (negative trend)** with time. These trends are also depicted in the time series of the 'Long Rains' season which contributes a significant amount of rainfall to annual totals over most

parts of the country. However, the changes (reductions) are not very significant. Most of the standard seasons also depict the same type of patterns in the highest daily rainfall values observed. Thus far, there is an indication of relatively ***more intense rainfall occurring more frequently*** over the coastal strip and the northern parts of the country in the September-October-November (SON) and December-January-February (DJF) seasons.

These changing temperature and rainfall patterns have profound impacts on Kenya's socio-economic sectors, most of which are climate-sensitive. Based on the contributions of stakeholders during the national and regional National Climate Change Response Strategy (NCCRS) workshops as well as literature review, both observed and potential impacts of climate change on Kenya's key sectors and land use systems were assessed. These key sectors include: agriculture; rangelands which are the backbone of Kenya's pastoralism, wildlife and tourism sectors; forestry; water resources; aquatic and marine resources; health; as well as physical and social infrastructure.

A key finding of this assessment is that climate change is already ravaging Kenya as shown for instance by the increase in the incidence and geographical spread of diseases like malaria as well as more frequent and more intense droughts, and erratic rainfall patterns. These impacts and others portend an increasingly worsening and worrying situation in the future if global and national efforts are not enhanced to reverse atmospheric GHG emissions which accelerate global warming.

3. Adaptation and mitigation needs

In order to cushion key sectors against the impacts of climate change, the NCCRS (also known as the 'Strategy') has identified sectoral adaptation and mitigation needs. In addition, the Strategy has recommended procedures contained in an Action Plan detailing the specific sectoral actions, implementation timeframe, key implementing or lead agencies

and the indicative costs. The Strategy is complementary and consistent with existing development and economic plans, principally the Vision 2030. These recommendations will be supported by a well-defined implementation, monitoring and evaluation framework.

Some specific adaptation actions include:

- producing and promoting of drought-tolerant, disease and pest resistant as well as early maturing crop varieties,
- promoting orphan crops, e.g. sorghum, cassava, pigeon pea, sweet potato,
- promoting agricultural produce post-harvest processing, storage and value-added,
- breeding of animals from various agro-ecological zones that adapt well to climatic variances, and
- providing special livestock insurance schemes to spread and transfer risks from climate change.

Chapter 4 specifies interventions to be undertaken in all the vulnerable sectors including in the water, agriculture, forestry, energy, wildlife, rangelands, coastal, infrastructure, etc. On-going interventions are highlighted as well as proposing new measures.

In addition, Kenya stands to benefit from carbon markets by putting in place mitigation measures including the promotion of energy efficiency and renewable energy technologies e.g. solar, wind, geothermal, biomass and small hydro plants, as well as a properly planned low-carbon public transportation system. These interventions are covered under Mitigation in Chapter 4. Other measures covered include growing trees for rehabilitation and restoration of degraded landscapes, particularly the five water catchment areas and trust-lands. These areas will support structured engagement of the communities in carbon trading for enhanced income generation and poverty reduction. In addition, this will support biodiversity conservation aspirations of our national development policies.

Further, several case studies are used throughout the report and especially in Chapter 4 to demonstrate successful applications of the interventions being recommended.

4. Communication, education and awareness programmes

The level of understanding of climate change and its impacts is very low countrywide. This calls for a focused awareness campaign that simplifies the science and impacts of climate change in a language that is understandable by all segments of the society. This will help improve national preparedness for the potential impacts of climate change. To this end, forums for engagement and information dissemination to the public on current and future climate change risks, and a concerted, focused and comprehensive approach to managing such risks will be established. Some of the ways of enhancing climate change education and awareness which will be applied include:

- establishing a National Climate Change awareness campaign using print and electronic media to pass climate change information in various articles and programmes on climate change in the media,
- incorporating climate change information into schools and colleges' curricula and syllabuses,
- online blogging on Facebook, Twitter, Google Groups, Yahoo Groups, Unite for Climate etc, through which various topics on climate change could be discussed,
- eco-tournaments engaging in sporting events such as athletics, football and basketball to raise awareness,
- use of drama and performance arts,
- providing timely and accurate information on Kenya's climate change policy, position and issues to be discussed with Kenyan missions abroad and the Ministry of Foreign Affairs,
- encouraging individual volunteers in raising awareness, and
- involving the corporate sector, especially the mobile telephone industry e.g. to display 'airtime top-up messages' on climate change.

5. Vulnerability assessments, GHGs and climate change impacts monitoring, and capacity building framework

There is inadequate national and local information on how climate change elements – temperature rise, change in precipitation, extreme weather events, sea level rise and other seasonal shifts – will affect phenomena such as floods, drought, water shortages (supply and quality), air quality, human health, and habitat loss. A thorough nationwide assessment of how these changes will affect human population, infrastructure, the environment, the economy and society as a whole. In parallel, it is important to conduct climate change scenarios and develop corresponding policy responses.

Further, there is limited information regarding the country's vulnerability to the impacts of climate change. The same is true concerning the level of knowledge about the status of key natural resources such as lakes and rivers; rangelands; important ecosystems including the Mt. Kenya and its glaciers, water towers like the Mau Forest Complex, Mount Elgon, Cherenganyi Hills and the Aberdare Ranges.

With regard to the tracking and reporting GHG emissions in Kenya, only few institutions notably the International Energy Agency (IEA) periodically do so. The IEA's data indicates Kenya's GHG emissions in 2007 were 11.43 MtCO₂eq. This level is still low when compared to emissions of major industrialised countries, but rising quickly especially due to increasing transport (i.e. high private car use) and energy sector emissions. There are currently, no institutions based in Kenya that monitor the country's GHG emissions.

Therefore, in addition to vulnerability assessments, periodic monitoring and assessment of

the status of key natural eco-systems will be required to help design appropriate response measures that can check against their degradation and help preserve them for the sake of current and future generations. An institution should also be established to undertake periodic determination of levels of GHG emissions in order to identify 'high-emissions' sectors and areas where significant GHG reductions can be realised. Such GHG emissions data could also feed into the National Communications as required under the UNFCCC.

Moreover, because there are few climate change specialists in the areas of science, policy, adaptation, mitigation and carbon finance and markets it is important to put in place a targeted capacity-building framework. Building the capacity of local communities to help them adapt to the adverse impacts of climate change as well as take opportunities such as those offered by the Reduced Emissions from Deforestation and Degradation (REDD) mechanisms is also important. Kenya will undertake various interventions to address its capacity needs by strengthening vulnerability analysis and food security monitoring, supporting the modernisation of the Kenya Meteorological Department, strengthening institutions in charge of Disaster Risk Reduction (DRR), the National Designated Authority (DNA) amongst other interventions discussed further in Chapter 6.

6. Research, technology development and transfer needs

The Strategy has identified specific sectoral research needs as a response to the impacts of climate change. In the agricultural sector, research is needed to develop superior (drought-tolerant, fast-maturing, disease and pest-resistant) crop varieties. As with the agricultural sector, the energy sector is also vulnerable to climate change. Some of the research areas that will need strengthening and focus include energy efficient innovations and technologies especially of the less advanced and low-cost energy appliances, tools and sources.

Some of these include the development of powdered fuel burner from agricultural wastes, solar water heaters fabrication, and biodiesel processor development, among others. Research interventions in these areas and in other sectors including water, forestry, wildlife and tourism as well as health are detailed in Chapter 7.

Information documentation and dissemination are important to ensure different stakeholders take appropriate action to respond to the challenges presented by climate change. To this end, one of the key priority areas will be improving national coordination of information through enhancing packaging and expediting timely dissemination.

Further, efforts should be made to support technology generation and absorption. This can be done by building the capacity of relevant institutions to enable them undertake research & development (R&D) in climate change related fields as well as through technology transfer from the industrialised countries to Kenya. To this end, the Strategy has identified some of the channels through which technology development, absorption and diffusion can be achieved, which include:

- through the Kyoto Protocol's CDM or its future successor,
- through the United Nations Industrial Development Organization (UNIDO),
- accelerating South-South partnerships,
- accelerating North-South transfers through Foreign Direct Investment (FDI) including taking advantage of 'patent-free' technologies,
- establishment and capacity enhancement of local technological innovation centres which will help strengthen institutional technology generation and transfer through learning-by-doing approach, and
- including climate change research and development in all budgets of Ministries with substantial allocations to institutions of higher learning to strengthen research capacities.

7. Climate change governance

An analysis of existing environmental policy and legal framework has revealed that Kenya currently has no policies or laws that deal directly and explicitly with climate change. The only policy that has attempted to address climate change to some extent is the draft National Environmental Policy of 2008. The Strategy therefore recommends a comprehensive climate change policy and related legislation be put in place by either reviewing and updating the clauses on climate change in the draft National Environmental Policy or developing a completely new climate change policy. This should be followed by a review of existing laws (in particular, the *Environment Management Coordination Act, EMCA of 1999*) to make them climate change responsive and/or enactment of a new and comprehensive climate change law. However, the Strategy recommends that a new climate change legislation be enacted, a process that could run concurrently with the policy formulation.

In addition, the Strategy has established that institutions currently in place to govern climate change affairs are inadequate. It has consequently recommended a dedicated and adequately funded climate change secretariat be established within the Ministry of Environment and Mineral Resources to oversee climate change issues including the implementation of the adaptation and mitigation programmes and the other aspects of the National Climate Change Response Strategy. This institution, including the proposed structures within it (see Chapter 8), should be anchored on the provisions of the new climate change laws to be enacted.

It is further proposed that MEMR establishes a **National Climate Change Steering Committee** to help it gather and collate input and advice from key climate change stakeholders for its use in the coordination of Kenya's climate change activities. Also, the **National Climate Change Activities Coordinating Committee (NCCACC)** will continue to serve in its current advisory capacity. The Climate Change Secretariat to be established at MEMR will provide secretarial functions for the two

committees. The IPCC focal point based in KMD will augment the NCCACC and strengthen its scientific advisory capacity.

8. Action plan and resource mobilization plan

The adaptation and mitigation programmes identified in the Strategy will be implemented over the next 20 years at an annual average cost of Ksh. 235.83 billion (approximately US\$ 3.14 billion).

The table on the next page shows that significant additional financial resources need to be mobilised for the implementation of this Strategy with every effort made to reallocate the country's budgetary resources and raise additional revenue for this purpose. Nevertheless, most of the funding will be mobilised from developed countries either directly or indirectly through the multilateral financial institutions and the UN agencies. Timely establishment of the proposed Climate Change Finance Facility is therefore critical.

In addition, all governmental and non-governmental institutions need to mainstream climate change proofing and responsiveness in their programmes and projects.

Estimated Annual Budget for proposed Climate Change Projects and Programmes

Sub- sector/Ministry	Annual Cost (Ksh Billion)
Productive Sector	76.96
Agriculture	10.60
Tourism	0.04
Marine & Fisheries Resources	2.52
Forestry and Wildlife	32.26
Environment & Mineral Resources	7.39
Cooperative Development and Marketing	0.15
Regional Development Authorities	24.00
Physical Infrastructure & Service Industry	111.52
Energy Sector	73.71
Water & Irrigation	5.96
Roads (maintenance)	20.00
Transport Sector (devt of Bus Rapid Transport BRT & LRT)	11.85
Manpower	37.45
Youth Affairs and Sports	2.75
Gender, Children & Social Development	2.70
Special Programmes (Famine and Disaster Risk Reduction-DRR)	32.00
Education	7.90
Health (Public)	1.30
ICT	0.70
Grand Total (Approx)	235.83

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Acronyms

AAU	Assigned Amount Units
AF	Adaptation Fund
AR4	4th Assessment Report
ASAL	Arid & Semi-Arid Lands
BPO	Business Process Outsourcing
BRT	Bus Rapid Transit
CA	Conservation Agriculture
CBD	Convention on Biological Diversity
CBO	Community Based Organizations
CC	Climate Change
CCA	Common Country Assessment
CCBA	Climate, Community and Biodiversity Alliance
CCCU	Climate Change Coordinating Unit
CCK	Communication Commission of Kenya
CCK	Communication Commission of Kenya
CCO	Climate Change Office
CCTT	Climate Change Technology Transfer
CDF	Constituency Development Fund
CDM	Clean Development Mechanism
CEEC	Centre for Energy Efficiency and Conservation
CEPA	Communication, Education, & Public Awareness
CER	Certified Emission Reductions
CGIAR	Consultative Group on International Agricultural Research
COP	Conference of the Parties (to the UNFCCC)
CORDIO	Coastal Oceans Research and Development in the Indian Ocean
COTS	Crown-of-Thorns Starfish
CP	Cleaner Production Programme
DANIDA	Danish International Development Agency
DEC	District Environment Committees
DELC	Division of Environment Law and Conventions
DJF	December-January-February
DNA	Designated National Authority
EMCA	Environmental Management and Co-ordination Act (of 1999)
ENSO	El Niño Southern Oscillation
ERSWC	Economic Recovery Strategy and Wealth Creation
ERU	Emission Reduction Units
ESDA	Energy for Sustainable Development Africa
ETS	Emissions Trading Scheme
EU	European Union
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GEF	Grid Emission Factor
GEF	Global Environment Facility
GHGs	Greenhouse Gases
GIS	Geographic Information Systems
GOK	Government of Kenya

GSI	Geotechnical Site Investigation
GWh	Gigawatt hours
HEP	Hydroelectric Power
ICPAC	IGAD Climate Prediction and Applications Centre
ICRAF	World Agroforestry Centre
ICT	Information and Communication Technology
IEA	International Energy Agency
IGAD	Intergovernmental Authority for Development (in East Africa)
ILRI	International Livestock Research Institute
IMCE	Inter-Ministerial Committee on Environment
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producers
ITK	Indigenous Traditional Knowledge
IUCN	International Union for Conservation of Nature
IVF	In-Vitro Fertilization
JI	Joint Implementation
KACCAL	Kenya Adaptation to Climate Change in Arid and Semi-Arid Lands
KAM	Kenya Association of Manufacturers
KARI	Kenya Agricultural Research Institute
KENGEN	Kenya Electricity Generating Company
KEPHIS	Kenya Plant Health Inspectorate Services
KFS	Kenya Forest Service
KIE	Kenya Institute of Education
KIHBS	Kenya Integrated Household Budget Survey
KIRDI	Kenya Industrial Research and Development Institute
KMC	Kenya Meat Commission
KMD	Kenya Meteorological Department
KMFRI	Kenya Marine and Fisheries Research Institute
KNBS	Kenya National Bureau of Standards
KNCPG	Kenya National Cleaner Production Centre
KOAETEC	Kenya Organic Agriculture and Environmental Technologies Institute
KP	Kyoto Protocol
KPA	Kenya Ports Authority
KPLC	Power and Lightning Company
KRB	Kenya Roads Board
KTDA	Kenya Tea Development Authority
KWS	Kenya Wildlife Service
LATF	Local Authority Trust Fund
LDC	Least Developed Countries
LDCF	Least Developed Countries Fund
LRT	Light Rail Transit
MAM	March-April-May
MDG	Millennium Development Goals
MDNKALS	Ministry of Development of Northern Kenya & Other Arid Lands
MEMR	Ministry of Environment and Mineral Resources
MOA	Ministry of Agriculture
MOE	Ministry of Education
MOH	Ministry of Health
MOW	Ministry of Water
MRC	Mekong River Commission

MTEF	Medium Term Expenditure Framework
MRV	Monitoring Reporting and Verification
MW	Megawatt
NADIMA	National Disaster Management Authority
NAPA	National Adaptation Programmes of Action
NASCOP	National Aids/STI Control Programme
NCCACC	National Climate Change Activities Coordination Committee
NCCK	National Council of Churches of Kenya
NCCRS	National Climate Change Response Strategy (NCCRS and 'Strategy' are used interchangeably in the document)
NCCSC	National Climate Change Steering Committee
NCPB	National Cereal Produce Board
NCPC	National Cleaner Production Center
NDOC	National Disaster Operation Centre
NEMA	National Environment Management Authority
NEP	National Environment Policy (draft)
NEP	North Eastern Province
NGOs	Nongovernmental Organizations
NIB	National Irrigation Board
OECD	Organisation of Economic Co-operation and Development
OP	Office of the President
PEV	Post Election Violence
PIN	Project Idea Note
PDD	Project Design Documents
PPPs	Public Private Partnerships
PV	Photovoltaic
REDD	Reduced Emissions from Deforestation and Degradation
RVF	Rift Valley Fever
SBSTA	Subsidiary Body for Scientific and Technological Advice
SCCF	Special Climate Change Fund
SEI	Stockholm Environment Institute
SIDA	Swedish International Development Cooperation Agency
SIDS	Small Island Developing States
SON	September-October-November
SST	Sea Surface Temperatures
TWH	Terawatt Hours
UK	United Kingdom
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNDAF	United Nations Development Assistance Framework
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
UNISDR	United Nations International Strategy for Disaster Reduction
UNWTO	United Nations World Tourism Organization
USA	United States of America
USAID	United States Agency for International Development
VCM	Voluntary Carbon Markets

WBCSD	World Business Council on Sustainable Development
WCED	World Commission on Environment and Development
WCS	World Conservation Society
WHO	World Health Organization
WMO	World Meteorological Organization
WRMA	Water Resources Management Authority

Chemical Symbols

CF ₄	Perfluoromethane
CH ₄	Methane
CFC-11	Chlorofluorocarbon-11
N ₂ O	Nitrous oxide
HFC-23	Hydrofluorocarbon-23
CO ₂	Carbon dioxide
SF ₆	Sulphur hexafluoride



1

Climate Change, from a Global Perspective

1.0 Introduction

1.1 History of Climate Change as a Global Problem

Scientists started to provide anecdotal evidence of anthropogenic climate change from the late nineteenth century but stronger evidence of human influence on global climate only emerged in the late 1950s when Keeling and others at the Scripps Institution of Oceanography began to measure the concentration of carbon dioxide in ice-cores.¹ The results of these studies showed that global carbon dioxide concentrations were rising and linked the rise in concentration to an increase in global temperatures. Carbon dioxide had been known then to have a greenhouse or warming effect, which is the inherent ability to trap and retain infrared radiation.

The 1960s and 70s saw a precipitation of concerns over the global environmental change. These became prominent in the 1980s with the release of the Brundtland Report (also commonly known as 'Our Common Future'). The report alluded to various environmental concerns including climate change² and associated the change with increasing atmospheric concentrations of greenhouse gases (GHGs). Climate change was considered one of the undesirable consequences of man's unsustainable development practices. Concerned with this, two UN bodies – the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) – jointly established the Intergovernmental Panel on Climate Change (IPCC) in 1989 to provide broad and balanced information about climate change.³ The IPCC does this by reviewing and assessing the most

recent scientific, technical and socioeconomic information produced worldwide relevant to the understanding of climate change and translating this information into *IPCC Assessment Reports*.

As a follow-up to the work of the Brundtland Commission, formally known as the World Commission on Environment and Development (WCED), which had produced the Brundtland Report, the United Nations Conference on Environment and Development (UNCED), informally known as the Earth Summit was convened in Rio de Janeiro, Brazil in June 1992. The Summit sought to take stock of past development paths and lay foundations for a new future economic development trajectory – one that would marry economic needs with environmental concerns.

Over 100 Heads of States and Governments attended the UNCED conference. It was a momentous gathering and from it emerged the United Nations Framework Convention on Climate Change (UNFCCC) along with the Conventions on Biodiversity, on Desertification, Agenda 21 and other major international environmental governance instruments and initiatives. The UNCED represents the first time all nations of the world have assembled without the aftermath or threat of war or without a major economic crisis. They gathered voluntarily to tackle *inter alia* the looming issue of climatic change with its effects transcending all borders and the risk of disaster increasing into the future. With the signing and ratification of the UNFCCC by 192 Member States, the world has embarked upon one of the most ambitious programmes in history, namely to arrest the growing negative

¹ For more information, please refer to the website of the Scripps Institution of Oceanography, University of California at San Diego

² See for example, Chapter 1 of the Brundtland Report

³ Refer to the IPCC website to get information on its history, organisation and mandate

Courtesy of work under the auspices of the UNFCCC and its subsidiary bodies, scientists can now state unequivocally that the earth is warming. Climate change is happening, largely spurred by human activities, and it will have many serious and potentially damaging effects in the coming decades.

effects on international climate by reducing emissions of GHGs which have a massive global warming impact.

Courtesy of work under the auspices of the UNFCCC and its subsidiary bodies, scientists can now state unequivocally that the earth is warming. Climate change is happening, largely spurred by human activities, and it will have many serious and potentially damaging effects in the coming decades. The IPCC, which is the scientific advisory arm of the UNFCCC release the Fourth Assessment Report (AR4) in November 2007. The Report states that '*warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level.*'

These effects of climatic change occur at all levels (local, regional and global) and have the potential to disrupt the Earth's ecological systems with serious negative consequences on agricultural production, forests, water supply, health systems and overall human development. The UNFCCC recognises these consequences and in Article 2 has called on the world's governments to take action aimed at reducing and stabilising concentrations of GHGs '*in the atmosphere at a level that would avoid dangerous anthropogenic interference with the climate system.*'

1.2 International Efforts and Challenges to Combating Climate Change

A significant weakness of the UNFCCC is that it did not set binding GHG emission reduction targets, but instead 'encouraged' Parties to the Convention to take measures to reduce their

GHG emissions according to their common but differentiated responsibilities and respective capabilities.

In 1997, at the Third Conference of the Parties (COP3) to the UNFCCC over 180 Parties gathered in Kyoto, Japan to adopt the Kyoto Protocol, which would commit them to reduce GHG emissions.⁴ The Protocol came into force in 2005. The 2010 records of the UNFCCC Secretariat show that 184 Member States of the United Nations, including Kenya⁵ have either ratified or acceded to the Protocol. The Protocol commits 37 industrialised countries to reduce their emissions by 5.2% below 1990 levels during the First Commitment Period, which is 2008 to 2012.

The Kyoto Protocol has set the world towards a low-carbon growth path. One of the main outcomes is the **carbon market**, an international market regime of three 'flexible mechanisms' designed and created to tackle climate change cost-effectively and assist with sustainable development. Two of these mechanisms – the Clean Development Mechanism (CDM) and the Joint Implementation (JI) – are project-based. The CDM and JI were created under Articles 12 and 6 of the Protocol, respectively. They are designed to help reduce GHG emissions through project activities involving *inter alia* renewable energy (including fuel switching), energy efficiency, reforestation/afforestation, and low-emission public transportation, and more. The CDM is relevant to Kenya as it applies to non-Annex 1 countries, which are developing countries that have undertaken to tackle climate change, but are not obliged to take on legally binding GHG emission reduction targets.

Other key highlights over the past 12 years since the adoption of the Kyoto Protocol

⁴ The six principal greenhouse gases covered under the Kyoto Protocol are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6) and two groups of gases: hydrofluorocarbons (HFCs e.g. HFC-23) and perfluorocarbons (e.g. CF_3Cl)

⁵ Kenya acceded to the Kyoto Protocol on 25 February 2005



include the commencement of the European Union's Emissions Trading System (EU ETS). The EU ETS is the most ambitious GHG emissions trading programme in the world. The EU ETS commenced in January 2005 and is the world's largest emissions trading scheme with 30 nations covering nearly 400 million people in the world's most industrialised region. Currently 27 EU Member States and three non-EU Member States (Iceland, Norway and Liechtenstein) engage in the trading scheme.

In 2002, the UK started the world's first national GHG emissions trading scheme, while New South Wales in Australia commenced one of the most ambitious and far-reaching climate change programmes in 2003 – the New South Wales Greenhouse Gas Reduction Scheme. Since 2006, 32 states in the USA and eight provinces in Canada have begun developing ambitious climate change programmes primarily focusing on targets under the 'cap-and-trade' schemes, which set targets (caps) permitting 'entities' (usually companies) to trade emission reductions with one another to achieve overall GHG emission reductions.

There is almost universal agreement that developed countries should take on targets to reduce GHG emissions and that such targets should get tighter over time to promote further emission reductions. Although developed countries differ over the magnitude of these reduction targets and the pace at which they should occur, there is little disagreement that the responsibility of significantly reducing emissions lies with industrialised countries because they are responsible for the historical accumulation of anthropogenic GHG emissions through industrialisation.

The most contentious element of climate change policy and discussion since Kyoto has been the contribution of non-Annex 1 countries in terms of commitments to reducing GHG emissions. The most significant debate arises from many countries (primarily Annex 1) maintaining that the most rapidly industrialising of the developing countries (primarily China, Brazil, India, Mexico and

South Africa – the G-5) should take on targets (caps) at some stage. However, most developing countries maintain that now is not the time for them to take on targets for mandatory reductions of GHG emissions. They are against taking up mitigation targets because of their limited technological and financial capabilities as well as in recognition of the need for developed countries to take on their 'historical responsibility' for climate change.

The other significantly contentious issue under the UNFCCC and specifically under the Kyoto Protocol is the issue of adaptation to climate change, particularly how to address it within an international climate change treaty. There is a universal agreement that climate change will affect the poorest members of society and the poorest societies more than the more economically advanced. This is simply due to the fact that economically advanced countries have the ability to adapt to climate change by their sheer wealth. The debate around adaptation covers what should be done, how much will it cost, who should pay for it and how such payments should be distributed, managed and accounted for.

Currently, two funds have been created under the UNFCCC to tackle adaptation to climate change. The **Least Developed Countries Fund** (LDCF) created under Article 4.9 of the UNFCCC supports the preparation of National Adaptation Programmes of Action (NAPAs) in countries classified as LDCs by the United Nations Development Programme (UNDP). The NAPAs help LDCs *identify priority activities that respond to their urgent and immediate needs to adapt to climate change – those for whose further delay would increase vulnerability and/or costs at a later stage*. Implementation of priority actions identified in NAPAs has only recently begun in select LDCs, with about 26 projects having been approved for funding. Kenya is not an LDC and therefore does not qualify for the LDCF. The **Special Climate Change Fund** (SCCF) is the other UNFCCC fund through which adaptation programmes and projects can be financed. This fund was

established in 2001 under decision 7 of COP7 (Decision7/CP.7) to finance projects relating to adaptation, technology transfer and capacity building, energy, transport, industry, agriculture, forestry, waste management, and economic diversification in non-Annex 1 countries. The Fund is not dedicated to adaptation activities, although adaptation remains the key priority. Kenya's project on *Adaptation to Climate Change in Arid Lands (KACCAL)* funded by the World Bank is one of the first SCCF projects. Also in the pipeline for Kenya is the *Adaptation to Climate Change and Health* project to be funded by SCCF and channelled through the World Health Organization (WHO) and UNDP.

International efforts to combat climate change have so far focused more on mitigation, i.e. reducing GHG emissions. The next stage of international efforts must deal squarely with adaptation, i.e., ways of coping with climatic impacts that cannot be avoided.

The only fund strictly dedicated to adaptation is the **Adaptation Fund (AF)**. This Fund was established under Article 12.8 of the Kyoto Protocol and Decision 10 of COP 7 (Decision 10/CP.7) to 'finance concrete adaptation projects and programmes in developing country Parties that are Parties to the Kyoto Protocol, as well as activities identified in paragraph 8 of decision 5/CP.7'. Such activities include water resources management, land management, agriculture, health, infrastructure development, fragile ecosystems including mountainous ecosystems and integrated coastal zone management. The AF revenue is to be derived from voluntary contributions and an international levy of two percent of Certified Emission Reductions (CERs) from CDM projects, which is known as the 'share of proceeds'. During 2008-2012, the Adaptation Fund generated US\$ 80-300 million a year.

In general, the three funds (LCDF, SCCF and AF) are not adequate to fund the massive adaptation needs of developing countries, many of which are already being ravaged by climate change. At present, the funds mainly constitute pledges by donor countries and agencies. As history shows pledges do not always lead to actual delivery and implementation of the

funds. Again, even with the pledges included, the funds still fall short of the US\$ 100 billion per annum which developed countries have pledged to mobilise under the Copenhagen Accord to help address *climate change needs*⁶ of developing countries by 2020. In any case, even this proposed figure is considered by many as a gross underestimate because it is based on a scenario where the global temperature increase would be limited to 2°C, whilst some climate models show that current emissions pathway leads us to a much warmer world (3°C and upward) and consequently higher costs.

International efforts to combat climate change have so far focused more on mitigation, i.e. reducing GHG emissions. The next stage of international efforts must deal squarely with adaptation, i.e., ways of coping with climatic impacts that cannot be avoided. This is both a matter of need and equity. It is a matter of need because climate change is already underway and is expected to continue as a result of past GHG emissions. Such accumulated GHG emissions are known to reside in the atmosphere and have a global warming potential for many years into the future. Regarding equity, the point is that negative impacts of climate change fall disproportionately on those least able to bear them.

The issues highlighted in the previous sections were among those that the delegates at COP 15 in Copenhagen discussed. The COP 15's main outcome was the **Copenhagen Accord**, which the COP only 'took note of'. The Copenhagen Accord, a complete deviation from the Kyoto-style emission reduction 'targets and timetables' has addressed some of the above concerns of developing countries, namely **adaptation, finance, technology transfer and reducing emissions from deforestation**. If adopted, the Accord will compel both developed and developing countries to mitigate climate change. In the case of developed countries, this will be through voluntarily pledged 'targets'

⁶ *The Copenhagen Accord is silent on whether this fund will address adaptation needs; it only mentions 'needs of developing countries,' without specifying which needs these are—adaptation, mitigation or both.*

Developing countries will do the same through Nationally Appropriate Mitigation Actions (NAMAs).

For this reason, the Accord has totally omitted the clause relating to 'historical responsibility' contained in the UNFCCC. Although this may be considered by some as a great violation of one of the key principles of the UNFCCC, the *principle of common but differentiated responsibility based on respective capability*, it is perhaps a good move forward in trying to find a solution to the climate crisis. This is because current climate science tells us that much more (in terms of mitigation) still needs to be done if we are to escape the worst effects of climate change; hence the compelling need to involve both developed and developing countries in mitigation, albeit at different levels of responsibility.

Significantly, the Accord has adopted the widely accepted scientific view that global temperature increase by 2100 should not exceed 2°C, which is considered the safe upper limit. To try to achieve this target, the COP requested Parties, that wished to be associated with the Accord, to submit their mitigation targets (for Annex 1 Parties) and NAMA programmes (for developing countries) to the UNFCCC secretariat for inclusion into the Accord. Most major emitters, including China and India among developing countries have complied with this request, signalling a possibility that the Accord will likely be transformed into a legally binding document. However, many are of the opinion that the reduction targets that have been pledged under the Accord are still likely to overshoot the global average temperature increase beyond the desired 2°C⁷ limit.

⁷ See for example, Climate Interactive's "Scoreboard Science and Data": [http://climateinteractive.org\(scoreboard\(scoreboard-science-and-data](http://climateinteractive.org(scoreboard(scoreboard-science-and-data).

2

Assessing the Evidence and Impacts of Climate Change in Kenya



In this picture taken by the National Geographic News on August 16th 2009, a Samburu pastoralist digs deep to find water for his cattle. The Ewaso Nyiro riverbed where this well was dug had been dry for months, causing people to travel long distances with their families and livestock in search of water.

2.0 Evidence and Impacts of Climate Change in Kenya

2.1 Evidence of Climate Change in Kenya over the last 50 years

Temperature and precipitation changes are the two climatic elements that have been widely studied globally to provide evidence of climate change. In Kenya, the Kenya Meteorological Department (KMD) has provided data of temperature and rainfall changes over the last fifty years.

2.1.1 Temperature Trends

The tables below summarise time series of annual minimum and maximum temperatures in different parts of the country since the early 1960s.

Table 1: Minimum temperature trend from 1960 (Data courtesy of the KMD)

Region	Trend	Magnitude (°C)
Western	Increase	0.8-2.9
Northern & North-eastern	Increase	0.7-1.8
Central	Increase	0.8-2.0
South Eastern districts	Increase	0.7-1.0
Coastal strip	Decrease	0.3-1.0

Table 2: Maximum temperature trend from 1960 (Data courtesy of the KMD)

Region	Trend	Magnitude (°C)
Western	Increase	0.5-2.1
Northern & North-eastern	Increase	0.1-1.3
Central	Increase	0.1-0.7
South Eastern districts	Increase	0.2-0.6
Coastal strip	Increase	0.2-2.0

An analysis of both minimum (T_{\min}) and maximum temperatures (T_{\max}) based on the standard seasons of December-January-February (DJF), March-April-May (MAM), June-July-August (JJA) and September-October-November (SON) reveals that the rise in temperatures over the northern parts of the country is relatively higher than in other parts especially from October to February period. Similarly, the decrease in minimum temperatures in the northern parts of the coastal strip is also relatively higher than in the southern parts of the coastal areas during the same period. Lamu in the north coast shows a drop of 1°C from a mean of 24.5°C in the early 1960s to 23.5°C in the recent ten years, whereas Mombasa in the south coast indicates a drop of about 0.3°C from 23°C in the early 1960s to 22.7°C in the recent ten years.

From the early 1960s, Kenya has experienced generally increasing temperature trends over vast areas. Over the inland areas, the trends in both minimum (night/early morning) and maximum (daytime) temperatures depict a **general warming** (increasing) trend with time. However, the increase in the minimum temperatures is steeper than in maximum temperatures. The result of the steeper increase in T_{\min} and a less steep increase T_{\max} is a reduction in the diurnal temperature range (difference between the maximum and minimum temperatures) – Figure 1 on the next page depicts these trends.

However, the areas near large water bodies particularly the coastal strip indicate a different pattern. In these areas, the minimum (night/ early morning) temperatures show no change or decreasing trends while the maximum temperatures depict an increasing trend since the early 1960s. Consequently,

an increase in the diurnal temperature range is evident over these areas because the days have become much hotter while the nights and early morning temperatures have either not changed or marginally reduced compared to the early 1960s. These trends are depicted in Figure 2 below.

2.1.2 Rainfall Patterns

Daily and monthly rainfall records are used to determine trends that have characterised rainfall in Kenya since the early 1960s. The time series of annual and seasonal rainfall for the standard seasons of December-January-February (DJF), March-April-May (MAM), June-July-August (JJA) and September-October-November (SON) indicate that:

- Neutral to slightly decreasing trends are manifested in the annual rainfall series over most areas. This is mainly due to an associated general decline with time of rainfall in the main rainfall season of March-May (the 'Long Rains') over most areas.
- There is a general positive trend (increase) in rainfall events of September to February period suggesting a tendency for the 'Short Rains' (October-December) season to be extending into what is normally hot and dry period of January and February over most areas. This may be attributed

to possibly more frequent occurrences of El-Niño events occasionally coupled with relatively warmer sea surface temperatures over the western Indian ocean (along the coast of east Africa) and relatively cooler than average sea surface temperatures (SSTs) to the east of the Indian Ocean. This sea surface temperature pattern is conducive for enhancing rainfall over the country. Even in the absence of El-Niño conditions, this pattern over the Indian Ocean results into heavy rainfall during the 'Short Rains' season as was the case in 1961-62 and the recent 2006-07 rainfall events.

High Intensity Rainfall

The highest rainfall events recorded every year and in each of the four standard seasons of December-January-February (DJF), March-April-May (MAM), June-July-August (JJA) and September-October-November (SON) were subjected to time series analysis to derive the trend patterns that they depict.

In general, annual highest rainfall events indicate the 24-hour intense rainfall amounts observed in the recent years are relatively lower than those in the early 1960s. Effectively, these values have ***been reducing (negative trend)*** with time. These trends are also depicted in the time series of the 'Long Rains' (MAM) season that contributes a significant

Figure 1: Temperature trend for Nairobi from 1960 to 2005 – increase in both T_{\min} and T_{\max} , but decrease in diurnal range of temperature (Data and figure from the KMD)

Figure 2: Temperature trend for Mombasa from 1960 to 2005 – increase in T_{\max} , decrease or no change in T_{\min} , and an increase in the diurnal temperature range (Data and figure from the KMD)

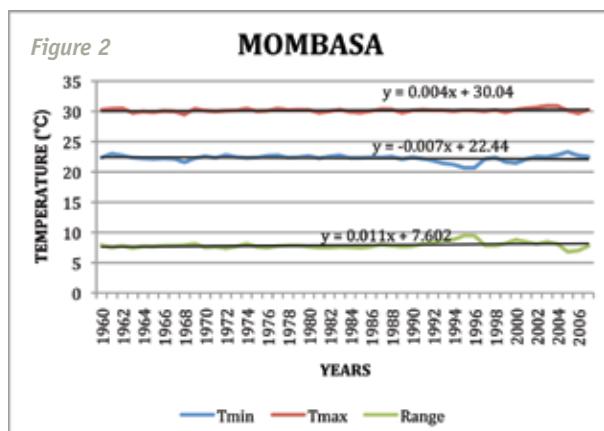
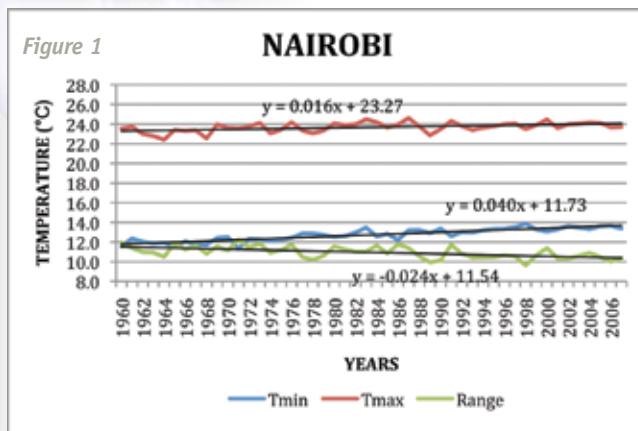
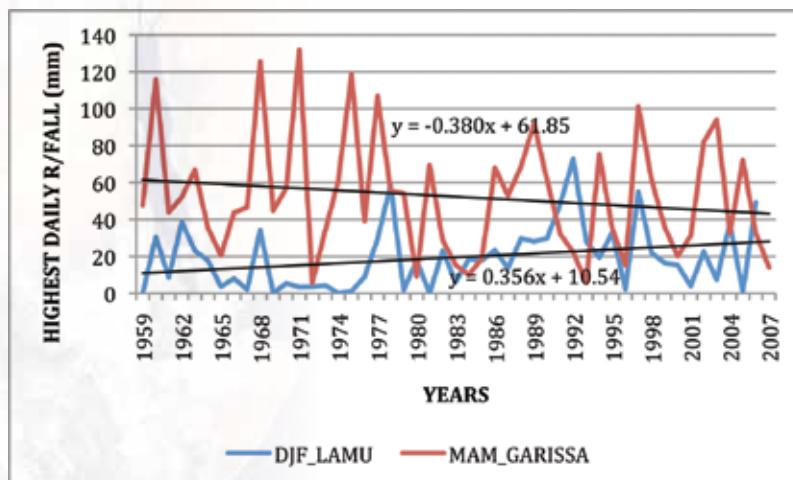


Figure 3: Rainfall trends over Lamu and Garissa over the past half century (Data and figure from the KMD)



amount of rainfall to the annual totals over most parts of the country. However, the changes (reductions) are not very significant. Most of the standard seasons also depict the same type of patterns in the highest daily rainfall values observed. There is an indication of relatively **more intense rainfall occurring more frequently over the coastal strip** and the northern parts of the country in the SON and DJF seasons. These trends are depicted in the following Figure 3.

2.2 Impacts of Climate Change on Kenya

What do these changing rainfall patterns and temperature increases locally, regionally and globally portend for Kenya?

Climate change is already happening and at an alarming rate. Highlighted in this section are some of the observed and potential impacts of climate change across Kenya. This information is based on the contributions of stakeholders during the national and regional NCCRS workshops as well as on literature review.

2.2.1 Impacts on Natural Systems

Kenya has a landmass of about 582,350 km² with only 17% of arable land while 83% consists of arid and semi-arid land (ASAL). There are indications that the ASAL is increasing. Kenya's natural resources, particularly its rich flora and fauna are among the country's most valuable natural assets. Unfortunately, climate change now threatens to eradicate this rich biodiversity.

2.2.1.1 Forestry and Land Use

The importance of forests cannot be understated. Forests serve as the ultimate climate regulators. Forest cover assists in slowing down the spread of deserts, attracting clouds and enabling rainfall. In addition, they serve as a carbon 'sink' which is a natural reservoir that accumulates and stores some carbon-containing chemicals such as carbon dioxide for an indefinite period of time. However with all the benefits of forest cover, deforestation continues unabated particularly in developing countries where experts fear that it is exacerbating the effects of climate change. According to the IPCC, deforestation accounts for approximately 20% of global annual GHG emissions.

Demand for energy is one of the main drivers of deforestation and land degradation in Kenya, where final delivered biomass energy accounts for 78% of all energy consumed (MOE, 2002). The other main drivers of deforestation in Kenya are illegal encroachments and

A deforested section of the Mau Forests that acts as the catchment for the Mara River. Climate change impacts will add to human pressures that forest ecosystems are already facing. Photo by Camco Kenya.



settlements, logging and livestock grazing. All these activities impact negatively on the ability of the 'Water Towers' to act as water catchments for Kenya's major rivers and lakes.

In the forestry sector, climate change will firstly affect the growth, composition and regeneration capacity of forests resulting in reduced biodiversity and capacity to deliver important forest goods and services. This will then cause desertification, deforestation and forest as well as land degradation as communities strive to derive their livelihoods on declining forest resources. This is already evident in many places including upper parts of Eastern Province like Machakos and Kitui, and Taita Taveta in Coast Province as well as all ASALs of Kenya.

Existing forested areas will undergo changes in vegetation types and species composition. New assemblages may be established, and more invasive species are projected to emerge. Invasions are already evident as shown by the spread of *Prosopis juliflora* ('mathenge'). This species has colonised important ecosystems in Baringo, Tana River, Garissa and other semi-arid areas of the country. In addition, excessive growth of some tree species has been observed, e.g., the excessive growth of *Acacia reficiens* after the 1997 El-niño in the North-Eastern Province and the consequent

suppressed growth of various grassland species.

The projected rise in temperatures and long periods of drought will lead to more frequent and intense forest fires. These have in the recent past affected Kenya's major forests including the Mau and Mt. Kenya Forests. Kenya has over the past 20 years lost more than 5,700 ha of forests per year to forest fires wreaking phenomenal economic damage that is yet to be quantified.

The rise in temperature could extend the ecosystems range of pests and pathogens. This is likely to affect many aspects of forests such as tree-growth, survival, yield and quality of wood and non-wood products. The impact of pests may result in the curtailment of plantation programmes, abandonment of a given tree species, or the necessity to harvest large areas dominated by infested trees as witnessed in the late 1990s when the country had to clear huge tracts of cypress plantations because of cypress aphid attack. There are already fears of a widespread attack on *Pinus patula* (Mexican weeping pine) plantations in South Africa and these could easily spread northwards to Kenya.

Projected increases in atmospheric carbon dioxide concentrations may raise the carbon to nitrogen ratio of forage for herbivores, thus reducing its food value and the carrying capacities of landscapes. For major wildlife habitats, this would have disastrous effects.

Changes in temperature will lead to a shift of vegetation to higher elevations while some species could become extinct. Indeed, across the country, some tree species including *Melia volkensii*, *Terminalia spinosa*, *Delonix elata*, and *Hyphenea coriaceae* in the North Eastern Province, and *Psychotria* species in the Taita Hills, Coast Province, are either tremendously dwindling in or extinct.

Further, climate change is also associated with increased flooding/sedimentation. In the low-lying coastal area where mangroves occur, a

The impacts of climate change on the Kenya's marine ecosystems include the likely submergence of approximately 17% of Mombasa or 4,600 ha of land area with a sea level rise of only 0.3 m.

small increase in sea level will leave mangroves submerged unless they can retreat further inland, which is improbable due to human settlements. Research undertaken by the Kenya Marine and Fisheries Research Institute (KMFRI) as well as other organizations and individuals indicates evidence of mangrove loss due to climate change and other factors in several areas along the Kenyan coast such as Gazi Bay, Mwache Creek, Ngomeni, Tana River Delta and Dodori Creek.

2.2.1.2 Rangelands and Wildlife Resources

Kenya's rangelands, which support millions of pastoralists and small-scale agro-pastoralists, mainly occur in areas where rainfall is low and erratic and soils are highly variable and infertile. Therefore the rangelands are unsuitable for production of crops that are not drought tolerant. The rangelands are characterised by a number of habitat structures ranging from open grasslands to closed woody and/or bushy vegetation with varying amounts and composition of grass cover and species.

The impacts of climate change on Kenya's rangelands include:

- Change in pasture productivity as has been observed in the North Eastern Province (NEP) where extremely strong winds and flash floods erode and wash away grass seeds. Consequently, the growth of grass is inhibited even during good rainfalls. Loss of wildlife habitats emerge as a secondary impact of these factors,
- Carbon dioxide fertilization, which leads to higher plant productivity, particularly the proliferation of invasive species,
- Disruption of natural ecosystems and subsequent change in species' ecological range, altering predator-prey interactions, decoupling animals from food sources

and/or reducing habitat span, and

- Droughts that affect grasslands causing massive livestock and wildlife deaths and an increase in human-human and wildlife-human conflicts. Cases of conflict have been reported in areas around the Lower Tana Delta, Laikipia, and Lagdera. As an example, in the Lagdera case (2005) warthogs attacked and killed goats and sheep to drink their intestinal fluids after the warthog's natural watering points dried up.⁸

2.2.1.3 Coastal and Marine Ecosystems

The Kenyan coastline is characterised by a rich diversity of flora and fauna including fish, coral reefs and mangrove forests. Kenyan coral reefs are well distributed around most of the oceanic islands. They buffer the coastline against the impacts of waves and the full force of storms and cyclones. With all its benefits, the Kenyan coastline is extremely vulnerable to sea level rise. The most vulnerable aspects of the coastline are developments in low-lying areas which consist of agriculture, infrastructure and both tourist facilities and hotspots.

The impact of climate change on the Kenya's marine ecosystems include the likely submergence of approximately 17% of Mombasa or 4,600 ha of land area with a sea level rise of only 0.3 m.⁹ Over the next century with the projected sea level rise between 0.17 and 0.59 meters,¹⁰ the Kenyan coastal development is exposed to considerable risks.

Rising sea levels will lead to the inundation and displacement of coastal wetlands, the erosion of shorelines, increased salinity and the intrusion of saline water into coastal aquifers. Saltwater intrusion into ground water resources and salt wedge estuaries are phenomena that have been observed already in some places such as Lamu.

8 From the proceedings of the NCCRS North Eastern Province regional workshop in Garissa

9 See Awuor C.B and others, 2008

10 Cited in the 2007 IPCC 4th Assessment Report

Rising sea levels associated with melting glaciers and polar ice, plus sea temperature increase (i.e. ocean waters absorbing the bulk of the heat from enhanced greenhouse effect) also threaten to cause deadly floods and high tides in low-lying coastal areas. Increasing sea temperature in the Indian Ocean could affect the entire Eastern African coast by increasing the frequency and intensity of El Niño-Southern Oscillation (ENSO) events (Klein et al., 2002).¹¹

Coral reef bleaching is a common stress response of corals to many of natural and anthropogenic disturbances. Beginning in the 1980s, the frequency and widespread distribution of reported coral reef bleaching events increased. This has been attributed to global warming and consequent rising seawater temperatures (P.W. Glynn and L. D'Croz, 1990). Upholding the results of a recent study that revealed that 59% of the world's destroyed coral reefs were located in the Indian Ocean,¹² studies by KMFRI in conjunction with other organizations¹³ have confirmed coral bleaching and loss of Kenya's coral reefs.

Further, predicted effects of climate change on mangroves include both more extreme droughts and flooding. In 1997, 1998 and 2006, massive sedimentation due to erosion of terrigenous sediments following extremely heavy rainfall caused mangrove dieback in many areas along the Kenyan coast. Mwache Creek, a peri-urban mangrove forest in Mombasa was the most affected, losing close to 500 ha of mangrove forest (KMFRI, 2008). This trend is likely to jeopardise the livelihoods of local people who depend on the mangroves particularly for fisheries, wood products and coastal protection. Increase in atmospheric temperature and further sea level rise will only accelerate these trends.

2.2.1.4 Water Resources

With its natural endowment of renewable freshwater of only 21 billion cubic meters (BCM) which amounts to 647 cubic meters (m^3) per capita per annum under normal circumstances, Kenya is classified as a water-scarce¹⁴ country. The country's water resources are unevenly distributed in both time and space in five drainage basins namely Lake Victoria, Rift Valley, Athi River, Tana River and Ewaso Ng'iro. Climate change will worsen this already precarious situation as it affects precipitation, thus further altering the spatial and temporal availability of water resources.

According to the National Environmental Management Authority's (NEMA) State of Environment Report of 2006/2007, major floods periodically afflict Lake Victoria basin, the Lower Tana basin and the coastal region – occurring at least six times in the past 50 years. In these areas, higher turbidity, siltation, and sedimentation occur. Floods carry fertiliser and pesticide residues into water bodies resulting in eutrophication, which has detrimental impacts on water quality and aquatic life. Until recently, such episodes were assumed to represent natural climate variability but now scientific evidence points to climate change as the driving force behind the frequency and intensity of these events.

According to the same report, serious droughts have occurred at least 12 times in the past 50 years. Major rivers including the Tana, Athi, Sondu Miriu, Ewaso Ngiro and Mara have experienced severe reduced volumes during droughts and many seasonal ones have completely dried up. The parts of the country most affected are the Eastern, North Eastern and parts of the Rift Valley provinces.

¹¹ Cited in the IPCC 4th Assessment Report, Working Group II, chapter 9: Africa

¹² UNEP (2002): *Vital Water Graphics: An Overview of the State of the World's Fresh and Marine Waters*.

¹³ E.g. the Coastal Oceans Research and Development in the Indian Ocean (CORDIO)

¹⁴ Water scarcity refers to a situation where a country's water resource availability is less than 1000 m^3 per capita per year

As a result of climate change, there will be increased frequency and intensity of extreme weather events like droughts and floods, which will lead to losses of productive assets, personal possessions and even life. For instance, due to droughts, the country's famine cycles have reduced from 20 years (1964-1984), to 12 years (1984-1996), to two years (2004-2006) and to yearly (2007/2008/2009).

2.2.2 Impacts on Key Economic Sectors

Kenya's key economic sectors include agriculture, tourism, livestock, horticulture, fisheries, and forestry. In 2006, the agricultural sector contributed 26% to the country's Gross Domestic Product (GDP) and a further 27% through linkages with other sectors, while the tourism and fisheries sectors contributed 10% and 0.5%, respectively. In the period leading to 2003, the estimated value of the production of forest products was Ksh. 2 billion per annum, which was equal to about 10% of the country's GDP.¹⁵ Horticulture is the fastest growing in the agricultural sector, generating over US\$ 300 million in foreign exchange earnings, while the capital value of the 46% (approx 15.2 million heads) of Kenya's livestock that is kept by pastoralists is approximately US\$ 860 million. This section discusses the potential impacts of climate change on these economic sectors.

2.2.2.1 Agriculture and Food Security

Climate change affects the four components of food security - food availability, food accessibility, food utilization and food system stability - in various direct and indirect ways. As a result of climate change, there will be increased frequency and intensity of extreme weather events like droughts and floods, which will lead to losses of productive assets, personal possessions and even life. This has already been observed, but will intensify in the future if efforts are not raised to stop global warming.

For instance, due to droughts, the country's famine cycles have reduced from 20 years (1964-1984), to 12 years (1984-1996), to two years (2004-2006) and to yearly (2007/2008/2009), necessitating the Government's distribution of 528,341.77 metric tonnes (MT) of assorted foodstuffs worth Ksh. 20 billion over the last five years alone to feed a population between 3.5 million and 4.5 million people annually.

Extreme climatic variations coupled with improper land use including deforestation have resulted into Kenya reporting successive seasons of crop failure, increasing the country's food insecurity. The 1999/2000 La Niña droughts resulted in 4.7 million Kenyans facing starvation, while the effects of the 2006-2009 successive drought episodes were worse with unofficial reports indicating nearly 10 million Kenyans faced starvation during the worst episode in 2009. The decline in agricultural productivity may also be attributed to variation in the diurnal temperature range, which has profound effects on agricultural production systems because crops have specific range of temperatures within which they grow optimally.

According to the Ministry of Agriculture's Food Security Report in June 2009, all regions of the country were expecting to report lower than expected maize yields in the next harvest. Recent crop failures have necessitated Government sponsored imports in order to address food deficits in many parts of the country. Between 2008 and 2009 alone, the Government had to import 2.6 million bags of maize worth Ksh. 6.7 billion.

The Ministry of Agriculture's 'Economic Review of 2009' indicated that the production of other major crops like tea, sugarcane and wheat had also declined. This could reduce Kenya's foreign exchange earnings in the long term, given that a commodity like tea is the country's principal export product. The ripple effect of this scenario to Kenya's economy is frightening considering the importance foreign exchange plays in international trade and investment.

2.2.2.2 Livestock

Drought leads to reduced forage availability, degradation of the environment and an increase in destitution. The 2006 to 2009 droughts are testament to the devastation that climate change could cause to the livestock sector.

¹⁵ Mbugua, D.K. (2003): *The Forest Revenue System and Government Expenditure on Forestry in Kenya. A paper prepared for the FAO work-programme component on financing sustainable forest management. Working paper: FSFM/WP/11. Policy and Planning Division, Rome Regional Office for Africa, Accra. May 2003*



The desolation that often characterises dryland areas as a result of drought leads to loss of livelihoods. Photo courtesy of the Noomayanat CBO, 2009

The strong winds and dust storms prevailing in most parts of Northern Kenya have contributed to the reduction of forage availability as they sweep away top soil together with grass seeds, thus making grass regeneration impossible even when it rains.

Outbreaks of diseases like the Rift Valley Fever (RVF) have been linked to climate change. The outbreak of RVF is known to occur during periods of high humidity that follow abnormally long rains especially those associated with ENSO events. Currently, Kenya is facing a ban on the export of meat to the European Union (EU) market until 2010 because of the failure to control RVF as well as foot and mouth disease. This has led to loss of income. In fulfilment of the EU precondition to lifting the ban, the Kenyan Government through the Ministry of Livestock Development had to initiate a programme to create disease free zones.

Avian influenza, cholera, ebola, Lyme disease, plague, tuberculosis, sleeping sickness, yellow fever, Rift Valley Fever, red tide and babesiosis are some of the diseases that are expected to spread as temperatures rise and precipitation patterns change. In a 2008 report titled the 'Deadly Dozen,' the World Conservation Society (WCS) observes that the spread of these diseases

since the mid-1990s has resulted in an estimated US\$ 100 billion in economic losses globally.

2.2.2.3 Horticulture

Much of horticultural practice in Kenya is carried out in ASALs, making the sector highly susceptible to the impacts of climate variability and change. The recent adverse weather has seen a decline in fresh vegetable production in Laikipia, Kieni, Kibwezi, Machakos and Mtito Andei. This has subsequently affected export earnings from this sub-sector. The sector is likely to be further affected by increasing pressure from European markets and consumers seeking to reduce their fresh produce 'carbon footprints,' i.e. the amount of GHG emissions associated with the production and consumption of fresh produce.

In addition, climate has profound effects on populations of crop pests (e.g. insects, mites, slugs), affecting their development, reproduction and dispersal. The rate at which most pests develop depends on temperature and every species has a particular 'threshold temperature' above which development can occur, and below which development ceases. As is projected, temperatures will rise in the tropics enabling some pest species, particularly those with short life-cycles such as aphids and the diamond-back moths to complete more generations within a given year. These changes will potentially disrupt natural pest control and consequently increase the costs of doing so.

Moreover, income losses from three horticultural crops grown along the Kenyan Coast – mangoes, cashew nuts and coconuts – are projected to reach US\$ 472.8 million for one metre of sea level rise (Gok, 2002).

2.2.2.4 Tourism

Frequent and severe droughts have hit the country since the 1990s, reducing forage in rangelands, as well as drying up and tremendously reducing the volume of rivers, which consequently affects wildlife – a resource the Kenyan tourism industry depends upon. Cases of wildlife deaths have increased in the recent past with the Kenya Wildlife Service (KWS) reporting the death of

14 elephants in 2007, 28 in 2008 and 37 in 2009 due to 'extraordinary and prolonged dry seasons.' Lately, the reduction in the volume of the Mara River due to climatic variations and the destruction of the Mau catchment has had a toll on one of the wonders of the natural world – the spectacular migration of hundreds of wildebeests across the Mara River as they migrate between the Serengeti National Park in Tanzania and the Maasai Mara Reserve in Kenya.

Global warming is likely to disrupt and even destroy some of the tourist sites such as the snow-caps of Mt. Kenya, the coastal rainforests, fragile marine ecosystems and the marine parks. For instance 'coral bleaching' of the Kenyan coral reef has been observed. Sea levels are rising with the implication that some of the popular beaches will eventually disappear. Already, hotels along the Kenyan coastline have been forced to construct sea walls to protect against increasingly strong sea tides (e.g. in Vanga and South Coast).¹⁶ Rising temperatures are changing weather and vegetation patterns across the globe, which in turn are forcing animal species to migrate to new areas in order to survive.

Experts predict that one-fourth of the Earth's plant and animal species will be headed for extinction by 2050 if the warming trend

Buffaloes grazing in the Aberdares National Park. Receding rangelands threaten to wipe out Kenya's wildlife, which is the basis of the country's tourism industry.
Photo by Camco Kenya.



16 From the proceedings of the NCCRS regional stakeholders workshop held in Mombasa

'Over the years, sand has been accumulating all along the long stretch of the beach here, deposited by an ever-rising high tide mark. The high tide mark is now attacking my beach fence, whereas in 1997 it never reached within 2 m of it. Since my home is on a raised bit of ground some 30 m from the high tide mark I figure I have about 10 years before I have to move. There is not much else I can do. I have heard similar stories of rising high tide mark from Zanzibar to Malindi, with fishing villages having to move further inland as the high tide began to invade their courtyards and homes. Here in East Africa, global warming with its predicted sea rise is not a future threat - it is here now'

Mr. Dan Stiles, Diani Beach resident – south Coast, August 2008, settled at the place in 1997 (Courtesy of the KMD)

continues at its current rate. In Kenya, lions may be extinct in the next 20 years due to expanding human settlements, farming, climate change and disease. Further, according to the KWS, drought has pushed lions closer to waterholes bordering human settlements,

which are themselves increasing at very high rates towards parks; thereby increasing the probability of human-wildlife conflicts.

Climate change is likely to lead to the emergence and re-emergence of certain wildlife diseases, which according to the 'Deadly Dozen' Report (2008) include babesiosis, trypanosomiasis, and a host of internal and external parasites. With the health of wild animals directly linked to their ecosystems and their environment, even minor disturbances can have far-reaching consequences on diseases they might encounter and transmit as the climate changes. In 2007, **drought-induced** anthrax in the scrub-peppered northern Kenya plains infested Grévy's zebras living in the Samburu National Reserve and surrounding area. If it were not for the quick intervention of the KWS, the anthrax would have annihilated the entire population of Grévy's zebras.

In addition, a key finding of the 2008 Davos Conference on Climate Change and Tourism was that carbon dioxide emissions from the tourism sector's transport, accommodation and other activities are estimated to account for between 4 and 6% of total emissions, and this figure is likely to increase by approximately 150% over the next 30 years.¹⁷ Air transport is greatly responsible for these emissions and currently there are negotiations on how best to address the emissions for global aviation. The Kenyan aviation sector will likely have to implement some mitigation measures as a result of these international negotiations. These measures are likely to hurt the tourism industry.

2.2.2.5 Forest Products

The ASALs are subject to recurring droughts, which when coupled with overexploitation of resources, result in high vulnerability to land degradation and desertification. This not only increases levels of GHG emissions, but simultaneously threatens livelihoods.

The distribution of most of Kenya's forests is determined by rainfall. With rainfall as one of the most affected climatic elements, the survival of Kenya's forest resources is likely to be severely affected. The vulnerability of Kenya's forest resource is further exacerbated by the depletion of forest and land cover through rapid increase in population and demand for human settlements, both agricultural and grazing land, construction materials, food, fuel wood, essential oils and herbal medicines. Climate change only adds to the stresses on Kenya's forest cover.

Climate change will have substantial impacts on forests by altering the growth of trees, causing dieback in forests and species to migrate, which will in turn impact on forest products supply. The reduction in forest cover will have disastrous effects on downstream agriculture and hydropower generation, as mighty rivers like Ewaso Nyiro are reduced to small streams and hundreds of other small rivers completely dry up during Kenya's dry seasons. This has serious implications for the livelihoods of those living downstream and the rest of the country, which depend on products from these ecosystems.

2.2.2.6 Fisheries

There is strong evidence partly linking ENSO events with systematic changes in plankton abundance and aquatic/marine plant as well as animal composition over recent decades in many regions worldwide. The ENSO events with phases of warm water reduce plankton production, and cause fish stocks to decline. In addition, changes in ocean circulation are predicted to lead to loss of certain fish populations or establishment of new ones. Temperature changes will likely result in changes of up-welling patterns, which might affect fish spawning period and success of larvae, thereby altering the entire life cycle and size of fish populations.

17 Davos Conference, 2008 report by the United Nations World Tourism Organization – UNWTO.

Fishing in major lakes such as Victoria and Turkana is likely to be affected by recurrent droughts and rising temperatures, conditions that starve the lakes of inflowing water and evaporate more of the water they have, leading to reductions in water levels. Coupled with improper practices such as over-fishing, these reductions in water levels will lead to tremendous reductions in fish stocks.

Heavy tropical storms and sea level rise that are projected with the changing climate will make fishing a dangerous activity. According to the IPPC estimates, the sea level will rise by between 17 cm and 59 cm by the end of this century, which is well below estimates by other scientists who predict a rise of up to 1 m even if GHG emissions were kept at a low level.

Fluctuation of river volumes and to some extent lake levels, alters breeding ecology not only of permanent populations but also of anadromous fishes, e.g. the eel *Anguilla bengalensis labiata* (Peters, 1852 in Okeyo D.O., 1998). Such fluctuations also have a deleterious consequence on the overall fish production in the country. Climate change is predicted to alter hydrological regimes, which in turn will influence biological, biogeochemical and hydrological functions of wetlands. However, owing to the heterogeneity of the wetlands, such impacts might be site-specific. Where these wetlands form important nursery grounds for fishery resources, changes in their functions would affect fisheries.

In addition, fishing in major lakes such as Victoria and Turkana is likely to be affected by recurrent droughts and rising temperatures, conditions that starve the lakes of inflowing water and evaporate more of the water they have, leading to reductions in water levels. Coupled with improper practices such as over-fishing, these reductions in water levels will lead to tremendous reductions in fish stocks¹⁸.

2.2.3 Impacts on Physical and Social Infrastructure

2.2.3.1 Transport Sector

In the 20th century, sea levels rose by an estimated 17 cm; the global mean projections for sea level rise by the turn of the century range from 17 cm to 59 cm. This will lead to the inundation and erosion of low-lying, coastal zones including coastal cities and infrastructure. A sea level rise of 0.3 m could

submerge 17% of Mombasa, which is located only 45 m above sea level, with a larger area rendered unusable thereby affecting the maritime transport system including the Mombasa Port facilities.

Coast Province is a region that is prone to torrential rains and flooding, and the probability and severity of such storm events will increase with climate change and lead to the destruction of port facilities. Higher temperatures and ocean acidification, which are the major characteristics of increasing GHG concentrations will also exacerbate the corrosion of port facilities constructed from steel. In addition, rising temperatures are expected to strengthen coastal winds and storms, which will affect ship navigation and other port operations.

In relation to coastal roads, a rise in the coastal zone ground water table would introduce a weakening in the underlying foundation upon which they are built. This could eventually lead to widespread structural instability and therefore affecting transportation of goods to and from the harbours.

The destruction of infrastructure including roads and bridges during storms is increasingly becoming a common phenomenon during the ENSO events and cause untold economic loss to the country. For instance, the damage caused by the eight-month 1997/1998 El-Niño rains to the country's transport and telecommunication infrastructure was estimated at one billion US Dollars (Ngecu and Mathu, 1999). It caused the worst flood-related casualties including the instant death of 36 passengers travelling in a 70-seat bus that plunged into a deep river near the slopes of Mount Kenya following the destruction of three kilometres of the Meru-Embu road. In October 2006, torrential rains pounded the eastern part of Kenya causing massive damage to roads, cutting off several of them and washing away bridges. In 2007, brief but also intense rains caused the

18 http://www.climateemergency.org/joomla/index.php?option=com_content&task=view&id=171&Itemid=172



A lorry is submerged due to river flooding in northern Kenya. Climate change will continue to pose challenges to Kenya's dilapidated road infrastructure. Photo by ESDA, now Camco Kenya

collapse of the Kainuk Bridge in Rift Valley Province cutting off the supply of crucial goods including foodstuff to the agriculturally unproductive Turkana and Samburu districts.¹⁹

Kenya's already dilapidated railway network is likely to be further damaged by floods and extreme heat, which the country is expected to experience as the climate changes in the tropics. The high temperatures are likely to cause warping of the rail track thereby exacerbating the chances of derailment of trains while flooding will wash away bridges. Such was the case in 1993 when 114 people perished in a train that plunged into a river after floods washed away a bridge at Ngai Ndethya National Reserve near Voi in Coast Province.

2.2.3.2 Communication Infrastructure

Kenya's communication infrastructure consists of the landline and mobile telephone network, the internet network, postal services, radio communication and television network, amongst other forms of communication. The Information and Communication Technology (ICT) sector is one of the key pillars that have been identified in the 2003 Economic Recovery Strategy and Wealth Creation (ERSWC) paper and the Vision 2030 to help jumpstart the country's economy. With Kenya now connected

to the global undersea fibre optic cable network, the country sees itself as a potential regional ICT giant providing services such as Business Process Outsourcing (BPO), call centre services, and development of broadband infrastructure among others.

It is undeniable that ICT is crucial to poverty reduction and is a key component in improving access to health and education services, as well as creating new sources of income and employment for the poor. With climate change, the ICT sector will face considerable challenges including damage to the telephone network by storms, poor radio and TV signals and delay in the delivery of mails during storm events. But a well developed ICT infrastructure could also help leverage some of the impacts of climate change on the economy, e.g. during rainstorms, access to quality internet and a reliable telephone system could enable people to telecommute, and this would have the added advantage of helping reduce transport-related GHG emissions.

2.2.3.3 Energy Sector

Kenya is a developing economy that requires large quantities of affordable, but quality energy services to affect a prudent pace of social transformation and economic development. Access to modern and clean energy, including electricity by all sectors, particularly manufacturing and service sectors, is therefore crucial.

Kerosene and biomass are the main types of energy consumed by households in Kenya. This is according to the MOE statistics that reveal that up to 68% of households use fuel wood as the main energy source for cooking and heating. Petroleum products account for 22%, the bulk of which is used in the transport, manufacturing and commercial sectors, while 9% is consumed in the electricity sector (*Energy Policy, 2004*).

Electricity, by virtue of its versatility in

19 Reports of various media sources

A waterfall for micro-hydro power generation. Hydropower potential has dramatically reduced in the past 20 years due to the destruction of water catchment areas. Photo by Camco Kenya



application, is crucial for economic growth and access to electricity is associated with high quality of life. Climate change affects all areas of the electricity sector, from generation through to distribution and consumption. Kenya's electricity supply largely depends on hydro sources, which account for over half of the total effective capacity (1332.2 MW). Geothermal sources of electricity account for 12.2% and the remaining 29.7% is predominantly petroleum based thermal generation. The Kenya Electricity Generating Company (KenGen) controls more than three quarters of the total electric power production and independent power producers (IPPs) generate the remaining. Kenya's solar energy

provision is also increasing quite rapidly. Currently, solar photovoltaics (PVs) provide 4 MW of off-grid electricity, mainly to small rural-based household consumers.

Hydropower potential has dramatically reduced in the past 20 years due to the destruction of water catchment areas. Climate change is likely to worsen the situation as it comes with extreme weather events like prolonged drought, which will reduce water levels in dams. This will reduce the hydroelectric power (HEP) production potential. For instance, the 1999-2000 droughts caused extended power cuts across the country. The country's economy dropped by 0.6% (reduced industrial productivity) compared to the previous year, while the Kenya Power and Lighting Company (KPLC) lost Ksh. 4.1 billion in revenues.

Hydroelectric power generation is also affected by soil erosion and the consequent siltation of dams. The decline in HEP production in 2002 for instance was caused by both the reduced river flow (volume) due to the 1999-2000 droughts and the siltation of dams by the 1997-1998 El-Niño floods²⁰. The gross storage capacity of the Kindaruma Dam has reduced from 16 million cubic metres to 11 million cubic metres due to siltation.²¹ Siltation is usually caused by heavy floods. Other causes include poor farming methods especially upstream and deforestation.

Further, scientists postulate an increase in land surface temperatures as a result of global warming will drive up demand for electricity for services like refrigeration and air-conditioning, while expanding agriculture to feed the growing population will require more energy for irrigation. Other impacts of climate change on energy include the gradual drying up and decline in the productivity of biomass, thereby affecting fuelwood supply. See the section on Forest Products (page 36) for further details.

20 See page 112 of Kenya National Water Development Report (2006)

21 Information from the KenGen website

Population displacement and migration from climate disaster-prone areas (e.g. drought prone northern Kenya and sea-level rise in the coastal region) are expected to increase. It is expected that most of those on the move from rural areas will head towards urban agglomerations where assistance, income opportunities and infrastructure may be perceived to be more accessible and readily available. This will create an enormous social, health, infrastructure and management challenge for cities, subjecting them to unplanned population growth.

2.2.3.4 Human Settlements and Land Use

There are many ways that climate change could affect human settlements directly or indirectly. Extreme climate conditions such as high wind, heavy rainfall, heat and cold can result in a wide range of scenarios such as tropical storms, floods, landslides, droughts and sea-level rise. Climatic catastrophes displace populations and cause sudden deaths, which in turn can lead to conflicts and civil unrest. Landslides and mudslides caused by heavy storms have in the past claimed many lives especially in the Kenya highlands. Maragua District in Central Province, for instance, is an area prone to landslides.

Insurance agencies and government would be burdened with having to make reparations to individuals for property damage and loss, unemployment, clean-up, and reduced socioeconomic viability of the communities affected.

Population displacement and migration from climate disaster-prone areas (e.g. drought prone northern Kenya and sea-level rise in the coastal region) are expected to increase. It is expected that most of those on the move from rural areas will head towards urban agglomerations where assistance, income opportunities and infrastructure may be perceived to be more accessible and readily available. This will create an enormous social, health, infrastructure and management challenge for cities, subjecting them to unplanned population growth. According to the United States Agency for International Development (USAID), recurrent droughts in Kenya have already forced many rural residents to seek refuge in cities and towns where, without any assets and little skill for urban income generation, they find life unbearable.

2.2.3.5 Human Health

Kenya's health sector is vulnerable to climate change in three ways: (i) the increase in vector-borne diseases such as malaria and RVF

(ii) mortality due to climate-related disasters; and (iii) overstretching of the health infrastructure. Due to these vulnerabilities, the country will likely be required to spend more on the health sector.

One of the potential impacts of climate change will be an increase in the incidence and geographical spread of such diseases as malaria, yellow fever and encephalitis. Currently malaria accounts for 50% of household expenditure on health, which is likely to increase as the disease spreads to highland areas where the cost of managing it will be disproportionately higher. This disproportion in cost is because people residing in the highland areas historically have low immunity to the disease unlike in malaria-endemic regions. Already there are signs that malaria is spreading to highland areas such as Kericho and Nairobi. This has been attributed to climate change in the form of warmer temperatures and variation in the rainfall pattern. Conditions such as warmer temperatures and rainfall variances are suitable for the survival of the malaria parasites and the mosquitoes that transmit them (Yanda et. al., 2006).

During floods especially those related to El-Niño events, environmental diseases such as typhoid, amoeba, cholera, and bilharzia, normally associated with contaminated water and poor sanitation, reach epidemic levels in areas where water and sanitation facilities are inadequate or are in poor state. This was the case for Nyanza, Western, Coast, Eastern and North Eastern Provinces which recorded several cases of cholera outbreaks during the 1997/1998 El-Niño rains. In addition, warmer waters provide conditions conducive for the survival of the amoeba protozoan. This probably explains why cases of the disease have risen steadily in areas that were predominantly cold but are now experiencing temperature rise like in lower Eastern Province²².

²² Information from the proceedings of the NCCRS Eastern Province regional workshop in Embu

Submerged huts in Western Kenya. During floods especially those related to El-Niño events, environmental diseases such as typhoid, amoeba, cholera and bilharzia normally associated with contaminated water and poor sanitation reach epidemic levels in such places.

Photo by Camco Kenya.



In the coastal region, epidemics of 'Chikungunya' fever, a viral disease transmitted by *Aedes* spp. mosquitoes causing febrile illness with joint pain and possibly other complications, have been reported. Between 2005 and 2006, the disease linked to droughts, affected more than 75% of the population (13,500 people) in Lamu where the first outbreak was reported (Chretien *et. al.*, 2007).

Climatic catastrophes like floods are also likely to cause populations to be displaced, or even lead to death, further burdening the health sector. Our over-stretched public health system for example, would be eroded further if

resources are diverted from its maintenance to disaster recovery.

Last but not least, malnutrition as a result of droughts can have a tremendous impact on those dependent on subsistence agriculture for their livelihoods. According to the World Health Organization (WHO), malnutrition causes millions of deaths each year from both a lack of sufficient nutrients to sustain life and the resulting vulnerability to infectious diseases such as malaria, diarrhoea, and respiratory illnesses.²³ Such cases abound especially in ASALs during any episode of La Niña induced drought.

23 WHO (2008): *climate change and human health*

3

Strategic Focus

3.0 Strategic Focus

3.1 Importance of the NCCRS to Kenya

As the preceding chapter shows, the direct and indirect impacts of climate change are already being felt across the country and there is a high possibility of increasingly severe changes in the future if unprecedented measures are not taken to reduce GHGs emissions. Natural disasters associated with climate variability and change can cost huge losses in GDP. For instance, the 1999 and 2000 droughts in Kenya caused damages equivalent to 2.4% of GDP.²⁴ The Stern Report²⁵ predicts that the cost of climate change in Africa could be as high as 7-10% of GDP by 2100.

Kenya's ability to cope with the impacts of climate change is compounded by many factors including poverty, weak institutions, poor infrastructure, lack of information, poor access to financial resources, low management capabilities, armed conflicts due to a scramble for diminishing environmental resources and high interest rates. It is vital that policies and measures for adaptation to climate change are put in place across all the economic sectors after a consultative process in order to minimise the impending climate change catastrophe.

The delivery of a participatory National Climate Change Response Strategy (NCCRS) is important for Kenya; not least because climate change is affecting and will continue to affect every facet of life of the Kenyan people. If the country is to avoid the worst effects of climate change it will need to seriously increase the limited efforts made thus far. This will require a comprehensive understanding of international

agreements, policies and processes on climate change.

It is necessary to put in place a conducive and enabling framework and a concerted programme of action to combat impacts of climate change. An informed public on climate change and its impact is the first step. A second step is the setting up of an institutional framework that translates the aspiration of the public as a whole and identifies specific roles and responsibilities of all actors – government, private sector, nongovernmental organisations (NGOs), religious organisations, farmers, and all vulnerable groups. These are some of the vital areas this NCCRS addresses.

3.2 Strategic Focus

The NCCRS's primary focus is ensuring that adaptation and mitigation measures are integrated in all government planning and development objectives. This calls for collaborative and joint action with all stakeholders (private sector, civil society, NGOs, etc) in tackling the impacts of climate change. The emphasis is to prioritise the most vulnerable sectors of the economy namely agriculture and food security, water, forestry, rangelands, health, social and physical infrastructure for quick and immediate action, while simultaneously providing explicit measures for addressing climate change in Kenya and defining criteria to track effectiveness of such measures.

3.3 Strategic Vision, Mission and Objectives

Like all planning documents, the NCCRS must have certain key components embedded in it.

²⁴ Mogaka Hezron, 2005: *Climate variability and water resources degradation in Kenya*, World Bank Working Paper, page 72

²⁵ Stern, N. 2007: *Economic Impacts of Climate Change*

These key components are the vision, mission, and the objectives that it intends to achieve.

3.3.1 Vision

The vision of the NCCRS is for a prosperous and climate change resilient Kenya.

3.3.2 Mission

The mission of the NCCRS (also the 'Strategy') is to strengthen nationwide focused actions towards adapting to and mitigating against a changing climate by ensuring commitment and engagement of all stakeholders while taking into account the vulnerable nature of our natural resources and society as a whole.

3.3.3 Strategic Objectives

In summary, the objective of the NCCRS is to respond to climate change by:

- enhancing understanding of the global climate change negotiations process, international agreements, policies and processes and most importantly the positions Kenya needs to take in order to maximise beneficial effects,
- assessing the evidence and impacts of climate change in Kenya,
- recommending robust adaptation and mitigation measures needed to minimise risks associated with climate change while maximising opportunities,
- enhancing understanding of climate change and its impacts nationally and in local regions,
- recommending vulnerability assessment, impacts monitoring and capacity building framework needs,
- recommending research and technological needs and avenues for transferring existing technologies,
- providing a conducive and enabling policy, legal and institutional framework to combat climate change, and

- providing a concerted action plan, resource mobilisation plan and robust monitoring and evaluation plan.

These objectives are expounded upon below:-

- **Enhance understanding of the global climate change regime**

In order to fully comprehend and appreciate the complex nature of the climate change problem, it is imperative to understand not only the local climate change challenges, but also the global context of the problem, which includes climate change negotiation processes, challenges and outcomes. This objective will be achieved by providing a brief and concise description of the global context of climate change.

- **Provide an assessment of evidence and impacts of climate change in Kenya**

Providing appropriate climate change response measures at local and national levels requires proper understanding of climate change challenges both regionally and throughout Kenya.

An assessment of local evidence and impacts of climate change should be carried out. This objective will be achieved by analysing local/national meteorological data from the Kenya Meteorological Department (KMD) and information gathered during the national and regional NCCRS workshops as well as desk-review of publications (books, journal articles and reports) on national and local climate change issues.

- **Develop sectoral and cross-sectoral priorities for climate change adaptation and mitigation in terms of short, medium and long-term actions**

It is undeniable that immediate action needs to be taken if the impacts of climate change are to be reduced and this needs to be prioritised according to vulnerability. To achieve this objective, the Strategy will identify adaptation and mitigation needs in key sectors and recommend actions needed. In addition, the Strategy

will identify key agencies to implement these actions and provide indicative costs needed to implement these actions in line with existing development and economic plans, especially the Vision 2030. These recommendations will be supported by a well-defined implementation and monitoring framework.

- **Develop comprehensive national education and awareness- creation programmes**

The level of understanding of climate change and its impacts is low countrywide. This calls for a focused awareness campaign that simplifies the science and impacts of climate change in a language that is more understandable to the public, particularly those dwelling in rural areas. This will help improve national preparedness for the impacts of climate change. Forums for engagement and information dissemination to the on current and future climate change risks will need to be established. In order to achieve this objective, the Strategy will recommend an education and awareness programme, as well as define a communication framework for inclusive stakeholder interaction to enable effective communication of targeted climate change information.

- **Conduct periodic vulnerability assessments, impacts monitoring at national and local levels, GHGs monitoring, and provide capacity building framework**

There is inadequate national and local information on how climate change elements (e.g. temperature rise, change in precipitation, extreme weather events, sea level rise and other seasonal shifts) will affect phenomena such as floods, drought, water shortages (supply and quality), human and domestic health risks, habitat loss, etc. Further, there is limited information regarding the country's vulnerability to climate change impacts. This is also true regarding the knowledge level of GHG emissions and mitigation

capacity (carbon-dioxide absorption/sequestration capacity) of key natural resources such as rangelands, lakes and rivers. This objective will be achieved by identifying key ecosystems for which such assessments should be carried out.

In order to address the shortage of climate change specialists in the areas of science, policy, adaptation, mitigation and carbon markets, it is imperative that a comprehensive national capacity building framework in strategic climate change areas be developed. This objective will be achieved by identifying sectoral capacity needs and will be complemented by successful models applied internationally. In addition, the country's capacity to respond to natural disasters has been stretched due to climatic events such as drought and floods. This objective will further seek to strengthen institutions involved in Disaster Risk Reduction (DRR) to enable them cope with climate disasters.

- **Identify specific Research and Development needs to address climate change, and opportunities for technology development, absorption and diffusion**

This will be achieved by an individual sector analysis of the knowledge and technology gaps that need to be addressed in the short, medium and long term. In addition, in order to foster faster transfer and adoption of climate friendly and resilient technologies in Kenya for sustainable development, the Strategy will seek to recommend avenues through which the transfer of such technologies can take place.

- **Strengthen governance of climate change, that is, policy, legislation and institutional frameworks**

This objective will be achieved by undertaking an analysis of existing policies and institutions, identifying their shortcomings, and applying lessons learnt both locally and internationally in order to identify and legally institute an

appropriate national climate change entity to undertake and oversee climate change activities in the country.

- **Provide an Action Plan and ensure its implementation in terms of having a robust monitoring and evaluation framework**

The identified adaptation and mitigation activities will require the mobilisation of additional and substantial financial resources for their implementation. An Action Plan and a Resource Mobilisation Plan will help achieve this. In addition, monitoring and evaluation activities will play an important role in ensuring an effective implementation of the project activities identified in the NCCRS. There is need for an efficient, focused and dynamic implementation framework and a robust monitoring and evaluation framework. This objective will ensure that such measures are in place.

3.4 Linkage between the NCCRS, Vision 2030 and Millennium Development Goals (MDGs)

Kenya's NCCRS is not only important for combating climate change, but its implementation timeframe also coincides with that of another of the country's important strategies – the Vision 2030. The Vision 2030 is Kenya's development blue-print projecting the country as a middle income economy by the year 2030. Vision 2030 is also intended to accelerate the attainment of the Millennium Development Goals (MDGs). The MDGs are a set of goals ranging from poverty eradication to reducing infant mortality to environmental sustainability that developing countries agreed to implement by 2015.

However, the Vision 2030 does not address climate change adequately, but it does refer to climate change adaptation in the context of building capacity as part of environmental management. One of the specific aims stated under environmental management is the goal to attract '*at least five Clean Development*

Mechanisms (CDM) projects per year in the next five years.'

The environment section of the Ninth National Development Plan (NDP) 2008-2012 states the Government and its agencies will *'formulate policies that minimise transport related environmental pollution from the different modes of transport.'* Yet these sentiments are not echoed within the transport section of Vision 2030. The NDP 2008-2012 also highlights adaptation issues in the context of El Niño and La Niña episodes and outlines the UNFCCC commitments including *'carrying out national programmes for mitigating climate change and adaptation to climate change.'* There is an appreciation of the impact of climate variability on resources (e.g. water) and a need to promote policies for sustainable environmental management. However, these adaptation provisions do not address fundamental long-term changes in the climate. Climate change concerns are not considered within other sections of the NDP 2008-2012 even though this is an explicit aim of the NDP itself – *'full integration of environmental concerns in development planning at all levels of decision making remains a challenge to the country.'*

In general, climate change is not fully recognised in the Vision 2030 as a problem that could hamper the country's ambitious development goals the Vision articulates. The Strategy acts to rectify this omission by proposing climate change 'proof' solutions necessary for the attainment of Vision 2030 goals. To this end, the Strategy proposes 'climate smart' development. In addition, to mainstream climate change into sectoral and development priorities, there is need to re-examine Vision 2030 with a view to amending it to reflect the climate change problem. Other economic blueprint papers should also be aligned with the Strategy.

The NCCRS will not operate in isolation. It is anchored on the UNFCCC and will complement two other similar treaties, the United Nations Convention to Combat Desertification (UNCCD) and the Convention on Biological Diversity (CBD).



4

Sectoral Adaptation and Mitigation Interventions



A demonstration plot with zai-pits ready for planting in Fundissa location, Magarini division, Malindi. It has been demonstrated that maize yields can double by use of simple water harvesting structures like zai-pits

(Source: Arid Lands Resource Management Project ALRMP, 2008)

4.0 Adaptation and Mitigation Interventions

4.1 Adaptation Interventions

Adaptation to global warming covers all actions aimed at coping with climatic changes that cannot be avoided and at reducing their negative effects. Adaptation measures include the prevention, tolerance or sharing of losses, changes in land use or activities, changes of location, and restoration. The primary reason for adaptation is that the GHGs already present in the atmosphere are enough to cause significant climate change, irrespective of if all emissions were stopped today. Anthropogenic climate change is already occurring: glaciers are melting, sea levels are rising, and hurricanes are increasing in intensity. With rising carbon dioxide levels, climate change is likely to worsen. For these reasons, the world must prepare for and adapt to the effects of global warming through adaptation actions and policies that are designed to tackle both current and future climate change threats.

In Kenya, the most vulnerable sectors include agriculture, tourism, infrastructure, health, and natural resources and biodiversity.

In Kenya, the most vulnerable sectors include agriculture, tourism, infrastructure, health, and natural resources especially biodiversity. The following sections highlight some of the proposed response measures in these sectors. The costs of implementing the programmes and projects in the respective sectors are provided in an Action Plan in Chapter 9 as well as in the Annex.

4.1.1 Agriculture, Horticulture and Food Security

Rain-fed agriculture is the second largest contributor to the country's GDP, with tea, coffee and horticulture contributing greatly to the country's foreign exchange earnings. Given its reliance on weather, agricultural production will bear the brunt of climate variability and change. Interventions in this sector should include:

- support for community-based adaptation

strategies, e.g. building or enhancing systems for conveying climate information to rural populations. The Government and development partners need to provide support to the KMD's Early Warning System to facilitate the timely dissemination of projected and downscaled weather information to farmers. This will enhance farmers' resilience to the impacts of climate change, e.g. through altering the timing of planting dates to adapt to changing conditions,

- enhanced financial and technical support to the Orphan Crops Programme so that indigenous and more drought tolerant food crops like cassava, millet, sorghum sweet potatoes can be re-introduced into the farming systems,
- promoting irrigated agriculture by developing irrigation schemes along river basins, construction of water basins and pans, but also reconfiguring irrigated production systems to use water more efficiently and to accommodate the use of marginal quality water,
- addressing land degradation by building soil and stone bunds, creating grass strips and contour levelling as well as incorporating trees or hedgerows. These measures will increase rain-water infiltration, reduce run-off during floods, reduce soil erosion, and help trap sediments including dead plant matter,
- promoting Conservation Agriculture (CA), whose aim is to achieve sustainable and profitable agriculture and ultimately improve farmers' livelihoods through the application of the three CA principles: minimal soil disturbance, permanent soil cover and crop rotations,

- diversifying rural economies, e.g. through value addition to agricultural products and financial support for sericulture and apiculture with the aim of reducing reliance on climate-sensitive agricultural practices,
 - Kenya also needs to create functional linkages with development partners for technology enterprise initiatives,
 - re-invigorating agricultural research and development (R&D) to produce crop varieties that can withstand projected climate variability. In Chapter 7, specific agricultural research areas that address climate change have been highlighted,
 - developing an innovative Insurance Scheme – low premium micro-insurance policy – which together with low-interest loans will insure farmers against crop failure due to droughts, pests or floods,
 - enhancing agricultural extension services to train farmers on how to better cope with climate variability and change,
 - strengthening integrated and environmental friendly pest management systems to cope with increased threats from insects, pathogens, and weeds, and
 - developing proper food storage facilities to cater for surplus harvest while promoting traditional and modern food preservation methods.
- 4.1.2 Livestock/Pastoralism**
- Nearly half of all livestock in Kenya is found in fragile ecosystems (i.e. ASALs) that are most vulnerable to climate change. Livestock production is therefore not exempt from the vagaries of climate change. It is likely to experience pressure from increased livestock pests and diseases as well as loss of pastures. These impacts will potentially result *inter alia* in community conflicts, loss of lives and livelihoods as well as migration. Certain interventions will need to be made in this sector and include:
- breeding animals from various agro-ecological zones that adapt well to climatic vagaries, through the assistance of the Kenya Livestock Breeding Board and other relevant institutions,
 - like in agriculture, developing special livestock insurance schemes that will provide an opportunity to spread and transfer climate change risks, e.g. to re-stock herds after decimation by starvation caused by droughts²⁶,
 - regular vaccination campaigns and cross border disease surveillance to reduce infections by migrating animals,
 - setting up measures to institutionalise Early Warning Systems on droughts, floods and disease outbreaks,
 - training communities on identification and establishment of emergency fodder banks from crop residues, growing seasonal/perennial fodder trees and grasses, preservation of seasonal wetlands during droughts and moving livestock into these during dry spells, as well as identification of forage types that suits various agro-ecological zones,
 - investing in programmes to harvest and store fodder for use during dry seasons. Fodder may also be sourced from other regions like the Kenya highlands which usually receive good amounts of rainfall,
 - inventorying indigenous knowledge that has conventionally been used by local communities to cope with erratic climate, e.g. on rainfall prediction and use of conventional medicine in treatment of

²⁶ Equity Bank, UAP and ILRI have established such a scheme, called Drought Insurance.

Kenya is a water scarce-country. With climate change expected to add to the water-stress that the country is already facing, actions aimed at protecting and conserving vital water catchment areas, river-banks, and water bodies such as Lake Victoria (photo below) from degradation and contamination should be enhanced. Photo by Camco Kenya



animal diseases, as well as supporting the improvement and dissemination of such technologies. These inventories are important elements for planning as they provide efficient, appropriate and time-tested ways of advising communities affected by climate change,

- promoting economic diversification among pastoral communities (e.g. cultivation of drought-tolerant crops such as millet),
- the Government, liaising with relevant experts in range dynamics, should enhance the provision of good quality water for both livestock and humans. Construction of dams is recommended to cater for pastoralists' water needs during the dry spells, but only after due consideration of a particular region's geologic and hydrologic characteristics, and
- awareness campaigns among the pastoralist communities on the importance of balancing stocking rates with the available land resources as a way of ensuring sustainable pastoralism.

4.1.3 Water

Kenya is a water scarce country, which essentially means that its annual per capita renewable water resource is less than the

conventional universal minimum of 1000 cubic metres. Climate change will aggravate the situation as it affects precipitation. For this reason, certain interventions need to be made in this sector including the following:

- constructing inter-basin and intra-basin water transfers to channel water from areas with excess water to areas with water deficit,
- investing in decentralised municipal water recycling facilities for both domestic and industrial use to reduce wastage,
- enforcement and/or enactment of laws and regulations required for efficient water resource management,
- increasing capture and retention of rainwater through the construction of waterways, strategic boreholes and other water harvesting structures to ensure availability of water during dry seasons,
- developing and maintaining an appropriate stock of water infrastructure (dams, water pans, supply lines),
- building capacity for water quality monitoring including training personnel to protect watersheds and monitor water quality,
- having a strategic fund to purchase water purification chemicals for disinfection of community wells and shallow boreholes during floods and drought episodes when water quality is most threatened,
- de-silting rivers and dams to improve carrying capacity, water storage and water quality,
- protecting and conserving water catchment areas, river- banks, and water bodies from degradation and contamination e.g., by imposing a water levy to generate funds for investment in conservation of water catchment areas,

- heightened awareness campaigns to underscore the importance of sustainable use of water resources, e.g. through the promotion of water harvesting techniques such as harvesting water from roof catchment at household level,
- developing artificial re-charging of groundwater for threatened aquifers,
- protecting flood plains through construction of dykes and river dredging,
- putting in place adequate hydrometric network to monitor river flows and flood warning telemetric systems, and
- introducing financial instruments such as subsidies to promote technologies that use water efficiently.

These interventions must however, take into consideration the importance of integrated water resources development and management, which has as its core the following principles:

- **water is a finite resource:** essential to life, human development and ecological functions. It should therefore be managed in a holistic manner by linking the need for socioeconomic development and protection of the natural resource,
- **water has an economic value:** failure to recognise the economic value of water has led to its unsustainable use and degradation of its natural base in many regions of the world, and
- **participatory approach:** involving different water users including gender groups, socioeconomic groups, planners and policy-makers in water resource management.

In Kenya, integrated approach to water resources development and management is embedded in the 'Integrated River Basin and Large-Water Bodies-based Natural Resource Management Programme', which is expounded upon below.

Integrated River Basin and Large-Water Bodies-based Natural Resource Management

For sustainable utilisation of natural resources in Kenya, there are basin-based institutions such as the six regional development authorities (RDAs). The Action Plan annexed to this Strategy presents details on RDAs. The RDAs are mandated to plan, implement and coordinate integrated basin-based natural resources management programmes. As a natural resource conservation approach, the integrated basin-based natural resources development and management tool include, but are not limited to the following:

- promotion of community empowerment initiatives such as high-value economic activities like sustainable fisheries including fingerlings production, livestock production, tree nurseries establishment and crop production as well as value addition initiatives such as refining honey, processing rice, milk and cotton. All these initiatives support conservation of water catchments because communities are able to see the importance of conserving their natural resources. In addition, they improve livelihoods,
- multi-use approach to development of water-basins, e.g. multi-purpose dams for flood control; hydropower generation; water use (domestic, industrial and irrigation); tourism as well as environmental conservation, and
- promotion of eco-tourism and cultural activities such as religious sites that contribute to conservation efforts.

4.1.4 Health

The country is vulnerable to a number of diseases including malaria, tuberculosis, diarrhoea, Rift Valley Fever and dengue fever. Changing climate and weather patterns influence the spread of these diseases. For example, rising temperatures are changing the geographical spread of disease vectors (e.g. increasing the habitat range of mosquitoes to include higher altitudes). The situation

therefore necessitates the implementation of the following recommended actions to deal with the health impacts of climate change:

- strengthening the public health systems which includes building hospitals and equipping them with medicine, equipment and well trained personnel,
- improving access to clean water and sanitary facilities to limit outbreaks of water-borne diseases such as cholera, typhoid and diarrhoea, alongside strong public awareness programmes to promote better hygiene,
- heightened surveillance of new outbreaks with subsequent rapid responses to control the epidemics. This should involve proper use of weather forecasts and pre-disposing environmental factors to identify areas of high risk in terms of disease and epidemics outbreaks,
- scaling up of programmes such as the ‘Roll Back Malaria’ in response to the expected increases in incidences of malaria outbreaks,
- setting up vaccination and immunisation programmes against diseases whose occurrences will be exacerbated by climate change and climate variability,
- creating ‘green spaces’ in urban centres, i.e. planting trees in urban centres to moderate temperatures and ensure fresh air for healthy living, and
- choosing healthy paths to a low-carbon future (e.g. promoting the safe use of public transportation and active movement such as biking or walking as alternatives to using private vehicles) could reduce carbon dioxide emissions and improve public health. These can not only cut traffic injuries, but also air pollution and associated respiratory and cardiovascular diseases.²⁷

4.1.5 Forestry

Over the past four decades Kenya has lost forest cover due to a combination of factors which include clearing forests for settlements and agriculture, illegal logging for commercial purposes, and encroachment into forest reserves. Climate change and variability are likely to increase the pressures that forests are already facing, as tree mortality increases with reduced rainfall, and incidences of pest, diseases and forest fires rise. Interventions needed in this sector include:

- intensified and sustained afforestation and reforestation programmes by the Government, individuals, schools, private sector, multilateral organisations, development partners through:
 - provision of financial incentives to rural communities to encourage the sustainable use of forest resources through a REDD+ mechanisms
 - establishment of woodlots (farm-forestry) for fuel-wood and other household uses
 - rehabilitation of degraded sites
 - increased surveillance
 - promoting growth of drought tolerant and pest and disease-resistant species
 - restoration of mangrove forests
- encouraging agroforestry which will enable poor rural households to meet their subsistence and energy needs,
- promoting alternative livelihood systems such as beekeeping, silkworm rearing, *Aloe vera* and gum arabic farming to take pressure off forest resources. The Government, in conjunction with its development partners and the private sector, should create a lending scheme for youth and women from which they can

27 For more details, refer to WHO (2009): *Protecting Health from Climate Change: Connecting Science, Policy and People*



An agroforestry farm in Central Kenya. One of the ways through which the Government plans to increase the country's forest cover is through agroforestry, which will enable poor rural households to meet their subsistence and energy needs. Photo by Camco Kenya.

borrow money to initiate these alternative income generating activities,

- promoting alternative energy sources, energy conservation initiatives, and efficient charcoal production and utilisation technologies to reduce biomass consumption,
- involving forest-dependent rural communities in forests management through a proper institutional framework that recognises and defines their role. This will enable them benefit from REDD+ activities which require community involvement in forests management,
- improving timber yields by planting mixtures of species, maintaining several age classes, reducing tree density, and pruning trees at strategic intervals,
- reducing the chances of pests and disease attacks by retaining a mixture of species and ages in mixed forests because mono-dominant stands are at most risk of disease and pest attacks, and

- reducing the frequency of fire outbreaks by maintaining lower tree densities to reduce fuel loads and competition, increasing investments in fire control services and personnel, and collecting as well as using dry biomass that accumulate on the ground.

Specific intervention programmes and projects are covered under *Mitigation-Forestry* in this chapter.

4.1.6 Energy

Kenya predominantly depends on biomass energy, which is comprised mainly of firewood, charcoal and agricultural waste. Most of the biomass energy is used in rural households and small businesses. The country also depends on hydropower, but potential has dramatically reduced during the past 20 years because of the destruction of water catchments areas. However, the country's demand has grown as high as its supply, leaving a reserve margin of only 7%. With climate change, the situation is likely to worsen as extreme events like frequent and prolonged droughts will lead to the reduction of water levels in dams, thereby affecting hydropower production potential. Some necessary interventions include:

- controlling river water abstraction upstream to improve availability of water for hydro-power production,
- zero-rating of taxes on renewable energy technologies,
- promoting the use of alternative renewable energy such as solar, biomass, wind, bio-fuels, and
- promoting efficient firewood cookstoves, solar and LPG cookers, with the Government addressing the issues of costs through giving subsidies or tax waivers to poor households.

For a detailed coverage of the interventions in the energy sector please refer to the section under *mitigation-energy sector* in this chapter.

4.1.7 Rangelands, Wildlife and Tourism

Tourism, which is Kenya's largest source of foreign exchange, largely depends on wildlife, which in turn depends for its survival on rangelands. However, due to desertification and the frequent and severe droughts that have hit the country especially since the 1990s, rangelands have been receding at an alarming rate. This is a source of great concern for the tourism industry, which needs to undertake urgent interventions including:

- developing a *National Wildlife Adaptation Strategy*,²⁸ a suite of well assessed climate change adaptation strategies by the Kenya Wildlife Service (KWS) and stakeholders including the World Wildlife Fund (WWF), the tourism industry, etc. This Strategy should be based on the outcomes of research presented in section 7.1.7 and will be accomplished by further:
 - assessing the current wildlife conservation policies and activities for their relevance to climate change adaptation
 - assessing the current adaptive capacity of the surrounding communities
 - assessing and reviewing the current development plans and activities to integrate climate change into the management of game reserves
 - undertaking community training and awareness raising through targeted demonstrations and group discussions
 - implementing training and research programmes at diploma and degree levels to train in wildlife and rangelands management
 - assessing adaptation issues and problems identified during project implementation,
- monitoring, management and remediation of degraded rangelands, which entails training and deployment of extra personnel to assist in protection and management of rangelands. Rangelands are a potential source of carbon finance given their ability to sequester thousands of tonnes of carbon if well managed,
- encouraging participatory approach to rangeland management involving pastoral communities who depend on rangeland resources for their livelihoods,
- creating community wildlife conservancies to help in the conservation of wildlife especially of endangered species,
- improving wildlife species conservation efforts for instance through wildlife translocation during extreme droughts, and
- evaluating potential socioeconomic impacts of remedial measures (e.g. carbon tax or levy impositions on the air transport industry) on Kenya's tourism sector, and develop strategies to deal with such likely future scenarios.²⁹

4.1.8 Social Infrastructure and Human Settlements

In Kenya, climate change will largely affect communities residing in poor urban neighbourhoods and those regions prone to drought, floods, geological movements (e.g. landslides). This will require implementation of climate change adaptation strategies including:

- strengthening disaster preparedness by increasing the number of well equipped (equipment, medication and personnel) health facilities, constructing dams and dykes in flood prone areas, plus improving knowledge and skills in disaster

²⁸ The USA and other countries have developed similar Strategies. For Kenya, such a Strategy should even be more important given the pertinent role that tourism plays in the country's economy

²⁹ Sectoral approach to mitigation is an idea that has been flouted in many climate change talks; it is plausible that such measures will one day be introduced, especially in the airline and maritime industry

As Kenya expands and modernises its infrastructure, it is important that the country introduce measures that will assure the resilience of infrastructure over its lifespan, particularly in the face of climate change, i.e. 'climate-proof the infrastructure.'

- preparedness and management in regions prone to such climatic disasters,
- developing climate change awareness programmes involving all stakeholders,
- proper planning of urban settlements which takes into consideration the expected high growth rate of urban population due to climate-induced migration from rural areas to urban centres. This will require urban planners and real-estate industry players to accordingly implement proper and adequate housing structures, waste disposal as well as piped water infrastructure,
- establishing insurance schemes to make reparations in regions affected by climatic disasters,
- diversifying economic activities to improve resilience to rural communities dependent on climate-sensitive sectors such as agriculture and livestock rearing,
- encouraging the formation of resident associations that can respond to emergencies, and involving them in key decision making, and
- expanding the Consolidated Social Development Fund and Women Enterprise Fund to address the following social and **gender-based** response strategies:
 - disburse self-help grants for boosting existing enterprises or establishment of new income generating activities by poor rural and urban women and men, e.g. making energy saving 'jikos' accessible and affordable to all families and individuals, particularly women; planting of crops used as alternative sources of income, e.g. aloe-vera, neem, and mangrove trees,
 - provide food rations to the hungry at times of need (during drought and flood disasters),
 - disburse grants to self-help groups in support of environmental conserva-
- tion projects such as tree nurseries development, afforestation, riverbank protection, construction/ installation of rain water harvesting tanks, spring protection,
- train gender focal points, women and men self-help groups in rural areas and urban poor in environmental management, and
- disseminate climate change information in local language through the use of field-based gender officers, women groups, Participatory Education Theatre (PET) and music groups.

4.1.9 Physical Infrastructure

Kenya's infrastructure continues to be built based on the assumption that the climate will remain unchanged in the future. Such an assumption is misguided, considering that climate change is already threatening vital infrastructure such as road and rail networks as well as water and energy systems. Lower annual rainfall in Kenya has reduced the power supply capacity of hydroelectric dams while temperature rise and glacial melt is causing sea level rise. Flooding of coastal and adjacent inland areas is exacerbating due to periodic torrential rainfall, thereby posing a risk to maritime, road, rail and air networks.

As Kenya expands and modernises its infrastructure, it is important that the country introduce measures that will assure the resilience of infrastructure over its lifespan, particularly in the face of climate change, i.e. 'climate-proof the infrastructure.' Ways of achieving this include:

- investing more in alternative energy sources like geothermal that are less sensitive to climate change and variability as highlighted in the energy section under mitigation. In addition, research needs to be conducted to determine the potential impacts of climate change elements like rainstorms on the country's power transmission infrastructure, road and rail networks, rising temperatures on solar energy systems, and changing

wind intensities on windmills (Benno and others, 2007) as well as measures to deal with such impacts. Considering infrastructural development funds, a **maintenance component** should be factored in to take care of the damage caused to the infrastructure by extreme weather events such as floods that sweep away roads and bridges,

- carrying out geotechnical site investigations (GSIs) to determine areas that are appropriate and/or inappropriate for infrastructural development, e.g. GSIs will help identify flood/landslide prone areas on which roads, railways and other infrastructure should not be constructed, and
- **accommodation**, which involves the continued use of the affected areas through measures practicable under the new prevailing conditions e.g.
 - using structures which can withstand strong winds, high temperatures etc, e.g., constructing railways with materials engineered to withstand high temperatures,
 - creating natural protective barriers against the sea so as to prevent its interference with the usual land practices, and
 - in coastal areas, buildings and infrastructure should be constructed using non-corrodible materials that cannot be damaged by rising salty sea waters.

4.1.10 Fisheries, Coastal and Marine Ecosystems

Kenya's inland lakes, coastal and marine ecosystems are a repository of rich natural resources which support local and national economies and include fisheries, terrestrial forests, mangroves, sea grass beds, and coral reefs. However, these ecosystems are threatened by resource overexploitation, transformation and degradation of habitat, pollution, and now, climate change. Some of

the interventions in these sectors include:

- promoting *sustainable* fish farming as a means of economic diversification and reducing over-fishing in inland lakes and rivers,
- developing county-wide maps depicting areas that will require shore protection (e.g. dykes, bulkheads, beach nourishment) and those areas to be left to adapt naturally,
- establishing a biodiversity monitoring network to identify species that will be affected by climate change and those that could be used as biological indicators,
- encouraging a coastal and watershed basin management approach linking land-use practices to marine and fisheries resource conservation,
- establishing networks of marine protected regions, including small enclosures comprising communities of species resilient to climate change impacts that serve as buffer zones as well as areas for seed regeneration,
- implementing adaptive management of fishing capacity based on climate and environmental forecasts to particularly protect against extreme events,
- conducting awareness campaigns on the impacts related to climate change amongst different stakeholders such as local communities, resource managers, and policy makers,
- providing economic incentives to diversify livelihood options to reduce dependence on climate-sensitive marine resources,
- strengthening co-management and community-based management institutions and the ability to enforce restrictions,
- developing financing mechanisms using non-consumptive options for supporting

marine ecosystem research and development, e.g. global carbon funds and biodiversity banking, and

- undertaking biological engineering and restoration of stress-tolerant organisms.

4.2 Mitigation Interventions

Mitigation refers to efforts that seek to prevent or slow down the increase of atmospheric GHG concentrations by limiting current and future emissions and enhancing potential sinks for GHGs. In Kenya, the sectors associated with high emissions include forestry as a result of logging; agriculture; energy and transport. The following sections describe some of the mitigation strategies Kenya needs and intends to undertake in the four sectors:

4.2.1 Forestry

Not only do forests and on-farm trees provide a unique opportunity for Kenya to participate in mitigation, but they also present the country with valuable opportunities for carbon trading and finance. The Kenya Government has initiated an ambitious programme of restoring the country's forest cover that is currently at 1.7%, down from 12% only 30 years ago. The overall aim is to grow about 7.6 billion trees on 4.1 million hectares of land during the next 20 years. This programme involves:

Planting of trees in deforested sections of the Mau Forests. The Government has initiated an ambitious reforestation plan that aims to increase the country's forest cover to 10% by 2030.
Photo by Camco Kenya.



- the participation of 35,000 schools, 4,300 women groups, 16,350 youth groups and six Regional Development Authorities. Each school is to be supplied with a 10,000 litre water tank to support water harvesting for the establishment and management of both tree nurseries and plantations, and
- large-scale landowners with at least 50 acres of land will be encouraged to construct dams for water harvesting and storage in order to support the establishment of irrigated private forests.

A detailed coverage of the Forest Restoration & Conservation Programme and Projects is provided in the Action Plan, which is annexed to this Strategy.

4.2.2 Energy

A study conducted by the Stockholm Environment Institute (SEI) on the economic impacts of climate change in Kenya (2009) found the country's current GHG emissions, both total and per capita to be relatively low. However, Kenya's GHG emissions are rising quickly and energy sector emissions are estimated to have increased by as much as 50% over the last decade.

In order to achieve the goal of a low-carbon developed society, Kenya should pursue an energy mix that greatly relies on carbon-neutral energy sources such as geothermal and other renewables. The implementation and use of renewables will increase Kenya's energy security. In addition, it will assist in mitigating climate change, which forecasts indicate will cause more intense and frequent droughts throughout the country. These droughts will affect all sectors that are rainfall-dependent including hydropower electricity generation, which is currently Kenya's main source of electricity.

Also, Kenya's present power generation capacity is grossly inadequate to meet demand. To bridge the supply gap, the Government occasionally rents imported emergency generation units. In the period from June 2006 to June 2008 approximately

The exploitation of abundant geothermal resources is the best option for Kenya. For this reason, it should be fast-tracked as a matter of highest priority. A financial analysis conducted on different primary sources of electricity generation revealed geothermal to be the most cost effective source of power. Approximately 1,000 MW of geothermal electricity can be harnessed at a cost of US\$ 0.06 per kWh in the next three to four years, while still generating substantial revenues for further investment.

150 MW worth of such generation units were rented. This is usually very expensive and requires large subsidies. The Government also usually leases thermal generation units during drought episodes. In addition to being a major contributor to GHG emissions, these thermal power Units are also quite costly.

To counter these and other potential threats to the energy sector Kenya needs to, and should implement measures described in the following sections.

4.2.2.1 Accelerate the development of geothermal energy

The exploitation of abundant geothermal resources is the best option for Kenya. For this reason, it should be fast-tracked as a matter of highest priority. A financial analysis conducted on different primary sources of electricity generation revealed geothermal to be the most cost effective source of power. Approximately 1,000 MW of geothermal electricity can be harnessed at a cost of US\$ 0.06 per kWh in the next three to four years, while still generating substantial revenues for further investment. In addition, not only are geothermal plants environmentally less disruptive, but also have the highest capacity utilisation factor (above 92%). In addition, they are immune to extreme weather conditions arising from climate change³⁰ and escalations in the cost of traditional fossil fuels such as petroleum.

4.2.2.2 Accelerate the development of green energy including wind, solar and renewable biomass

Green energy sources refer to those sources with zero or low levels of GHG emissions. Such green energy sources include hydroelectric power (HEP) generation,³¹ wind, solar and renewable biomass. Timely development of green energy projects is imperative if the country is to meet the growing demand

and reap other benefits including reducing foreign exchange expenditure on crude oil and other petroleum products. Importation of crude oil and petroleum products currently cost Kenya over 40% of foreign exchange earnings. Renewable energy also provides CDM opportunities and creates green job opportunities. To help facilitate renewable energy development, in June 2009 the Kenyan Government established the National Task Force on Accelerated Development of Green Energy with a mandate to accelerate development of green energy through mobilisation of technical and financial resources.

The Task Force aims at realising an additional 2,000 MW by 2012, which is enough to meet the expected growth in demand, achieve a reserve margin of at least 30% of firm capacity, and sustain normal electricity supply even during very severe droughts. Thus far the Task Force has identified green energy projects which it considers highly desirable and implementable in the short to medium term. These identified projects are estimated to provide an additional installed capacity of 2,790 MW between 2010 and 2014. Evidently, more needs to be done to meet the peak demand, which is expected to reach 10,000 MW by 2030. To further promote green energy, in 2008, the Government developed a renewable energy feed-in tariff (REFIT) policy with the aim of attracting investments in this sector. Kenya's strategies for facilitating the green energy development programme should include:

- resource assessment encompassing updating the country's renewable energy resources maps. Some of this information is currently available, but needs to be updated in view of emerging technologies that can allow for a greater depth of information to be captured. A comprehensive renewable energy map will

³⁰ See <http://www.pewclimate.org/docUploads/Geothermal-Fact-Sheet.pdf>

³¹ e.g. hydro schemes CO₂ free and CH₄ - free except in some particular reservoirs in tropical zones, with emissions that are associated with anaerobic decays in some dams. See *Tackling Climate Change on the Ground*, a WBSCD 2009 publication for more details

need to be developed and stored ideally in an easy-to-access interactive web-portal for quick reference by potential investors,

- enhancing solar rural electrification provision through credit facilities to meet the high demand for solar household energy systems and complement tax incentives currently in place. Given the geographic remoteness of many rural households, off-grid electricity production is one of the only viable options for the electrification of rural households in the short and medium term because it is cost-effective and convenient,
- reviewing and gazettlement of regulations for mandatory installation of solar hot water systems in residential and commercial houses,
- investmenting in renewable biomass energy including biofuels and sustainable charcoal, particularly in the ASALs. The ASALs can support the sustainable cultivation of some species like *Jatropha curcas*, *Moringa* sp., and *Croton* spp. from which biodiesel can be extracted. According to Muok and Källbäck (2008) and ESDA (2005) sustainable biofuels and charcoal production in Northern Kenya can act as a source of income generation for poor families and could both alleviate poverty and stem rural-urban migration, as well as reverse environmental degradation in the region,
- in line with a recommendation of the *Energy Act* (2006), investment in bio-ethanol processing³² to provide ethanol for blending with petrol will increase energy security, reduce fossil fuel imports, provide rural development opportunities, diversify agricultural industries, and create green jobs. At the moment, a bio-ethanol blending programme is being instituted and will commence in the western regions and expand to other areas subject to adequate availability of feedstock,
- investment in cogeneration, which is the production of heat or steam and electricity from renewable biomass waste. According the Ministry of Energy, Kenya's sugarcane belt can generate additional 300 MW through cogeneration³³ and given that Kenya is a major tea and coffee producer that generates coffee husks and used tealeaves waste, the opportunities for cogeneration using agricultural waste are abundant,
- encouraging the manufacturing sector to grow trees for fuel switching (i.e. sustainable thermal energy-electricity conversion) in line with the *Energy Policy* (2004) in order to reduce the country's reliance on fossil fuel imports, which currently account for 25% of Kenya's foreign exchange earnings,³⁴
- developing waste-to-energy programmes for converting municipal solid waste (MSW) into energy for domestic supply. Such programmes have other added benefits including improving health and lowering demand for both landfilling waste and fossil fuels, and
- developing Nationally Appropriate Mitigation Actions (NAMAs) programmes detailing mitigation opportunities in energy, transport and other sectors. Developed countries can support NAMAs through *technology, financing and capacity building* under the post-Kyoto regime. Such programmes can help attract some of the funding required to implement large-scale solar (e.g. concentrated solar power plant) and wind energy projects.

³² Kenya has previously experimented with bioethanol-petrol blending (at Muhoroni Sugar Factory), but stopped the programme in 1993; this will therefore, not be an entirely new technology in the country

³³ An example is the Mumias Co-generation Clean Development Mechanism project

³⁴ Other than the transport sector, Kenya's manufacturing sector is the largest consumer of fossil fuels imported into the country for heat and steam generation.

4.2.2.3 Energy Efficiency

Energy efficiency is simply defined as using less energy to provide the same service without compromising the quality of service. This falls within the broader concept of eco-efficiency, which is widely accepted to be the ‘efficiency with which ecological resources or goods are used to meet human needs’ (OECD, 1998 in Mickwitz et. al., 2006). With energy efficiency proposed as a route to promote sustainable development, the following energy efficiency programmes and projects should be implemented:

- mandatory energy audits by large commercial and industrial consumers should be enforced in line with the Government of Kenya *Energy Policy (Sessional Paper No. 4 of 2004)*, which encourages energy efficiency and conservation in all sectors of the economy. This will readily help identify consumption patterns where significant energy savings can be made,
- reviewing the tax policy on importation of motor vehicle with a view to incorporating measures that will encourage importation of environmental-friendly and low-fuel consuming motor vehicles such as hybrid designed models,
- providing subsidies and other tax incentives to promote and sustain wider adoption of energy-efficient fluorescent light bulbs and other energy saving electrical gadgets used by households,³⁵ and
- reviewing the country’s building codes with a view to incorporating measures that will encourage ‘climate-proofing’ and the construction of energy-efficient buildings, e.g. buildings that use as much natural light as possible while avoiding direct solar heating that would otherwise necessitate air conditioning.

4.2.3 Agriculture

Although emissions from the agricultural sector in Kenya are quite low and are considered to be ‘survival emissions’, some mitigation actions in this sector are also adaptation measures and should be promoted as a matter of priority. Mitigation measures to adopt in the agricultural sector include but are not limited to the following:

- applying agricultural technologies to increase food production while simultaneously limiting or reducing GHG emissions, e.g. through the appropriate use of biotechnologies,³⁶ as subscribed in the *National Biotechnology Development Policy* (2006),
- proper management of agricultural waste that includes using waste to produce biogas, which consequently also reduces the direct release of methane emissions into the atmosphere. Reducing methane emissions from uncontrolled anaerobic decomposition are potential CDM opportunities that Kenya is yet to tap into,
- encouraging improved crop production practices, e.g. mulching instead of repeated tilling to control weeds. Methane is produced in termites as part of their normal digestive process and repeated tilling only enhances emissions³⁷ from these creatures, which are the second largest natural source of methane emissions globally,
- promotion of intercropping in *plantations*³⁸ especially tree-based intercropping (TBI) as an agro-forestry system where a crop is established between planted tree rows.

³⁵ For instance, according to the KPLC, the planned Government’s programme to replace 1 million incandescent bulbs with fluorescent bulbs will save the country 49 MW, equivalent to the current installed capacity of the Kindaruma hydro plant

³⁶ See ‘Tackling Climate Change on the Ground’-World Business Council for Sustainable Development, WBCSD (2009)

³⁷ See <http://www.epa.gov/highgwp/sources.html>

³⁸ This recommendation should strictly apply to plantations and private land; otherwise, if broadly interpreted, it could lead to encroachment into natural and reserve forests



An anaerobic digester and discharge system for biogas generation. Controlled methane emissions such as this can provide rural farming communities with clean energy as well as enable them benefit from the CDM opportunities. Photo by Camco Kenya.

Agroforestry systems are known to store more carbon than conventional cropping systems through two mechanisms: TBI systems increase carbon storage in the biomass of planted trees and increase carbon stored in the soil, and

- promotion of organic farming, e.g. using crop

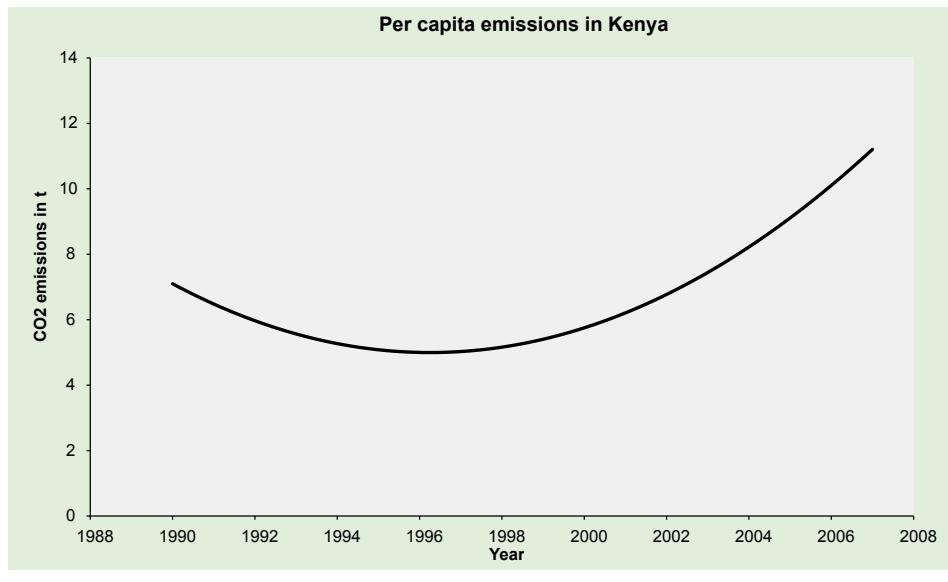
residues and cow-dung as manure, which,

- directly reduces GHG emissions as they are of non-fossil origin (i.e. are renewable and part of the natural cycles), and therefore
- according to unpublished data **may** be better in fixing soil carbon compared to conventional methods.³⁹

4.2.4 Transport

The transport sector accounts for a large share of global GHG emissions and are on the increase even in developing countries where these emissions are still low. In Kenya, the transport sector emissions are growing rapidly due to increases in private car use that is expanding as incomes rise, the middle class expands and the public transport sector continues to erode.

This trend could potentially ‘technologically lock in’⁴⁰ Kenya towards a high emissions path (see figure 4) and negate the opportunities it



39 See e.g. http://www.rodaleinstitute.org/ob_31

40 ‘Technological lock-in’ refers to the concept that once led down a certain technological path, an entity (country, region, organisation, etc) may find that the process of reverting to another, principally, a cleaner path, may prove quite difficult either due to prohibitive costs or the learning process that accompanies such transitions

could derive from the carbon markets. Kenya therefore needs to put in place measures that can curb GHG emissions in this sector. Some of these measures include the following:

- promotion of low-cost public transport modes such as bus rapid transit (BRT)⁴¹ and other means of mass transport,
- proper urban and transport planning to facilitate efficient and low GHG modes of transportation, e.g. decongesting roads,
- encouraging non-motorised modes of



An artist's impression of the Bangkok Bus Rapid Transit (BRT) line. A well developed BRT system would offer a fast, comfortable and convenient means of movement within a busy traffic metropolis such as Nairobi, and would attract middle-income people "to get out of their cars". Many developing countries are developing BRT systems to help them reduce their transport GHG emissions. Photo source: <http://transitmy.org/2010/03/17/do-bus-lanes-worsen-congestion/>

transport (NMT) by creating bikeways and pedestrian walkways,

- creating transport demand management measures that encourage or favour public transport and NMT,⁴²
- creating a programme to phase out old and inefficient (high fuel-consuming) motor vehicles, while encouraging importation of efficient vehicles through tax incentives and other financial tools,

- creating awareness and possibly car-pooling policies through punitive taxes and charges, e.g. road and fuel levies to reduce unnecessary travel,
- strictly enforcing vehicle inspection rules to ensure motor vehicles are well-maintained in order to reduce pollution. In addition, the Government should enact a law that would compel vehicle owners to install pollution-control devices, such as the three-way catalytic converters that can *inter alia* converting nitrogen oxides including the infrared-active global-warming causing nitrous oxide (NO_2) to nitrogen and oxygen,
- developing a Light Rail Transit (LRT) in major cities and towns to decongest traffic, and
- improving the rail-network to facilitate low-cost and low-carbon long-distance transportation of cargo and passengers.

4.2.5 Carbon Markets: a Benefit of Mitigation

Developing countries (also known as Non-Annex 1) such as Kenya can choose to undertake mitigation projects in the sectors described above (e.g. energy, transport, agriculture) as well as manufacturing and others. These projects can gain monetarily from 'carbon markets' that allow them to sell certified emission reduction (CER) credits to developed countries (also known as Annex 1) to help the latter cost-effectively mitigate against climate change. This is legislated under the Kyoto Protocol's CDM compliance markets. Carbon markets also comprise of the buying of 'carbon offsets' by individuals and organisations who wish to voluntarily offset their GHG emissions, i.e. under the Voluntary Carbon Markets (VCM). Details about these have been provided in Chapter 1. Measures that Kenya can implement in order to effectively participate in and benefit

⁴¹ GTZ (2008): There is no clear definition of what constitutes a BRT. A BRT is instead defined by various features which makes the system faster than conventional bus transport systems and these could include dedicated (exclusive right-of way) lanes; rapid boarding and alighting; free transfers between lanes; pre-board fare collection and verification; clear route maps; real-time information displays, etc

⁴² For more information concerning the first four interventions, see Karekezi S., Majoro L. and Johnson T.M., 2003: Climate Change and Urban Transport: Priorities for the World Bank

from the carbon markets are highlighted below.

4.2.5.1 The Clean Development Mechanism (CDM)

In order for Kenya to participate effectively in the carbon markets including the CDM, the following measures will need to be undertaken:

- calculation of the baseline GHG Grid Emission Factor (GEF) for the electricity grid of Kenya to facilitate CDM projects in the power sector and assist carbon project developers and consultants,
- target capacity building for the private sector and investors to increase the knowledge of GHG reduction project development and markets, e.g. developing a handbook for CDM Project Activities detailing the role of government and the UNFCCC, CDM cycle, types of projects, eligibility criteria, CDM transaction costs and how to sell Certified Emission Reductions (CERs),
- need for a government-fronted manual that guides CDM implementation; this can be placed on a public website, as has been done by a number of countries including Tanzania,
- strengthening relevant institutions such as the DNA and removing barriers to carbon trading such as high initial transaction costs and low level of awareness of CDM potential on the part of private sector, particularly investment and financial organisations,
- providing tax incentives and favourable import tariffs on technology for projects that reduce emissions,
- having clear energy pricing and CDM project policies including a general institutional framework and good governance,
- ensuring that Kenya establishes itself as a cost-effective host country to GHG emission reduction projects,
- designing a general ranking of the easiest and most viable project types to the most difficult and least viable (low hanging fruits first to build momentum),
- creating a database of existing projects, emission reduction volumes, other benefits, project developers, financiers, government

support, and

- exploring ways of integrating carbon markets into the main economy and opening it to conventional legal and banking systems.

4.2.5.2 Reduced Emissions from Deforestation and Degradation in Developing Countries

Carbon emissions from deforestation and forest degradation account for about 20% of global anthropogenic emissions (IPCC-WG I, 2007). Since the eleventh session of the Conference of Parties (COP-11) to the UNFCCC in December 2005, strategies and incentives for Reduced Emissions from Deforestation and Degradation (REDD) in developing countries have emerged as one of the most active areas discussed during climate change negotiations and a REDD Mechanism has now been created under the Copenhagen Accord.

Specific recommendations that can enable Kenya to benefit from REDD opportunities include:

- robust monitoring, reporting and verification (MRV) institutional arrangements (clear credible national forest monitoring baselines and guidelines),
- filling the historical data gaps on forest cover throughout the country,
- addressing the risk of non-permanence and leakage as a necessary condition for any parties or entities to participate in a REDD mechanism and activities,
- assistance with methodology development especially on REDD, which has the potential to not only mitigate climate change but also support livelihoods, maintain vital ecosystem services, and preserve globally significant biodiversity,
- need for financial support, technology transfer and provision for capacity building especially among forest-dependent communities, and
- joint action involving both the public and private sectors in order to mobilise the necessary finance and accelerate REDD actions.



5

Communication, Education and Awareness Programmes

5.0 Communication, Education and Awareness Programmes

Climate change awareness is low countrywide. This was evident from findings of consultative workshops conducted in all the eight provinces of Kenya during preparation of this Strategy. The need for awareness creation, targeting specific groups and communities, and using different tools and media such as the print and electronic media, drama, community forums (*barazas*⁴³) is therefore pressing. Equally important is the incorporation of climate change into the nation's educational curricula at different levels, starting with primary through to tertiary institutions.

The UNEP Division of Environment Law and Conventions (UNEP-DELC) acknowledges that many governments and NGOs are already working actively to raise awareness on climate change. It however, accepts that the scale of the changes required and the vast number of people and interests that must be informed and influenced call for outreach activities of a much greater magnitude. Borrowing from the Communication, Education and Public Awareness (CEPA)⁴⁴ programme of the Conventions on Biological Diversity (CBD), an effective public education and awareness programme on climate change will entail:

- **communicating** the scientific and technical work of the UNFCCC, the Kyoto Protocol, and the post Kyoto agreement documents in a language that is accessible to many different groups,
- integrating climate change into **education** systems of all Parties to the Convention, and
- raising **public awareness** of the importance of climate change and its implications to our lives.

5.1 Communication

The crucial role of communication is to make citizens better-informed on climate change issues and actively participate in programmes to combat it. There is therefore need to develop appropriate models of communications that will serve to transmit and disseminate information on climate change. The essential characteristics of such communication models should include:

- community ownership and participation through ensuring local content,
- language and cultural relevance,
- using appropriate technology that can be owned and controlled by the people to meet their real needs, and
- learning and sharing among networks of people with similar concerns.

It is vital for the Government to gather and systematise already available data and generate additional information to ensure an adequate analysis including disaggregated data for marginalised groups. The following measures should be pursued for effective climate change communication:

- **Communication needs assessment:** There is need to assess the information needed by marginalised groups, and their most accessible source of information at local, national and international levels (e.g. radio, television, and printed materials as well as theatre, storytelling and other traditional community media),
- **Improving access to climate change information:** This should be done through formats and communication channels

43 Kiswahili for public forums

44 See <http://www.cbd.int/cepa/>

that are easy to understand and use. There is need to have well developed ICT infrastructure and skills to facilitate effective dissemination of climate change information and education. The Government should develop a website on climate change issues and all the relevant information, programmes, projects, related to climate change and establish one-stop resource centres which should be equipped with climate change material,

- **Dissemination of credible and reliable climate change information and research findings:** The Government should put in place strategic planning and public review processes to facilitate 'credible fact finding' on (a) key climate science issues, (b) comprehensive climate and ecosystem observing and data management systems, and (c) the development of decision support resources,
- **Supporting public debate on climate change issues** by promoting parliamentary public hearings, participatory policymaking initiatives at both central and local level, and a vibrant civil society, and
- **Developing a comprehensive communications plan:** The Government needs to develop a comprehensive communications implementation plan and funding plan, based on an inventory of existing communication activities and building on experience from several short-term pilot projects to determine and shape ongoing effective communication strategies.

5.2 Education

A major concern in Kenya is the lack of adequate climate change information, knowledge and long-period data to researchers, planners, policy-makers and the general public on climate change impacts, adaptations and mitigations measures. The following measures should be pursued:

- **Curricula review to integrate climate change into education systems:** The

Ministry of Education should incorporate climate change into school curricula at all levels as part of education and public awareness. The expected outputs should include:

- updated school curricula with climate change content,
- updated textbooks and other learning material with climate change content,
- better educated pupils/students in the field of climate change, and
- updated or new courses incorporating climate change issues,
- **Develop, strengthen and harmonise national education, research institutions and programmes** on issues regarding the impacts of, adaptation to and mitigation against climate change. This in turn should lead to the development of technological capacity in various climate change fields,
- **Involvement of local administration and community leaders:** Educating and training development workers, local authorities, community leaders on climate change results in committed mutual understanding and concerted action against climate change, and
- **Developing and disseminating climate change literature in local languages** for the benefit of marginalised populations and the general public, thereby encouraging their involvement in adaptation and mitigations programmes. Scientific data and terminologies should be well explained and simplified in literature, which could be in the form of brochures, illustrated pamphlets, billboards and journals.

5.3 Public Awareness

Everyone should be well informed of climate change, its impacts and the necessary adaptation and mitigation measures to be taken. Public awareness and education on climate change – particularly the importance

of actions that reduce GHG emissions– needs to be improved. Training at community level is necessary to ensure that various communities are aware of climate change and can use climate data and information acquired through systematic observations.

Some ways of raising public awareness include:

- establishing a National Climate Change Awareness campaign. The National AIDS/ STD Control Programme (NASCOP) model for sexually transmitted diseases can be adapted,
- using print and electronic media to pass climate change information in various articles and programmes on climate change in the media,
- Education-based entertainment: educating the citizens on climate change while entertaining them at the same time through theatrical performances,
- mainstreaming climate change awareness in all programmes and projects undertaken by the Government, NGOs, CBOs, media etc,
- creating climate change training material and programmes for target groups of stakeholders and specific groups, i.e. women, men children, youth, people with disabilities, religious groups,
- promotional activities and sponsorship of events with climate change themes, e.g. a reward scheme for pupils or individuals who plant trees and maintain them,
- schools or colleges' competitions where students perform drama, poetry, essays and music with climate change themes and the best get rewarded,
- decentralising Environmental Committees to the village level,
- formation of youth, women's and men's groups, CBOs, as forums for outreach, and including existing youth groups and initiatives in ongoing climate change and decision making activities,
- documenting climate change impacts and linking them to community livelihoods,
- online blogging on sites such as Facebook, Twitter, Google Groups, and Yahoo Groups through which various topics on climate change could be discussed,
- formation of online networks, which are almost similar to online blogging but differ in the sense that there is a possibility for physical contact and face-to-face discussions,
- using graphical images to pass climate change information,
- eco-tournaments – using sporting events (athletics, football, etc) to raise awareness
- encouraging individual voluntarism in raising awareness, and
- involving the corporate sector, especially the mobile telephone industry e.g. to display 'airtime top-up messages' on climate change.

6

Vulnerability Assessment, Impact Monitoring and Capacity Building

6.0 Vulnerability Assessment, Impact Monitoring and Capacity Building

6.1 Vulnerability assessment

The IPCC defines vulnerability as ‘the extent to which climate change may damage or harm a system’ and adds that ‘vulnerability depends not only on a system’s sensitivity, but also on its ability to adapt to new climatic conditions.’⁴⁵

Although chapter 2 of this Strategy has attempted to discuss Kenya’s vulnerability to climate change impacts, the level of knowledge about Kenya’s current vulnerability is still more or less **general**. It is accepted that ‘Kenya is vulnerable to climate change because most of her people depend on climate sensitive natural resources for their livelihoods. However, how vulnerability varies across the country is something that is yet to be determined. An appropriate approach to coping with climate change impacts requires proper knowledge of the vulnerable nature of communities, groups and sectors. This will then inform the measures that need to be taken in order to minimise the negative impacts of climate change, and exploit the beneficial ones.

How vulnerability varies across Kenya is something that is yet to be determined. An appropriate approach to coping with climate change impacts requires proper knowledge of the vulnerable nature of communities, groups and sectors. This will then inform the measures that need to be taken in order to minimise the negative impacts of climate change, and exploit the beneficial ones.

information on how climate change elements – temperature rise, change in precipitation, extreme weather events (such as floods and drought), sea level rise and other seasonal shifts – will affect these ecosystems and their services e.g. water supply (quantity and quality), air quality, human and domestic health, habitat-loss, etc.

Thorough periodic nationwide assessments of how these changes will affect human population, infrastructure, the environment, the economy and society as a whole should be conducted. An understanding of how ecosystems might evolve is needed in order to project how humans will modify their environment in the future and in turn be affected by the changes (Odada et. al., 2009).

Such assessments should lead to the development of essential climate change scenarios and corresponding policy responses. The indicators to be monitored would include changes in the atmosphere, marine and terrestrial biodiversity as well as important ecosystems such as major water towers (the Mau Escarpment, Cherenganyi Hills, Mount Kenya, Mount Elgon and the Arberdare Ranges), major lakes such as Victoria and Turkana, water quantity including river floods and droughts, freshwater quality, agriculture, forestry, and human health, among others.

6.2 Climate change impacts and GHG emissions monitoring

Climatic and Ecosystem Trends

There is limited information regarding the status of key natural ecosystems such as major water catchment areas, lakes and major rivers. Further, there is inadequate national and local

Trends in GHG Emissions

Local capacity to monitor and determine the status and trends of GHG emissions in Kenya is lacking. Only a few institutions, notably the International Energy Agency (IEA), periodically monitor and report on Kenya’s GHG emissions. The IEA’s data shows that

45 IPCC Third Assessment Report: Climate Change 2001

Kenya's GHG emissions in 2007 were 11.43 mega tonnes (Mt)⁴⁶.

The overall objective of the UNFCCC is to stabilise GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. To facilitate the realisation of this objective, Annex-1 Parties to the Convention are required to monitor and report yearly on their GHG emissions to the UNFCCC Secretariat through National Inventory Reports (NIRs). Developing countries including Kenya could and should also develop and implement a *GHG Monitoring and Reporting Programme* to assess, quantify and report on sectoral GHG emissions. This information could feed into the National Communications (NCs) as is the requirement under the UNFCCC, but would more importantly be useful in identifying 'high-emissions' sectors and areas where significant GHG reductions can be realised.

In view of the risks and opportunities presented by climate change, enhanced capacity building is required to strengthen capability of developing countries like Kenya which have very few climate change specialists in the areas of science, policy, adaptation, mitigation carbon trading and carbon markets. Therefore, it is important to put in place a targeted capacity-building framework, and build the capacity of local communities to help them adapt to the adverse impacts of climate change.

6.3 Capacity Building

Capacity building for climate change refers to the development or strengthening of personal skills, expertise, relevant institutions and organisations to reduce GHG emissions and/or to reduce vulnerability to climate-related impacts. The need for capacity building is enshrined in Article 9 (d) of the UNFCCC, which calls upon the Subsidiary Body for Scientific and Technological Advice (SBSTA) – the body created under Article 9 of the Convention – to provide '*ways and means of supporting endogenous capacity-building in developing countries*'.

In view of the risks and opportunities presented by climate change, enhanced capacity building is required to strengthen capability of developing countries like Kenya which have very few climate change specialists in the areas of science, policy, adaptation, mitigation carbon trading and carbon markets. Therefore, it is important to put in place a

targeted capacity-building framework, and build the capacity of local communities to help them adapt to the adverse impacts of climate change. Further, the actions being recommended in the Strategy will require people with adequate necessary skills to implement.

In line with the UN's 'Acting on Climate Change, the UN System Delivering as One' report, the following are as some of the key critical areas for Kenya where capacity building should be targeted:

Training on Climate Change Competencies and Strengthening Institutions:

- regional and sub-regional preparatory workshops for climate change negotiators where Kenya would participate with other developing countries, SIDS and LDCs, on the UNFCCC negotiation process,
- technical and policy support to Kenya as a party to the UNFCCC for preparing its National Communications,
- support to the country in its efforts to implement UNFCCC decisions through country-driven approaches,
- awareness-raising, development of communication tools, training and planning workshops at local, national, regional and global levels,
- capacity building and support for the modernisation and development of national meteorological services e.g. the Kenya Meteorological Department and IGAD Climate Prediction and Applications Centre (ICPAC),
- mobilising and enhancing the capacity of the Government, employers and workers' organisations to contribute to coherent policies and effective programmes leading to greening economies with green jobs,

⁴⁶ CO₂ Emissions from fuel combustion only. Emissions are calculated using IEA's energy balances and the Revised 1996 IPCC Guidelines. Also, see chapter 4 under **mitigation** for GHG emission trends

- capacity building in the use of geo-referenced demographic and socioeconomic data, in addition to setting up a GHG reduction policy and tools, and
- strengthening the Designated National Authority (DNA), including additional personnel.

Capacity Building in Adaptation

- providing advisory services on how to mainstream climate change considerations into development decision-making e.g. for the achievement of the MDGs,
- supporting city and other local governments mainstream climate change adaptation into their programmes,
- strengthening planning and capacity development initiatives to reduce risk, prepare and recover from disasters including strengthening institutions in charge of Disaster Risk Reduction (DRR) cope with climate disasters through:
 - improving application of advanced technology (weather and climate information) in risk identification and evaluation,
 - invest in user specific models and application products,
 - improve downscaling of climate models
 - build forums for data integration and exchange (extensive regional networks),
 - invest in climate information systems,
 - improve community & family preparedness information tools,
 - invest in people-centred early warning systems (EWS) on climate change,
- enhancing communication among scientists, decision/policy makers, NGOs and communities through:
 - building on existing structures e.g. MEMR, NEMA, climate change departments and Inter-Ministerial Committee on Climate Change to raise awareness,
 - building on existing forms and centres to bring together expertise (e.g. through the United Nations International Strategy for Disaster Reduction (UNISDR) hosted workshops, ICPAC training forums, the media and regional links; invest in 'translators' working manuals,
 - engage people at the grassroots to build on existing coping/adaptation mechanisms,
- providing a coordinating framework to facilitate oversight and national ownership through:
 - implementing the National Disaster Management Policy with a National Disaster Management Authority (NADIMA) to coordinate the activities of different stakeholders and initiatives engaged in disaster management,
 - building on cross-sectoral liaison within existing disaster and hazard structures e.g. the Early Warning System (EWS) of the Kenya Arid Lands and Resource Management Project (ALRMP) and National Disaster Operation Centre (NDOC),
 - monitor research and outputs of NGOs and other organisations to encourage collaboration rather than duplication,
- developing structures that facilitate sustained application of the National Disaster Management Policy by:
 - investing in implementing structures with clear responsibilities and points of contact,
 - building partnerships with local communities,

- providing a role for national leadership in international policy dialogue e.g. for the National Adaptation Platform,
- mainstreaming Disaster Risk Reduction (DRR) and adaptation e.g. putting measures to reduce poverty and empower marginal communities through:
 - tackling underlying vulnerability/poverty as detailed by the Vision 2030 (especially important for slow-onset disasters),
 - mainstreaming risk and adaptation within the Government plans and budgets,
 - using the development of a National Adaptation Platform as a tool to mainstream climate change adaptation, initiate systematic development programmes and enhance national partnership with UN agencies,
 - investing in 'climate-proofing' development agenda and increasing awareness of DRR in projects,
 - investing in local adaptive capacity e.g. invest in projects that protect livelihood assets like special water management projects in arid lands which could facilitate cross-sectoral and multi-scale coordination,
- promoting flexibility in approaches to disaster risk management through:
 - regularly updating risk plans and information,
 - decentralising responsibilities and skills,
 - ensuring community participation e.g. through skills sharing forums/initiatives, and
- creating financial mechanisms for disaster management and invest in regional partnerships through:
 - the use of the National Disaster Management Policy to facilitate the introduction of Disaster Trust Funds, risk transfer mechanisms and formal donor partnerships,
 - building on regional partnerships to share costs and expertise, and pool resources at the district level with the engagement of NGOs, private sector and Government special projects, if necessary through regulation,
 - investing in institutional capacity building, collaborative projects and networks (to increase awareness on international funding) and strengthen links with development banks and donor agencies,
 - the use of international funding opportunities e.g. from the GEF to fund large-scale adaptation projects.

Capacity Building in Finance/Mitigation

- assisting Kenya to improve its level of participation in the CDM, and
- supporting the identification of policy options that enable the rural poor to engage in climate change mitigation by building the foundation for pro-poor payment for ecosystem service markets.

Capacity Building in Technology transfer

- supporting education, training, information exchange, best practices and national strategy initiatives related to the development and applications of/access to state-of-the-art climate friendly technologies,
- creation of regional networks of climate change focal points in governments to promote exchange of experience and knowledge on technology transformation,
- training programmes and capacity building

in the use of the patent information systems and practical mechanisms for technology transfer, and

- capacity building seminars/workshops in different regions to assist promote implementation of new standards aiming at the reduction of GHG emissions through radio and ICT devices.

Capacity Building to enhance Reduced Emissions from Deforestation and Degradation (REDD) programmes in Developing Countries

- Capture opportunities offered by the UN-REDD Programme and Forest Carbon Partnership Facility as well as the REDD

Mechanism under the Copenhagen Accord to prepare developing countries like Kenya for REDD, e.g. to

- train personnel in carbon markets; offsets mechanisms; documentation (e.g. developing Project Idea Notes (PINs) and Project Design Documents (PDDs)); Monitoring, Reporting and Verification (MRV); forest mapping, and participatory forest management, and
- help communities develop alternative livelihoods (i.e. there is always an economic drive behind deforestation).

7

Research, Technology Development, Absorption and Diffusion



7.0 Research, Technology Development, Absorption and Diffusion

7.1 Research and Development

Research and development is important not only in understanding the causes, manifestations and impacts of climate change, but also in responding to it. Indeed, research activities are explicitly encouraged by numerous international Conventions and Agreements including the UNFCCC and the Kyoto Protocol, which call on Parties to promote, and to cooperate in, scientific, technological, technical, socioeconomic and other research, systematic observation and development of data archives.

Research focusing on technological development plays an important role in preparing a low-carbon society of the future by improving existing climate-friendly technologies and developing new ones. Agricultural research on the other hand, facilitates the identification of cost-effective ways of producing food for

the growing human population. Thanks to the IPCC and other research organisations and individuals involved in climate change issues, our knowledge is advancing rapidly. Through research and economic analysis, the most cost-effective measures to mitigate climate change can be identified. Further, research is required in predicting climate-related changes at local levels so that appropriate adaptation measures can be taken.

Kenya's sectoral research needs on climate change include the following:

7.1.1 Agriculture, Livestock and Food Security

As an important sector to the country's economy and one of the sectors most vulnerable to climate change, there is need to scale up research in agriculture in areas that respond to climate change including:



Research produces improved local crop and livestock breeds with higher productivity and disease resistance.
(Source: KARI, undated)

- strengthening biotechnological research in crop and livestock varieties that are resistant or tolerant to pests and diseases, drought, and have improved nutritional value,
 - undertaking countrywide assessments to determine regional vulnerability of the sector to climate change elements,
 - strengthening research in vaccines against priority livestock diseases and inoculants for improving soil nitrogen and phosphorous in acid soils and enhancing soil biological resources,
 - promoting research that combines traditional and modern methods of food preservation,
 - promoting sericulture and apiculture technologies,
 - strengthening research on good agricultural practices,
 - integrating a long-term climate-risk perspective into district planning and investments,
 - strengthening research on better marketing strategies/identification of new market niches for livestock products, and
 - validating indigenous knowledge (IK) with a view to disseminating it for integration into conventional technologies.
- investing in research on the production chain and sustainability of biofuels particularly biodiesels,
 - promoting development of appropriate local capacity in the manufacture, installation, maintenance and operation of basic renewable technologies such as biodigesters, solar water heating systems and hydro-turbines,
 - promoting development, commercialisation and widespread utilisation of renewable energy technologies,
 - promoting research into efficient methods of conversion of wood and agricultural waste (coffee husks, used tea leaves, etc) into commercially useful forms of energy, and
 - promoting research on improved kilns and 'jikos' for the production and use of charcoal respectively that will reduce biomass consumption while generating the same amount of energy.

7.1.3 Forestry

Forestry research areas that address climate change and which should be promoted include the following:

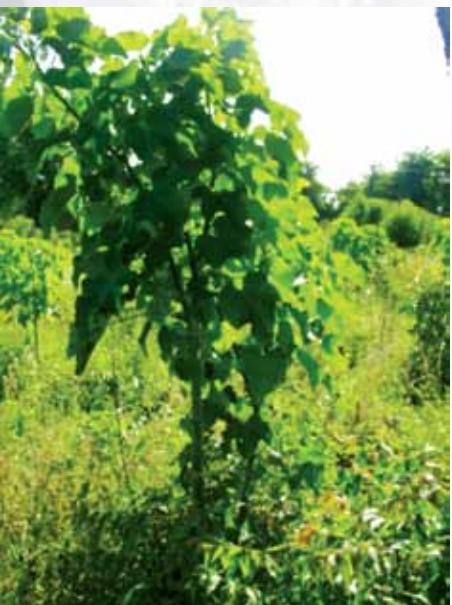
- promoting cross-breeding to produce superior tree species, i.e., those that are:
 - fast-maturing
 - heat and drought-tolerant, and
 - pest- and disease-resistant in order to enhance forest seed banks, and allow the forestry industry to counter the threat of climate change,
- initiating research to generate information to support forest management and conservation e.g. by:
 - monitoring regeneration and growth of natural forests
 - developing and demonstrating methods of natural forest rehabilitation

7.1.2 Energy

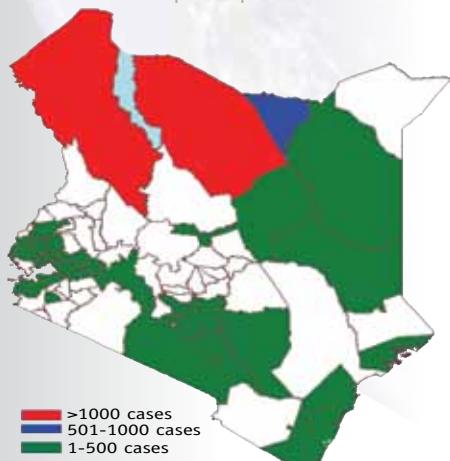
Kenya can and should undertake research in the following energy research areas that together with the transfer from and absorption of the advanced and clean energy technologies of developed, industrialised countries, will enable it avoid a high-emissions path:

- investing in research and development in renewable technologies such as cogeneration, geothermal, wind, solar, small hydro and biomass,

A *Jatropha curcas* plant from whose seeds biodiesel can be extracted. Research studies to support the sustainability of biofuels, especially those following a life cycle approach such as life cycle assessment (LCA), should be promoted. Photo by Camco Kenya



A map showing an acute diarrhoea and cholera situation in Kenya following flash floods in 2009. With the projected climate change extremes like torrential rainfalls and floods which will result in frequent water-borne diseases' outbreaks, such disease surveillance and mapping will become even more pertinent in identifying disease patterns so that appropriate measures can be taken. Map provided by the Ministry of Public Health and Sanitation during the NCCRS development process.



- proper site-species matching,
- developing technologies to rehabilitate naturally degraded areas or those cleared for charcoal burning,
- developing technologies for domestication of indigenous species,
- developing research on management of invasive species such as *Prosopis juliflora*,
- validation and integration of indigenous knowledge and technologies in woodlands management,
- market research on wood species of high market demand,
- developing on-farm efficient wood conversion technologies,
- demonstrating alternative plantation species including indigenous species,
- developing integrated strategies for the management of new insect pests,
- promoting research programmes on indigenous tree germination, growth rates and flexible forest management regimes,
- evaluating the potential for remunerating natural resource users for natural forests conservation and restoration with funds from carbon markets (e.g. under a REDD+ scheme), and
- determining the carbon sequestration capacity of various indigenous species by age, ecology, spacing and the effects of climate variables.

7.1.4 Health

In line with the recommendations of the report 'Protecting Health from Climate Change: Global Research Priorities' by the World Health Organization (2009), the following are some of the priority climate change-related health research areas that Kenya should undertake:

- assessing the risks of populations to climate change (including short and long-term public health effects of e.g. extreme weather events) using climate-disease prediction models, and identifying the most effective interventions,
- guiding health-promoting mitigation and adaptation decisions in other sectors,
- undertaking research to improve decision support in matters related to climate change impacts and health,
- estimating the costs of protecting health from climate change,
- support the use of Geographic Information Systems (GIS) to map the spatial distribution of interacting risk factors and other critical data, and to communicate research results effectively to policymakers, stakeholders and the public,
- promote research on socioeconomic implications of climate change e.g. climate change-related migration leading to high population densities in urban centres and the likely spread of infectious diseases,
- promote more research on epidemiology, laboratory science, infectious disease ecology of all diseases that are likely to become more prevalent with climate change, and
- support Kenya Medical Research Institute (KEMRI) to engage in innovative research to produce vaccines against diseases such as malaria, cholera and others whose outbreaks will intensify with climate change.

7.1.5 Water

Research on climate change-related water challenges should span hydrological systems, drinking water, wastewater and storm-water issues, and should involve:

- intensified research on hydrologic cycle predictions as these have a direct effect on the spatial and temporal distribution of

- 
- rainfall and therefore the quantity of fresh water available for domestic, commercial and industrial use,
- assessment of watersheds and water resource vulnerability due to hydrological cycle changes,
 - assessment of water quality as it relates to source and receiving waters, storage, treatment, conveyance and demand, in addition to research on adaptation and management practices to protect and manage water quality,
 - assessment of the potential impacts of climate change on water, waste-water and storm-water infrastructure – including risk exposure of key infrastructural nodes to weather extremes – and the impact of rising sea level on coastal water infrastructure, and
 - assessing the use of cost effective and environmentally friendly water purification methods e.g. using locally available natural adsorbents to purify water in drought prone ASAL regions.
- 7.1.6 Fisheries**
- Enhancing the resilience of fisheries and aquaculture systems to climate change impacts will require research in the following areas:
- supporting vulnerability assessments of aquatic, coastal and marine ecosystems to determine resilient regions and species to be accorded conservation priority,
 - evaluating current land-ocean interactions and the impact of their changes on fisheries resources,
 - assessing the socioeconomic impacts of climate change on the livelihoods of fishing and coastal communities,
 - assessing the level of awareness of climate change-related impacts among different groups e.g. local communities, resource managers, policy makers,
 - undertaking ecosystem-based monitoring of aquatic, marine ecosystems and fisheries under the major current uses, including full fisheries closures, gear-managed and open access management systems,
 - evaluating current natural resource management schemes and determine their effectiveness in adapting to the impacts of climate change and providing ecosystem services,
 - investigating the adaptation strategies of communities dependent on fisheries resources,
 - identifying policy processes and finance mechanisms that will best enable small-scale fisheries to implement adaptation measures,
 - identifying changes in yield, distributions, and markets, including agriculture and fisheries,
 - improving reporting standards and access to fisheries catch data to improve assessment of the impacts of climate change on fisheries,
 - identifying extinction-prone species, and
 - analysing of environmental consequences of shore protection and promotion of shore protection techniques.
- 7.1.7 Wildlife and Rangelands**
- Kenya's rangelands and wildlife are already being affected by climate change. With projected future climate change expected to be worse, there is urgent need to initiate research in the following priority areas to make our rangelands and wildlife resources more resilient to climate change:
- assessing current climate change threats and risks to wildlife, and vulnerability indicators:

- analyse the current climate variability in marginal rainfall areas,
- identify rainfall homogenous areas,
- identify and analyse climate risk factors,
- collect and analyse historical data on climate induced impacts in the areas,
- collect and analyse data on climate induced human disturbances in the wildlife areas,
- assess the socioeconomic dynamics and activities of the communities living in and around wildlife protected areas,
- assess the current human-wildlife conflicts,
- carry out sensitivity analysis,
- assessing future climate variability and the vulnerability of species and ecosystems to projected climate change:
 - use modelling to project future climate change in the marginal rainfall areas and other game reserves,
 - identify rainfall homogenous zones under the changed climate scenarios,
 - analyze future rainfall and temperature characteristics of the homogenous zones,
 - project future changes of the current vulnerability indicators,
 - project future changes in the socio-economic dynamics in the surrounding communities,
 - make a projection of future changes in the climate induced human disturbances in the wildlife areas under business as usual scenarios,
 - make a projection of future trends in human-wildlife conflicts,
 - identification of botanical composition of grazing animal diets; interaction of climate change and other environmental factors on invasive plant species; identification, characterisation and transfer of microbial endophytes into native plant materials to improve success of rangeland restoration, and
 - creating a National Biological Inventory and Monitoring Partnership that facilitates a more strategic and cohesive use of the conservation community's monitoring resources, and generates empirical data needed to track the impacts of climate change on the distribution and abundance of wildlife.

7.2 Technology Transfer

In the context of climate change, technology transfer is defined as '*a broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders such as governments, private sector entities, financial institutions, nongovernmental organisations and research/education institutions.*'⁴⁷

Technology transfer is one of the 'building blocks' of the Bali Action Plan (BAP), which calls for enhanced action on technology development and transfer to support action on mitigation and adaptation, including, *inter alia*, consideration of:

- effective mechanisms and enhanced means for the removal of obstacles to,

47 IPCC (2000) *Methodological and Technological Issues in Technology Transfer: A Special Report of the Working Group III of the IPCC-Summary for Policy Makers*, p.4, <http://www.ipcc.ch/pdf/special-reports/spm/srtt-en.pdf>

and provision of financial and other incentives for, scaling up of the development and transfer of technology to developing country Parties in order to promote access to affordable environmentally sound technologies,

- ways to accelerate deployment, diffusion and transfer of affordable environmentally sound technologies,
- cooperation on research and development of current, new and innovative technology, including win-win solutions, and
- the effectiveness of mechanisms and tools for technology cooperation in specific sectors.

Even though environmentally sound technology is a key means to achieving a climate-resilient/low carbon growth trajectory as well as technology transfer to developing countries being a major component of the UNFCCC, achievements in the area have been minimal. For this reason, it is obvious that technology development (in both developed and developing countries), transfer to and diffusion in developing countries to help them meet sustainable development needs should be urgently accelerated.

As required under the UNFCCC, Kenya undertook in 2005 a technology needs assessment study that highlighted Kenya's mitigation technological needs and the barriers to technology transfer to Kenya. In view of this, the following section highlights some of the channels through which technology transfer to and within Kenya may be achieved including through:

- the Kyoto Protocol's CDM or its future successor,
- the United Nations Industrial Development Organization (UNIDO),
- accelerating South-South transfer of technology,

- accelerating North-South transfer of technology through Foreign Direct Investment (FDI) including taking advantage of 'free-patent' technologies,
- development partner initiatives,
- establishment and capacity enhancement of local technological innovation centres which will help strengthen institutional technology generation and transfer through learning-by-doing approach,
- technology transfer within a future climate change agreement framework, and
- including climate change research and development in all budgets of Ministries with substantial allocations to institutions of higher learning to strengthen research capacities.

7.2.1 Technology Transfer through the CDM or its Future Successor

The CDM does not have an explicit technology transfer mandate but it usually leads to such, i.e., to the transfer of clean technologies from developed countries to developing countries. If the technology to be used in a CDM project is not available in the CDM host developing country, the technology must be imported. This is often from a developed country where such technologies exist; hence, the project leads to a technology transfer. This technology may consist of 'hardware' elements such as machinery and equipment involved in the production process, and/or 'software' elements including knowledge, skills and know-how.

The CDM or its future successor therefore, presents great opportunities for developing countries like Kenya to access advanced climate-friendly technology that has so far only been developed and used in developed countries like the USA, France, Germany, Japan, and the UK. In the UNFCCC's 2008 report on CDM, about 36% of 3,296 registered and proposed CDM projects involve technology transfer according to claims made by project

The CDM or its future successor presents great opportunities for developing countries like Kenya to access advanced climate-friendly technology that has so far only been developed and used in developed countries like the USA, France, Germany, Japan, and the UK.

participants in their project design documents (PDDs). The report lists Kenya among developing countries whose rate of CDM technology transfer is **significantly higher** than the average.

Areas of opportunities for technology transfer under the CDM for Kenya include:

- bagasse-based cogeneration projects e.g. the Mumias Sugar Company Cogeneration Project,
- landfill gas waste management, which is still an untapped CDM potential in Kenya,
- efficient hydroelectric power generating equipment to replace the old technology currently in use,
- wind power generation, which has huge potential in northern parts of the country,
- geothermal power generation technologies,
- energy efficiency technologies,
- technologies that remove industrial GHG such as perfluorocarbons, hydrofluorocarbons, etc, and
- innovative agricultural (land-use) technologies that reduce GHG emissions while delivering economic benefits to poor communities, among others.

7.2.2 Technology Transfer through UNIDO

The UN report *Acting on Climate Change: the UN System Delivering as One* (2008) identified UNIDO as one of the UN bodies through which coordination of the transfer of clean technology to the developing world can be facilitated. UNIDO's role as a host organisation for the Cleaner Production (CP), which was created to foster environmentally sound production and consumption in developing countries, also makes it a suitable channel for transfer of technology. Kenya has an active Cleaner Production centre, the Kenya National Cleaner Production Centre (KNCPC). Some of

the past and ongoing mitigation programmes of the KNCPC include those in industrial energy management and CDM opportunities, as well as waste minimisation with tandem methane reduction, among others.

7.2.3 Accelerating North-South Technology Transfer

Most climate-friendly technologies have so far been developed and used in developed countries, from where they are expected to transfer to developing countries through well-known channels including trade, foreign direct investment (FDI) and cross-border technology licensing. In order to attract these technologies, the Government needs to tackle barriers that have and continue to hinder FDI in the country. These include insufficient human capabilities, high transaction costs, trade and policy barriers as well as institutional limitations such as weak intellectual property protection laws and enforcement.

The FDI remains the major channel of technology transfer to developing countries like Kenya, and Kenya's private sector can therefore play an important role. Indeed, the world corporate sector, essentially the World Business Council on Sustainable Development (WBCSD), has realised the role it can play in helping developing countries grow sustainably. In 2008, the WBCSD formed the Eco-Patent Commons initiative to encourage the sharing of patents that provide environmental benefit but do not represent an essential source of business advantage. This sharing of environmental patents 'can promote environmental sustainability including eco-efficiency, enabling technology innovation to meet social innovation' (WBCSD, 2008). It is in such initiatives where the private sector in Kenya needs to get involved to support the transfer of advanced technologies of developed countries to Kenya.

7.2.4 South-South Technology Transfer

Technologies to support adaptation to climate change is an area that the international discourse on climate change technology transfer (CCTT) has not dealt with much. Despite

the fact that adaptation to climate change is a primary concern of Kenya, the *Technology Needs and Needs Assessment – Kenya 2005* report did not capture technologies needed to adapt to climate change due to what it termed as ‘insufficient resources.’ To bridge this technology gap, greater collaborations with and learning from other developing countries is therefore essential.

South-South technology transfer can be used to solve food insecurity and disease problems now exacerbated by climate change elements. Moreover, according to the UNFCCC, 2006,⁴⁸ ‘crop and animal varieties are sensitive to local conditions and therefore much of the technology transfer in this area is expected to take place between regions with similar agro-climatic conditions.’ Essentially, this means that agricultural technology transfer is expected to flow between and among countries in the southern part of the globe because of their ‘similarities’ in agro-climatic conditions.

South-South technology transfer was successfully tested as early as the 1960s during the Green Revolution, when semi-dwarf wheat varieties, originally developed in Mexico, were transferred to India, which also benefited from infusions of germplasm collected by the International Rice Research Institute (IRRI) from other parts of Asia (G.B.Chettri, 2003). Therefore, South-South and even North-South technology transfer pathways can enable the transfer of the following adaptation technologies, among others to Kenya:

- agricultural technologies e.g. appropriate biotechnologies, bio-pesticides, and soil management techniques,
- cost effective early warning systems,
- low-end energy systems including affordable solar lighting systems,
- waste management technologies (re-

cycling, re-use including as an energy source),

- water resource protection and harvesting, and
- water purification systems.

7.2.5 Development Partners’ Initiatives

To help developing countries meet their sustainable development needs, certain developed countries have established funding facilities to facilitate the transfer of their advanced technologies to low-income economies. A good example is the Nordic Climate Facility (NCF), which was created within the Nordic Development Fund (NDF) of the five Scandinavian countries – Norway, Denmark, Finland, Sweden and Iceland. The NCF finances projects that have a potential to combat climate change and reduce poverty in low-income countries such as Kenya. These include energy efficiency, water resource management, solar technologies, etc.

7.2.6 Establishment and Capacity Enhancement of Local Technological Innovation Centres

Kenya should establish and fund local technological centres that can be used to develop, advance and disseminate local technologies. Such centres can be used for educational purposes (e.g. train local communities on early warning systems), and to promote sustainable agricultural practices, enhance the growth of indigenous small and medium enterprises (SMEs).

The core aim of technology transfer is to help facilitate sustainable development in developing countries, and this can only be achieved by **developing indigenous innovation capabilities** in developing countries, i.e. the capabilities to adapt, develop, deploy and operate clean technologies effectively within specific developing country contexts. Further, empirical evidence suggests that incremental

48 UNFCCC, 2006. Technologies for adaptation to climate change, http://unfccc.int/resource/docs/publications/tech_for_adaptation_06.pdf

and adaptive innovation processes within developing countries facilitate the diffusion and development of technologies.⁴⁹ This requires sufficient innovation capabilities amongst developing country firms, universities and research institutes, and appropriate links with public sector actors including production sectors.⁵⁰

This sufficient innovation capability amongst developing countries could be realised through:

- providing an opportunity for competent personnel to train others on new technologies, and encouraging local and regional institutional partnerships in technology development and transfer. Local academic and research institutions are already undertaking this. However, their capacity should be enhanced,
- ensuring and encouraging equal representation of men and women in technology development, training and transfer,
- providing incentives to local innovators e.g. awards for best technologies,
- establishing forums for students' participation in technological development e.g. through professional student bodies such as Engineering Students' Associations, Physics Students' Associations etc. These institutions should be holding forums where the best science and engineering innovators are awarded, with the corporate sector playing a sponsorship role, and

- establishing linkages between the private sector (production centres) and local research and academic institutions to develop and commercialise local technologies and innovations.

7.2.7 Technology Transfer within a Future Agreement Framework

It appears that a consensus is emerging on several elements of a future deal on a technology framework. Notably, Parties to the UNFCCC seem likely to agree on the establishment of a technology body in the future climate change agreement, although the structure, mandate, name and funding of the proposed mechanism remain unclear. The creation of a technology body has been supported in particular by developing countries, specifically the G77 and China group, which proposed the establishment of a technology mechanism, comprising an Executive Body and a Multilateral Climate Technology Fund (MCTF), both subsidiary to the COP.

Non-Governmental Organisations have also supported the establishment of new institutions, with some proposing a mechanism dealing specifically with technology and others proposing a general mechanism for mitigation, adaptation, technology related measures and funding.⁵¹ The recent creation of a 'Technology Mechanism' within the Copenhagen Accord, which is yet to be adopted, gives the strongest indication ever that such a mechanism will one day exist. Kenya should place itself strategically - in terms of building the necessary capacities and identifying priority areas in which it can benefit from technology transfer through such a mechanism.

49 Ockwell David and others (2009): *Fulfilling the United Nations Framework Convention on Climate Change (UNFCCC) Bali Action Plan: Maximising the impact of low carbon technology transfer*. University of Sussex

50 Juma C. (2006): *Re-inventing African Economies-Technological Innovation and the Sustainability Transition*. The John Pesek Colloquium on Sustainable Agriculture

51 Christiane Gerstetter and Dominic Marcellion. *The Current Proposals on the Transfer of Climate Technology in the International Climate Negotiations*. Ecologic Institute, Washington D.C., November 2009

8

Climate Change Governance

8.0 Climate Change Governance

Climate change governance in this context is interpreted to refer to climate change policy, legal framework and institutional/organisational framework.

8.1 Climate Change Policy

Kenya's need to develop a suitable climate change response strategy including a suitable climate change governance framework should stem from both the realities of the negative impacts of climate change and from obligations placed upon it by the UNFCCC and Kyoto Protocol. It should be Kenya's position that any climate change action taken is not just to meet its international obligations, but more importantly to address climate change problems that have already been recognised to affect it and its people.

Kenya has a number of environment-related policies governing various environmental sectors including the *Wildlife Policy (Sessional Paper No. 3 of 1975)* and *Food Policy (Sessional Paper No. 3 of 1993)*, but these hardly recognise climate change as a serious threat and problem. The closest Kenya ever came to developing a comprehensive environmental policy was with the drafting of *Sessional Paper No. 6 of 1999 on Environment and Development*. However, this policy paper does not adequately recognise climate change, and adaptation and mitigation are not addressed. The only policy that has attempted to address climate change to some extent is the draft National Environmental Policy of 2008.

- A comprehensive policy on climate change should therefore be formulated in line with the UNFCCC's requirement of Parties. Such a policy coupled with a related legislation proposed in section 8.2 below would support implementation of the NCCRS comprehensively and effectively.

8.2 Appropriate Legal Framework

A legal framework is the foundation for an effective policy. Being a purposeful statement by a government expressing its recognition of a problem and stating its commitment to address a problem through specified actions, one of the key functions of policy is to advise and direct the government and the governed on necessary actions to address identified problems. However, given that policy is not binding, there would be no legal consequence on a government or a people for failing to implement their policy. Thus, every policy should be translated into law for effective implementation but a law has other functions that ought to be well understood.

These key points inform the need for an appropriate climate change legal framework in Kenya:

- law provides legitimacy for actions (programmes and activities) to address the problem(s) whose resolution may otherwise be unacceptable,
- law sets goals that a society desires to accomplish in light of a recognised problem,
- law is the only acceptable tool in regulating human behaviour and conduct, and
- law has official sanctions and can ensure compliance.

Currently, there are a number of sectoral laws – including the new *Forests Act (2005)*, *Agriculture Act (Cap 318 of Kenyan Laws)* – which address various aspects of climate change, even though climate change is not the focus of the laws. Provisions of such laws ought to be carefully analysed and reviewed to determine which ones may be strengthened

to facilitate climate change mitigation and adaptation in related sectors. In addition, there is a comprehensive environmental law – the *Environmental Management and Coordination Act (EMCA, 1999)* – which has relevant provisions for mitigation against climate change. These include provisions for the establishment of air quality standards together with emissions requirements (Part VIII), environmental impact assessment requirements (Part VI), environmental restoration orders and environmental conservation orders (Part IX).

However, EMCA, 1999 does not effectively address several climate change issues including:

- development of national inventories of anthropogenic emissions of GHG in Kenya by source and removal of GHG by sinks,
- national framework for carbon finance,
- development of national and regional programmes to mitigate climate change by addressing anthropogenic emissions by source,
- promotion of education, training and awareness on climate change; appropriate technology transfer arrangements and their authorisation, and
- access to environmentally-sound technologies.

For this reason, there ought to be a law that provides legitimacy for all climate change activities including necessary actions intended to mitigate against climate change such as provisions authorising carbon trading. The way to arrive at this law could be through:

- strengthening existing EMCA provisions to adequately provide for climate change adaptation and mitigation measures agreed in the UNFCCC and its Kyoto Protocol, and/or
- developing a new legislation on climate change, in which case, the National En-

vironment Management Authority (NEMA) should take the lead as Section 124 of the EMCA 1999 obligates NEMA to initiate legislative proposals for the purpose of giving domestic effects to international agreements to which Kenya is a Party. Although the making of a new legislation may be time-consuming and expensive, it may, given the current circumstances in Kenya, be the better option.

8.3 Institutions Governing Climate Change

Between 2008 and 2009, the Ministry of Environment and Mineral Resources (MEMR) established its Directorate of Environment (DOE) headed by an Environment Secretary. The DOE has 3 directorates covering:

- Policy Formulation, Interpretation and Implementation,
- Programmes, Projects and Strategic Initiatives, and
- Multilateral Agreements.

Within the DOE, MEMR also established in 2009 its National Climate Change Coordinating Office. This office now acts as the Secretariat for the **National Climate Change Activities Coordinating Committee (NCCACC)** established in 1992 as a requirement under the UNFCCC. Membership of the NCCACC is drawn from line ministries, academia and research institutions, Non-Governmental Organisations (NGOs) as well as the private sector.

Further, under the oversight of MEMR, the National Environment Management Authority (NEMA) hosts the country's Designated National Authority (DNA), which is responsible for approving the CDM projects under the Kyoto Protocol.

In the context of the UNFCCC, the Ministry is the focal policy making entity responsible for international negotiations while NEMA, as has been mentioned, hosts the country's DNA.

Still under the oversight of MEMR, the Kenya Meteorological Department (KMD) is mandated to provide meteorological and climatological services to the country for the benefit of all sectors and the public in general. Climate research and monitoring are also some of KMD's responsibilities.

In addition, there is a Climate Change Coordination Unit (CCCU) at the Office of the Prime Minister, whose aim is to provide high-level political support to climate change activities in Kenya.

Confounding the situation further is the need for the Ministry of Foreign Affairs to infuse international environment diplomacy on climate change and other similar Multilateral Environment Agreements. The inter-weaving of diplomacy, policy, politics and practice is particularly challenging in the case of a cross-cutting issue like climate change. This confounding situation is not peculiar to Kenya. Most African countries are yet to streamline climate change governance,⁵² a factor that has contributed to weak engagements in international negotiations on climate change and country-level effectiveness of climate change programmes and projects.

Because of its diffuse nature, the existing institutional arrangement has not supported a coordinated approach to combating climate change. This therefore calls for a focused and functional climate change governance system – guided by appropriate policies and legislation arrangements – that will among other things, facilitate the implementation of this Strategy.

8.3.1 Proposed Climate Change Governance Structure

In determining an appropriate institution, there ought to be careful consideration of:

- the Government's obligations towards meeting GHG emissions reductions as well as adaptation and other mitigation measures – Article 4 and 12 of UNFCCC and Kyoto Protocol,
- what the relevant national laws (in this case *EMCA* 1999) says about such an institution,
- institutions that already conduct climate change activities and what they do, and
- plausible effective options.

It is important that the package of activities needed to combat climate change be anchored within a policy and legal framework (as described in Sections 8.1 and 8.2 above) that enables Kenya to meet its long-term development goals while fulfilling its global obligations towards combating this problem. A dedicated climate change institution is important as it establishes a coordination instrument which ensures that all cross-sectoral activities match the overall vision of the NCCRS – **a prosperous and climate change resilient Kenya**. Emphasis should be laid on low carbon development strategies.

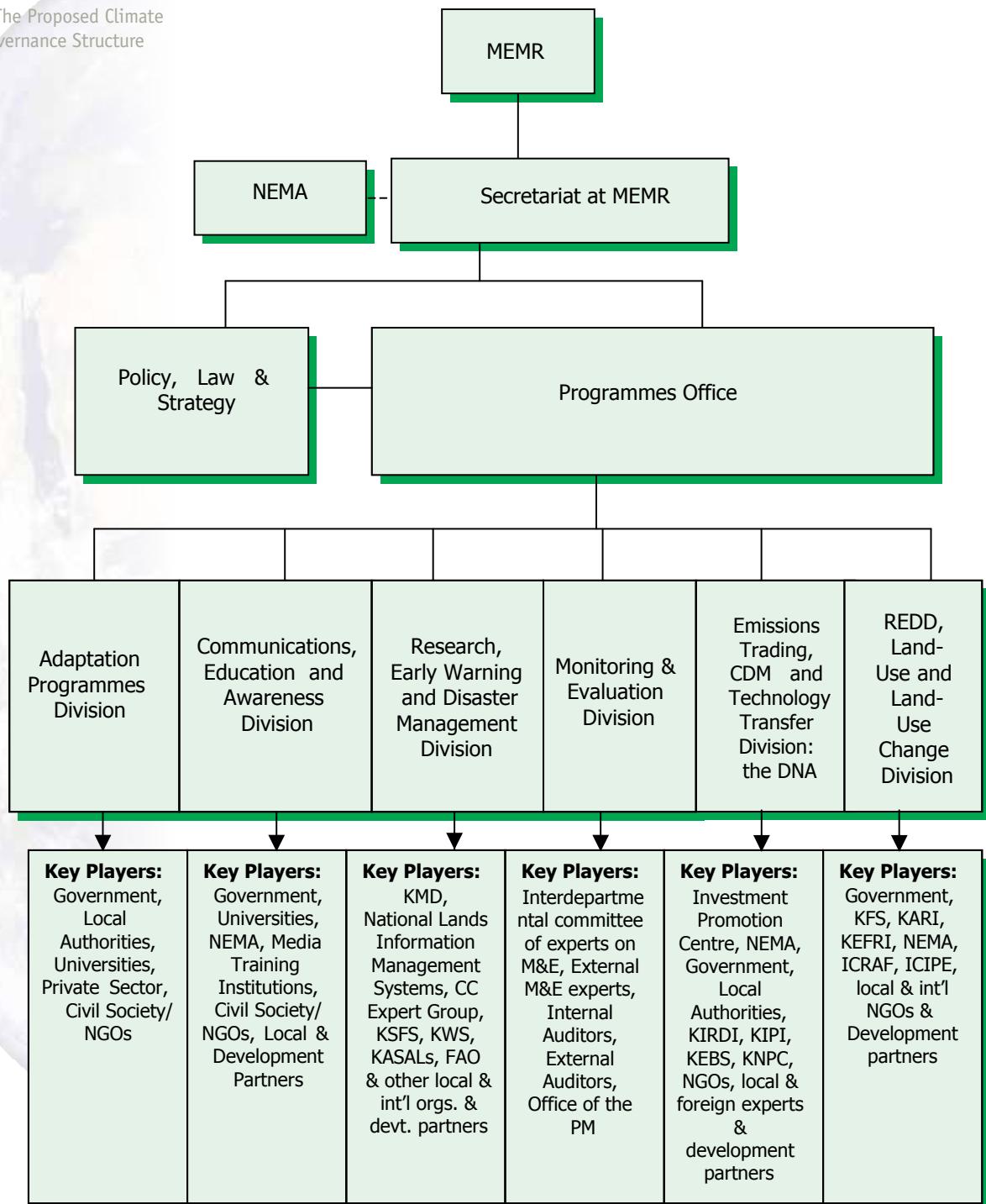
In view of this, it is proposed that:

- a dedicated and adequately resourced **Climate Change Secretariat⁵³** be established within the Ministry of Environment and Mineral Resources, with several offices and divisions as shown in figure 5 on the next page,
- a **National Climate Change Steering Committee (NCCSC)** be established by MEMR to help it gather and collate input and advice from key climate change stakeholders for its use in the coordination of Kenya's climate change activities, and
- the **NCCACC** will continue to serve in its current advisory capacity.

⁵² Kaudia A. A (2010). *Governance And Institutional Arrangements For Climate Change Mitigation. A Discussion Paper Presented to Regional Course Participants*. Kenya Forestry Research Institute. March, 2010

⁵³ For more information on other plausible options, refer to the institutional paper developed as part of this Strategy

Figure 5: The Proposed Climate Change Governance Structure



The Climate Change Secretariat to be established at MEMR will provide secretarial functions for the two committees (NCCACC and NCCSC). The IPCC focal point based in KMD will augment the NCCACC and strengthen its scientific advisory capacity.

8.3.2 Functions of Various Offices and Divisions

8.3.2.1 Climate Change Secretariat at the MEMR
This shall be constituted by the MEMR and shall have officers – co-opted from within and outside the public sector – with expertise in climate change matters and can therefore add value to the coordination of the implementation of this Strategy and other climate change activities. The Permanent Secretary in the MEMR shall determine the composition and specific structure of this secretariat, which shall receive and collate inputs from the players and stakeholders involved in the implementation of this Strategy and ensure that activities implemented by other ministries are undertaken in a timely manner and conform to this Strategy's implementation plan.

8.3.2.1.1 Policy, Law and Strategy Office
This office of the Secretariat shall comprise key government agencies with policy- and law-related functions including the Office of the Attorney General and key NGOs. It shall, in conjunction with NEMA, initiate all necessary policy, legal, strategy and planning processes, and promote and cooperate on legal information on matters related to climate change. This office shall also play a key role in international climate change negotiations, as well as work with other government agencies to phase out subsidies that contravene the objectives of the UNFCCC.

8.3.2.1.2 Programmes Office
This office shall serve as the central administrative office for all climate change programmes, with focal points (representatives) in each programme division. In addition, it shall serve as the liaison office between the programme divisions and the Secretariat. Its divisions or departments shall be:

- a Designated National Authority (DNA), responsible for carbon emissions/CDM trading and technology transfer under the Kyoto Protocol or its future successor,
- a REDD and Land-Use Division,
- an Adaptation Programmes Division,
- a Communications, Education and Public Awareness Division,
- a Research, Early Warning and Disaster Management Division, and
- a Monitoring & Evaluations (M&E) Division.

This office shall coordinate the functions and activities of various Programme divisions to ensure that all of them work towards achieving the overall aim of reducing the country's GHG emissions, and will take responsibility for administrative matters of the programmes in collaboration with the Programmes divisions. In addition, it should also be the office to develop appropriate climate change mainstreaming strategies and action plans for all key sectors, and ensures mainstreaming of climate change adaptation and mitigation measures in ongoing and future activities of all key sectors.

Functions of the proposed divisions of the Programmes Office include the following:

a) Emissions Trading, CDM and Technology Transfer Division: the DNA

This will be the national focal point (Secretariat's division) responsible for CDM projects, i.e. it will be the DNA. Core functions of this division shall be to:

- develop a practical CDM implementation strategy including human and technical requirements,
- establish national infrastructure to enable investments in CDM and other emissions reduction projects in the country including voluntary carbon markets,

- undertake technology needs assessment in the country and develop mechanisms for the transfer of environmentally-friendly technologies in strategic areas,
 - facilitate the creation of enabling environments for CDM and technology transfer by e.g. increasing the cost-effectiveness of emissions reduction measures and duly clarifying the ownership of emission reductions generated by CDM projects,
 - collaborate with local and external partners to implement collaborative activities aimed at increasing the use of mechanisms and devices that emit less GHG,
 - record and report progress in carbon investment and emissions reductions mechanisms through CDM,
 - regularly communicate effectively with potential project developers, development partners, investors and decision makers within the Government,
 - establish a fund for CDM,
 - undertake CDM project development, approval and management,
 - promote renewable energy mechanisms including energy efficiency,
 - confer with UNFCCC's Expert Group on Technology Transfer,
 - document current and ongoing CDM and other emissions reduction projects to be brought under the programme,
 - coordinate and supervise ongoing CDM and other emissions reduction activities to ensure that they are in line with and contribute towards meeting the county's environment and sustainable development goals as well as Vision 2030,
 - establish and maintain a project database and keep track of emerging, proposed and approved CDM and other emissions reduction projects, and
 - strictly monitor, account for and report to the M&E division on CDM activities, their success and challenges.
- In addition, this division shall oversee an inventory of GHG emissions in Kenya by source and location through:
- measuring anthropogenic GHG emissions by source, location and quantity,
 - developing a national inventory of GHG emissions,
 - establishing inventories of forests and other ecosystems that absorb GHG, and
 - providing periodic emissions reports to the M&E office on GHG emissions, status of carbon sinks and emissions trading.
- b) REDD, Land-Use and Land-Use Change Division**
- This division will be in charge of all activities related to REDD, REDD+, Land Use and Land Use Change, and will:
- develop monitoring, reporting and verification (MRV) institutional arrangements – clear credible national forest monitoring baselines and guidelines,
 - offer options to fill the historical data gaps on forest cover,
 - address the risk of non-permanence and leakage as a necessary condition for any Parties or entities to participate in a REDD mechanism and activities,
 - facilitate fundraising for financial support, technology transfer and provisions for capacity building, and
 - recommend joint action involving both the public and private sectors in order to mobilise the necessary finance and accelerate REDD actions.

c) Communications, Education and Awareness Division

In order to increase climate change awareness in Kenya, a climate change Communications, Education and Awareness division shall be created within the Programmes Office with the following functions:

- set communication goals including community empowerment on mitigation and adaptation measures,
- develop and implement a programme for communication of information on climate change, with plans and appropriate procedures for communication,
- develop tools for effective outreach, training and capacity building on climate change,
- collaborate with learning and training institutions and civil society organisations to disseminate climate change information,
- simplify climate change terminology for ease of communication and local understanding,
- collaborate with media houses to disseminate information on climate change, and
- promote and cooperate in education, training and public awareness on climate change matters, encouraging the widest participation in this process.

d) Adaptation Programmes Division

Since adaptation is a priority concern of developing countries including Kenya, this division shall equally be of paramount importance not only to the Programmes Office but also to the country as a whole. Its functions shall include:

- identify priority adaptation measures,
- develop and support implementation of plans and projects for adaptation to

climate change in various key sectors in consultation with line ministries and other stakeholders,

- develop procedures for evaluating and approving climate change adaptation projects related to land use and land use change,
- activities including flood control,
- formulate, implement and promote programmes for reduction of GHG emissions including conservation of forests,
- promote sustainable forms of agriculture, and
- periodically report on national measures to promote climate change adaptation to the Secretariat.

e) Research, Early Warning and Disaster Management Division

This division shall work in collaboration with other scientific agencies including the KMD. It will be responsible for all matters concerning climate change science and research. It shall:

- undertake climate and weather research include climate modelling,
- assess climate change threats and risks at national and local levels,
- identify vulnerable communities and groups in order to propose specific sectoral adaptation or cross-sectoral adaptation measures,
- develop concrete plans for systematic research on climate change and related phenomena,
- develop infrastructure for and disseminate scientific information,
- develop effective early warning systems and issue warnings on likely disasters related to climate change,

- develop and promote implementation of disaster management programmes,
- publish research results and disseminate widely,
- work closely with the Intergovernmental Panel on Climate Change (IPCC) and United Nations Environment Programme (UNEP),
- promote scientific and technical cooperation on matters related to climate systems and climate change, and
- advise the Climate Change Secretariat, through the Programme Office, the Government and the public on matters of science, technology and methodology in relation to climate change.
- strictly monitor the implementation of all climate change activities in collaboration with the respective offices and the Secretariat,
- in collaboration with experts, evaluate each programme activity at inception and completion to provide balanced decisions and views on success, failures (if any) and opportunities for improvement,
- assess and review the viability, methodology and outcomes of all climate change programmes,
- support the development of relevant policies, laws, rules, regulations and standards in relation to climate change activities, and
- present periodic reports on the activities to the respective programme divisions within the Programmes Office and to the Secretariat.

f) Monitoring and Evaluation Division

This division shall work closely with specialists, officers implementing programmes, and the Secretariat in all of its functions. Its responsibilities shall be to:



9

Action Plan, Implementation Framework and Resource Mobilization Plan

9.0 Action Plan and Resource Mobilisation Plan

9.1 Action Plan and Costs

From Chapters 4 to 8, the Strategy has outlined sectoral adaptation and mitigation interventions, communication and awareness programmes, capacity building, research and development, and climate change governance. The summarised action plan presented in Table 3 outlines specific activities, their

timeframe, and estimated cost. The estimates were generated by Ministries as part of climate change project concepts they submitted to the Ministry of Environment and Mineral Resources (MEMR) during preparation of this Strategy. The main Action Plan detailing projects and programmes' implementers, activity costs, and implementation timeframe is provided in the Annex.

Table 3: Annual Budget for Climate Change Projects and Programmes (2009 estimates)

Sub-sector/Ministry	Annual Cost. Ksh. Billion
Productive Sector	76.96
Agriculture	10.60
Tourism	0.04
Marine & Fisheries Resources	2.52
Forestry and Wildlife	32.26
Environment & Mineral Resources	7.39
Cooperative Development and Marketing	0.15
Regional Development Authorities	24.00
Physical Infrastructure & Service Industry	111.52
Energy Sector	73.71
Water & Irrigation	5.96
Roads (maintenance)	20.00
Transport Sector (devt. of BRT and LRT)	11.85
Manpower	37.45
Youth Affairs and Sports	2.75
Gender, Children & Social Development	2.70
Special Programmes (Famine and DRR)	32.00
Education	7.90
Health (Public)	1.30
ICT	0.70
Grand Total (Approx)	235.83

9.2 Resource Mobilisation Plan

The purpose of the Resource Mobilisation Plan is to ensure proposed programmes and projects are fully implemented. The Plan targets domestic resources from both local and national government as well as from the private sector. In addition to international funding agencies such as the World Bank and International Monetary Fund (IMF), the Mobilisation Plan also covers external resources from development partners and regional funding agencies such as multilateral development banks e.g. the African Development Bank (AfDB). The Plan covers a duration of 20 years, coinciding with the country's Vision 2030 and the initial five years coinciding with the Millennium Development Goals (MDG) fulfilment.

9.2.1 Devolved Domestic Funds

There are two types of devolved funds in Kenya that can benefit climate change response programmes. These are the Local Authority Transfer Fund (LATF) and the Constituency Development Fund (CDF). LATF comprises 5% of the national income tax collected annually and is estimated to constitute about 24% of local authority revenues. At least 7% of the total fund is shared equally among the country's local authorities. Approximately 60% of the Fund is disbursed according to the relative population size of the local authorities while the remainder is shared out based on the relative urban population densities. The LATF monies are combined with local authority revenues to implement local development priorities.

The CDF on the other hand was established to correct imbalances in regional development in the country. It targets all constituency-level development projects, particularly those aimed at combating poverty at the grassroots. The Fund comprises an annual budgetary allocation equivalent to 2.5% of the Government's ordinary revenue. 75% of the Fund is allocated equally amongst all 210 constituencies while the remaining 25% is allocated according to constituency poverty levels. Each constituency

is required to set aside 5% as an emergency reserve. Approximately 2% of the funds are ear-marked for constituency-level environment activities.

Combating climate change as depicted by the indicative costs in the Action Plan mentioned above is a high-investment undertaking, hence the need to include these two sources – LATF and CDF – in order to have great impact at local level especially in dealing with climate-related emergencies.

9.2.2 National Adaptation Facility (NAF)

National planning on climate change adaptation has been located in two exercises under the UNFCCC in developing countries – National Communications (NCs) and National Adaptation Programmes of Action (NAPAs) for Least Developed Countries. Other exercises to build capacity, such as through assessments have produced a wealth of information to support adaptation planning.

Prior to establishing a significant funding source for climate change adaptation and mitigation (e.g. from the recently created 'Finance Mechanism' under the Copenhagen Accord) there is a need for national governments to establish a coordinated strategy and operational capacity for accessing this Fund. For mitigation (specifically CDM), a Designated National Agency is required, and guidelines are available on what is expected. This is not the same for adaptation.

Adaptation is more closely aligned to development baselines and is operationally spread across many actors on all levels and linked to global climate policy through more channels than just the UNFCCC. Guidelines for mainstreaming adaptation were initially developed by the UNDP in the Adaptation Policy Framework and more recently by OECD and several NGOs (see weADAPT.org for an inventory and comparison of adaptation guidelines). It is worth noting that these guidelines, however insightful, are simply voluntary.

Currently, discussions in the Adaptation Fund Board include the nature of entities that would qualify for funding, the role of national coordination, and capabilities required for monitoring, reporting and verification. Even though the form of a national adaptation strategic and implementing entity has not yet been elaborated in the UNFCCC, an entity such as a National Adaptation Facility (NAF) will be necessary in future. A National Adaptation Facility or Authority should therefore be established to enable mobilisation and consolidation of resources from multiple sources. In developing such a capacity, there are many options that must be based on the unique structures of national government and civil society. The term "authority" is open in that where a cross-sectoral, multi-stakeholder capacity is required it might involve a single 'authority' or 'agency' or a multi-party structure with operational capacity that might be termed 'facility', 'hub' or 'partnership.' It will also require consultative and governing structures (i.e. advisory committee, council, board, governing body) and funding will be vital to its success. A pilot fund⁵⁴ is suggested for gearing up a broad effort, preparing sound project proposals and mobilising stakeholder engagement.

The NAF should be anchored on a national policy and legal framework that sets out the key aims and processes with the policy framework then translated into sectoral objectives, targets and performance indicators. While all sectors and regions will be exposed to climate change, early action should be focused with the Strategy recognising regional requirements and the urgent needs of vulnerable socioeconomic groups.

The mobilisation of knowledge is required over the medium term with the consideration of questions including: What will you want to know in five or ten years time in order to plan effective action? What level of institutional competence exists now? What level is achievable within the next five years? It is also important to define institutional competence in measurable terms such as organisational mandate, staffing, resource budgets, information systems, pilot actions, even sectoral leadership and local champions. Effective monitoring and evaluation will test the achievements of interventions undertaken to reduce future climate impacts, and public accountability will be essential.

A multi-stakeholder financial facility for mobilising early actions on adaptation and learning may be a desirable feature of the National Adaptation Facility. Such a pilot fund would not supplant the larger stream of funding from national budgets or international projects. The governance of the facility will need to consider effective decision-making for rapid responses, accountability and representation of multiple stakeholders, transparency in allocating funds as well as effective reporting to enable an analysis of what works.

9.3 Monitoring and Evaluation

Monitoring and evaluation activities will play an important role in ensuring an effective implementation of the project activities identified in the NCCRS. These functions will be performed by the Monitoring and Evaluation division of the Programmes Office as explained in Chapter 8.

⁵⁴ The choice of the denotation 'pilot fund' is deliberate, as 'facility' and 'trust fund' imply a much larger capacity

10

Recommendations and Conclusions

It is undeniable that climate change is currently affecting Kenya. Droughts and floods have become frequent and intense and the country has also seen an increase in average temperatures, hotter days, colder nights, successive crop failures and the spread of vector-borne diseases such as malaria to places where the disease is not known to be endemic. These climatic changes affect resources critical to the health and prosperity of Kenya. For example, the 1999/2000 La Niña droughts resulted in 4.7 million Kenyans facing starvation, while according to unofficial reports, the effects of the 2006-2009 successive drought episodes caused 10 million people - over a fourth of the country's population - to starve.

As global GHG emissions are continuing unabated, climate change impacts are likely to intensify an already precarious situation into the future. If no action is taken to reduce or minimise expected impacts from climate change, the costs to society and the economy will be immense. The Strategy therefore identifies the sectors that are most vulnerable to climate change impacts and proposes interventions to reduce or mitigate these impacts, while promoting a low-carbon economy and climate change-resilient production systems. In addition, the Strategy proposes the establishment of a dedicated climate change secretariat that will oversee its implementation.

Activities identified in the Action Plan require substantial additional and adequate financial resources for their implementation, and funding is therefore required from both internal and external sources. Given the importance of adaptation, it is recommended that the Kenyan Government create a multi-stakeholder National Adaptation Facility (NAF) for mobilising resources for adaptation activities.

All stakeholders should mainstream climate-proofing and climate change responsive activities in their programmes and projects. In achieving this, most line ministries particularly those offering development and infrastructural services have developed climate change response programmes and projects, which form and are included in the Action Plan of this Strategy.

While Kenya stands to benefit immensely from the advanced technology of developed countries, efforts should be made to support local technology generation and application through institutional capacity building programmes. Consequently new and additional resources are needed to support Kenya's research, development as well as strengthen academic institutions



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Annexes

10.1 Annex: Action Plan and Costs

Sector	Sub-Sector	Description of Specific Activities	Implementing Institutions	Implementation Timeframe	Resource requirement per year (Billion Ksh.)
Health	Public Health	Construction of more health facilities including setting up 40 nomadic clinics	Min. of Public Health and Sanitation, Min. of Medical Services, Bilateral partners, Private sector	20 years	0.22
		Strengthening disease surveillance support systems	KEMRI, Min. of Public Health and Sanitation, Min. of Medical Services, Bilateral partners, Private sector	20 years	0.14
		Establishing clear linkages and instrumentation required for efficient dissemination up to District level	KEMRI, Min. of Public Health and Sanitation, Min. of Medical Services, Bilateral partners, Private sector	20 years	0.05
		Strengthening Health Systems Governance through employing additional employment, implementation of policies and guidelines; and improving logistics and supply systems	KEMRI, Min. of Public Health and Sanitation, Min. of Medical Services, Bilateral partners, Private sector	20 years	0.43
		Strengthening Public Health Education and Health Promotion programmes (social access) to reduce vulnerability	KEMRI, Min. of Public Health and Sanitation, Min. of Medical Services, Bilateral partners, Private sector	20 years	0.43
		Improving access to water and Sanitation, e.g. through the demonstration of ECO-SANITATION Technologies, protecting wells and springs, encouraging rain water harvesting, and promotion of proper storage of domestic water	KEMRI, Min. of Public Health and Sanitation, Min. of Medical Services, Bilateral partners, Private sector	20 years	0.25
		Addressing childhood malnutrition through enhanced feeding programmes, microteaching during clinical visits and purchase & supply of pediatric mixes, Vitamin A and other Vitamins supplements	KEMRI, Min. of Public Health and Sanitation, Min. of Medical Services, Bilateral partners, Private sector	20 years	0.03

Sector	Sub-Sector	Description of Specific Activities	Implementing Institutions	Implementation Timeframe	Resource requirement per year (Billion Ksh.)
		Prevention of immunizable diseases through enhanced awareness campaigns focusing on households, mothers and children; procuring vaccines and procurement of additional cold-chain storage facilities	KEMRI, Min. of Public Health and Sanitation, Min. of Medical Services, Bilateral partners, Private sector	20 years	0.08
		Capacity building of Public Health personnel through training technical staff	KEMRI, Min. of Public Health and Sanitation, Min. of Medical Services, Bilateral partners, Private sector	20 years	0.01
		Strengthening Research and other medical Laboratory Capacity through investing in level 2 and 3 facilities, training in instrumentation, and construction of additional laboratories	KEMRI, Min. of Public Health and Sanitation, Min. of Medical Services, development partners, Private sector, research and academic institutions	20 years	0.03
Sub-total					1.3
	Productive Agriculture	Increasing the acreage under irrigated agriculture	MOA, Private Sector, Development Partners	20 years	5.2
		Investing in water harvesting programme, e.g. construction of water pans	MOA, Private sector, NGOs, development partners	20 years	2
		Provision of farm inputs such as fertilizers and environmental-friendly pesticides, e.g. through Govt. subsidies	MOA, private sector, NGOs, development partners, Min. of Finance	20 years	0.8
		Promotion of conservation agriculture-Agroforestry, Soil and water conservation	MOA, Private Sector, Development Partners, NGOs	20 years	0.82
		Financial and technical support to the Orphan Crops Programme	MOA, Private Sector, Development Partners	20 years	0.5
		Enhanced agricultural research, including international collaborations	MOA, KARI (CGIAR) and Academic & Research Institutions	20 year	1.28
Sub-total					10.6
	Marine and Fisheries Resources	Assessment of marine and inland water resources	Dept. of Remote Sensing, Min. of Fisheries, KMFRI	20 years	1.14
		Evaluation of current land ocean interactions and their impact of their changes on fisheries resources	KMFRI, Academic & Research Institutions, Min. of Fisheries, Dpt. of Remote Sensing	20 years	0.381

Sector	Sub-Sector	Description of Specific Activities	Implementing Institutions	Implementation Timeframe	Resource requirement per year (Billion Ksh.)
		Assessment of socio-economic impacts of climate change on livelihoods of riparian communities	KMFRI, KIPRA and other research institutions	20 years	0.026
		Capacity building in climate change monitoring and oceanographic studies	Min. of Fisheries, KMFRI, Dept. of Remote Sensing, Academic & Research Institutions	20 years	0.035
		Developing mitigation measures against resource decline, e.g. through <ul style="list-style-type: none"> • enactment of necessary laws • strengthening monitoring and surveying systems • upscaling sustainable aquaculture activities in fresh, brackish and marine water systems to ensure food security 	Min. of Fisheries, KMFRI, Devt. Partners	20 years	0.035
		Mitigation against loss of biodiversity through restoration of degraded ecosystems e.g. mangrove restoration, planting of vegetation to prevent riverine and lake-shore erosion	KMFRI, Min. of Fisheries, Forestry, Devt. Partners	20 years	0.35
		Enhancing adaptive capability of riparian communities e.g. through creation of alternative sources of livelihoods such as bee-keeping, aquaculture, etc	Min. of Fisheries, KMFRI, Min. of Special Programmes, Min of Finance, MOA	20 years	0.0735
		Reducing the sector's carbon emissions through promotion of solar lamps for "dagaa" fishing, solar driers for fish curing, improved energy fish smoking ovens, etc, and planting of trees around ponds	Min. of Fisheries KMFRI, MEMR, Private Sector, Devt. Partners	20 years	0.13
		Climate change education and public awareness among the riparian communities	Min. of Fisheries, KMFRI, MEMR, NGOs, Youth and Women Groups	20 years	0.35
		Sub-total			2.52
	Forestry and Wildlife	Afforestation and Reforestation targeting additional 4.1 million Ha of land under forest cover <ul style="list-style-type: none"> • Rehabilitation and restoration of all degraded forests and riverine vegetation • Production of 3.5 billion seedlings in 35,000 schools countrywide 	Min. of Forestry, KFS, KEFRI, MEMR, MoT, Devt. Partners	20 years	5.55

Sector	Sub-Sector	Description of Specific Activities	Implementing Institutions	Implementation Timeframe	Resource requirement per year (Billion Ksh.)
		<ul style="list-style-type: none"> Production of 4 billion seedlings by KFS for rehabilitation of degraded forest areas, reclaimed forests and farmlands, Establishment of additional arboreta Other interventions 			
		<p>Enhancing Conservation and Management of all types of forests</p> <ul style="list-style-type: none"> Preparation and maintenance of a comprehensive forest resources data base Development and implementation of forest management plans Recruit an additional Forest Rangers Capacity building and strengthening of Forest Conservation Committees and Community Forest Associations Fencing of the Mau Complex and other major water towers Other interventions 	Min. of Forestry, KFS, MEMR, CBOs, ICRAF, NGOs and Private Sector	20 years	4.05
		<p>Promoting Sustainable Management and Utilization of Industrial Forest Plantations</p> <ul style="list-style-type: none"> Emergency reforestation of open areas through community programmes Establishing plantation monitoring unit Enhancing silvicultural and selective based harvesting Promotion of efficient wood conversion technologies Other interventions 	Min. of Forestry, KFS, KEFRI, MEMR, CBOs, ICRAF, NGOs and Private Sector Min. of Forestry	20 years	3.0
		<p>Engagement with an Expanded Portfolio of Stakeholders e.g.</p> <ul style="list-style-type: none"> Strengthening collaboration with e.g. schools, youth groups, Community Associations Strengthening partnership with the Min. of Devt. of Northern Kenya and other Arid Lands Mainstreaming gender in environment and forestry Extensive national tree planting campaigns and education Other interventions 	Min. of Forestry, KFS, KEFRI, MEMR, CBOs, ICRAF, NGOs and Private Sector, Community Forest Associations (CFAs)	20 years	2.39

Sector	Sub-Sector	Description of Specific Activities	Implementing Institutions	Implementation Timeframe	Resource requirement per year (Billion Ksh.)
		<p>Mobilization of Volunteers to Support Forestry and Environmental Conservation Programmes</p> <ul style="list-style-type: none"> To plant and raise seedlings—which KFS can purchase 	Min. of Forestry, KFS, KEFRI, MEMR, CBOs, NGOs and Private Sector, institutions, Devt. Partners, Community Forest Associations (CFAs), Min. of Youth Affairs and Sports	20 years	3
		<p>Pursuit of Innovative Funding Mechanisms for Forestry Development</p> <ul style="list-style-type: none"> Payment for environmental services Preparation of tree planting proposals for funding through the Constituency Development Fund (CDF) and Local Authority Transfer Fund (LATF) Setting up a Forest Management and Conservation Fund (FMCF) Revenues from sale of plantation timber And other measures 	Min. of Forestry, KFS, KEFRI, MEMR, CBOs, NGOs and Private Sector, Devt. Partners	20 years	8
		<p>Operationalization of the Forests Act (2005) and Environment Management and Coordination Act 1999</p> <ul style="list-style-type: none"> Full staffing of field stations Setting up institutional linkages to support wider stakeholder participation Establishment of guidelines to enable KFS, communities and the private sector Other interventions 	NEMA, Min. of Forestry, KFS, KEFRI, MEMR, CBOs, NGOs and Private Sector	20 years	4.5
		<p>Research targeting current climate change threats and risks to wildlife and rangeland resources; and wildlife's vulnerability to current climate variability, e.g</p> <ul style="list-style-type: none"> analyse the current climate variability in marginal rainfall areas assess the socioeconomic dynamics and activities of the communities living in and around wildlife protected areas 	KWS, KEFRI, Academic and research institutions, Multilateral Organizations such as the UNEP, NGOs, Wildlife Conservation Societies, Devt. Partners, MoT	20 years	0.14
		Research to project future climate change scenarios and likely impacts on wildlife and rangelands	KWS, KEFRI, Academic and research institutions, Multilateral Organizations such as the UNEP, NGOs, Wildlife Conservation Societies, Devt. Partners, MoT	20 years	0.39
		Developing the National Wildlife Adaptation Strategy	KWS, UNEP, MoT, Forestry, MEMR, Devt. Partners, Private Sector, NGOs, Wildlife Conservation Societies	20 years	1.47

Sector	Sub-Sector	Description of Specific Activities	Implementing Institutions	Implementation Timeframe	Resource requirement per year (Billion Ksh.)
		Awareness raising by Wildlife Clubs of Kenya	KWS, Wildlife Clubs of Kenya, MoT, Devt. Partners, Private Sector	20 years	0.073
Subtotal					32.26
Environment		Green Schools Programme targeting primary and secondary schools <ul style="list-style-type: none"> Tree planting, roof water catchment, biogas production Promote environmental education 	MEMR, Min. of Forestry, KFS, KEFRI, CBOs, KARI, NGOs and Private Sector	20 years	1.0
		Integrated Natural Resource Conservation and management programme targeting rural communities <ul style="list-style-type: none"> Diversification of livelihoods Tree nursery development & seedling 	MEMR, Min. of Forestry, KFS, KEFRI, CBOs, KARI, NGOs and Private Sector	15 year	1.66
		Environmental governance programme <ul style="list-style-type: none"> Regulation of environmental & natural resource use 	MEMR, NEMA and lead agencies	6 years	0.33
		Pollution and waste management Programmes targeting urban councils, public institutions, private institutions <ul style="list-style-type: none"> Minimise pollution through reduce, reuse, recycle and recover (4Rs) 	MEMR, NEMA, Private Sector, Institutions	15 years	1.66
		Capacity building in climate change <ul style="list-style-type: none"> Participation in LPAC, National & International training/exchange programmes 	MEMR, Forestry, KFS, NEMA and other relevant government agencies	6 years	0.33
		Investment in climate change programmes and projects together with other relevant ministries and institutions-Agriculture, Forestry, Water, etc	MEMR, Forestry, Agriculture, Water and Irrigation, Devt. Partners,	20 years	1.0
		Climate change activities governance (the cost of running the proposed climate change secretariat)	MEMR	20 years	0.60
		Lake Turkana Basin Ecosystem and Livelihoods Sustenance Programme <ul style="list-style-type: none"> Promote integrated environmental management Promote renewable energy technologies 	MEMR, Min. of Forestry, KFS, KEFRI, CBOs, KARI, NGOs and Private Sector	20 years	0.5

Sector	Sub-Sector	Description of Specific Activities	Implementing Institutions	Implementation Timeframe	Resource requirement per year (Billion Ksh.)
		Special support to Nairobi River/Dam project <ul style="list-style-type: none"> • Routine cleanup, surveillance • Maintenance works • Addressing emerging governance issues 	MEMR, City Council of Nairobi, Devt. Partners, Private Sector	20 years	0.5
Sub-total					7.39
	Tourism	Establishing a tourism industry climate change response consultative team. Key activities:- <ul style="list-style-type: none"> • Research continuous • Annual workshops • Annual reports and updates 	MoT, MEMR KATO, KATA, Eco-tourism Kenya, KWS and Regional tourism associations, Development partners	20 years	0.003
		Putting priorities and targets for tourism development in line with Vision 2030 and the strategic plan support the desired mitigation and adaptation measures <ul style="list-style-type: none"> • Ensure legislation that enforces responsible practices (by June 2013) • One major conference every two years • Reviews every five years 	MoT, KTF, MEMR, Development partners, State Law Office	20 years	0.0026
		Climate change awareness among industry stakeholders <ul style="list-style-type: none"> • 8 regional seminars by June 2013 	MoT, KTF, Regional Organisations, MEMR, Development partners	3 years	0.0016
		Diversification of tourism destinations in Kenya through identification and marketing of new market areas	MoT, KTF, Local Community organisations, Development partners, investors	20 years	0.0024
		Develop and enforce the Green Strategy and Code (June 2011) Create a Green Code certification scheme (June 2012)	MoT, MEMR, KTF, Development partners, State Law Office	2 years	0.02
		Brand Kenya as a green destination <ul style="list-style-type: none"> • Develop Green Brand based on the Green Code by June 2013 • Marketing (Display the Green brand on all marketing material) continuously 	MoT, Brand Kenya Board, MDRs, KTF, Development partners	20 years	0.01
Subtotal					0.0396
	Regional Development Authorities	Tana & Athi River Development Authority (TARDA) <ul style="list-style-type: none"> • High Grand Falls Multi-Purpose Project • Munyu Multi-Purpose Reservoir and Kibwezi Irrigation Project 	Min. of Regional Development, MOA, MOW, MEMR, Min. of Forestry, KWS, KenGen, MOE	10 yrs	4.5

Sector	Sub-Sector	Description of Specific Activities	Implementing Institutions	Implementation Timeframe	Resource requirement per year (Billion Ksh.)
		<ul style="list-style-type: none"> Upper Tana Catchment Afforestation and Conservation Project 		1	
		<p>Lake Basin Development Authority (LBDA)</p> <ul style="list-style-type: none"> Nandi Hydropower Integrated Development Programme Magwagwa Multipurpose Project Webuye – Teremi Multipurpose Project 	Min. of Regional Development, MOA, MOW, MEMR, Min. of Forestry, KWS, KenGen, MOE	0 yrs	4.5
		<p>Ewaso Ng'iro North Development Authority (ENNDA)</p> <ul style="list-style-type: none"> Wajir Integrated Development Programme Programme On Development Of Gum Arabic And Gum Resins 	Min. of Regional Development, MOA, MOW, MEMR, Min. of Forestry, KWS, KenGen, MOE, Min of Gender and Youth	10 yrs	3
		<p>Coast Development Authority (CDA)</p> <ul style="list-style-type: none"> Sabaki River Integrated Development Project Lake Chala Integrated Water Resource Project Mwache Dam Multi-Purpose Development Project 	Min. of Regional Development, MOA, MOW, MEMR, Min. of Forestry, KWS, KenGen, MOE	10 yrs	4.5
		<p>Kerio Valley Development Authority (KVDA)</p> <ul style="list-style-type: none"> Turkwel Multipurpose Project: Downstream Riverine Conservation and irrigation <u>Development of Aror Integrated Multipurpose Project</u> Cherangany Hills Watershed Conservation and Rehabilitation Project 	Min. of Regional Development, MOA, MOW, MEMR, Min. of Forestry, KWS, KenGen, MOE	10 yrs	4.5
		<p>Ewaso Ng'iro South Development Authority (ENSDA)</p> <ul style="list-style-type: none"> Lower Ewaso Ngiro River Basin Integrated Multipurpose Project Integrated Mau Catchment Conservation And Development Project 	Min. of Regional Development, MOA, MOW, MEMR, Min. of Forestry, KWS, KenGen, MOE	10 yrs	3
Subtotal					24
Cooperatives Development		Farming Approach Interventions <ul style="list-style-type: none"> Coffee processing waste-pulp and husk used for domestic and industrial heating (steam turbines, gasification technology, compacted in burners or briquettes through carbonisation) 	Cooperatives, Private Sector, MEMR, Devt. Partners	20 years	0.1

Sector	Sub-Sector	Description of Specific Activities	Implementing Institutions	Implementation Timeframe	Resource requirement per year (Billion Ksh.)
		<ul style="list-style-type: none"> Sustainable forestry to support tea factory tea drying Mini or Micro hydro for power generation for all factory processing units Biogas digesters for cattle dung and also organic fertiliser production Methane reduction in processing activities of rice and coffee pulp processing Promoting sustainable use of agricultural waste 			
		Lifestyle and livelihoods interventions <ul style="list-style-type: none"> Promotion of energy efficient cookstoves Development of rural sewage treatment plants 	Cooperatives, MOE, Private Sector, MEMR, Devt. Partners	20 years	0.05
Sub-total					0.15
Physical Infrastructure and Service Industry	Water & Irrigation	Construction of inter basin and intra-basin water transfers	MOW, Disciplined Forces, Local Authority, Regional Devt., and Private Sector	20 years	0.7
		Installation of hydrometric stations (hydrological monitoring)	MOW, Local Authority and private sector	20 years	0.026
		Procurement of additional water treatment chemicals and technologies	MOW, Local Authority, MOH and Sanitation	20 years	0.05
		In conjunction with the Ministry of Agriculture, undertaking irrigation projects	MOW, Local Authority, Private Sector	20 years	2.0
		Construction and maintenance waterpans	MOW, Local Authority, MOH and Sanitation, MEMR, Private Sector	20 years	0.112
		Construction and maintenance of large 24 dams	MOW, Min. of Public Works, Disciplined Forces	20 years	2.8
		Construction and maintenance of 1000 boreholes	Min. of Forestry, MOW, Private Sector, Min. of Tourism, MDNKALS,	20 years	0.25
		Exploitation of deep aquifers	MOW, Private Sector, Local Authorities	20 years	0.018
		Artificial recharging of aquifers	MOW, Local Authorities, Private Sector and Individuals	20 years	0.005
Sub-total					5.96

Sector	Sub-Sector	Description of Specific Activities	Implementing Institutions	Implementation Timeframe	Resource requirement per year (Billion Ksh.)
	Energy	Accelerated development of geothermal power by the government and its development partners	GDC, KENGEN, Min. of Energy, devt. partners	10 years	20.3
		Accelerated development of geothermal power by the private sector (GDC will take up if there are no suitable investors)	IPPs	10 years	12.1
		Accelerated development of green energy (solar, wind, renewable biomass, etc) by the govt. and its devt. partners	GDC, KENGEN, Min. of Energy, devt. partners	5 years	15
		Accelerated development of green energy (solar, wind, renewable biomass, etc) by the private sector	IPPs	5 years	22.5
		Provision of efficient (fluorescent) bulbs to domestic consumers	Min. of Energy, KPLC, development partners, private sector	10 years	0.36
		Water catchments protection programmes e.g. afforestation	KPLC, MOE, Private sector, development partners	10 years	0.375
		Provision of improved jikos	Min. of Energy, Private sector, devt. partners	10 years	0.075
		Promotion of low-end solar devices including solar drip irrigation, solar water heating, etc	Min. of Energy, Private sector, devt. partners	10 years	3
<i>Subtotal</i>					<i>73.71</i>
	Transport	Development of a Bus Rapid Transit (BRT) system	Min. of transport, Min. of Roads, KRB, devt. Partners, private sector, local authorities	4 years	8.75
		Development of Light Rail	Min. of transport, Min. of Roads, KRB, devt. Partners, private sector, local authorities	4 years	3.10
<i>Subtotal</i>					<i>11.85</i>
	Roads	Road maintenance	Min. of Roads, KRB, Devt. Partners, Local Authorities, Private Sector	20 years	20
<i>Sub-total</i>					<i>20</i>

Sector	Sub-Sector	Description of Specific Activities	Implementing Institutions	Implementation Timeframe	Resource requirement per year (Billion Ksh.)
Manpower	Gender, Children & Social Services	<p>Establish a Consolidated Social Protection Fund targeting the aged, destitute children and the disabled</p> <ul style="list-style-type: none"> • Flag out and register the very poor men, women, destitute children and persons with disability for support • Disburse the social protection fund to identified beneficiaries • Disburse self-help grants for boosting existing enterprises or establishment of new income generating activities by poor rural and urban women and men. • Provide food rations to the hungry at times of need • Education and awareness programmes • Train women and men in Self-help groups in environmental management • Expand Women Enterprise Fund kitty • Support environmental conservation groups • Support Self-Help groups in planting of emerging crops i.e. aloe-vera, neem, and mangrove trees as alternative sources of income • Disburse grants to self help groups in support of environmental conservation projects such as tree nursery development, afforestation, riverbank protection, construction/ installation of rain water harvesting tanks 	Min. of Gender, Children & Social Services, NGOs, CBOs, Devt. Partners, Min. of Finance	20 years	2.7
Sub-total					2.7
Youth Affairs and Sports	Mass tree planting countrywide under the theme "Planting Our Future" using "Groasis Water Box" technology to enhance tree survival especially in arid and semi-arid regions	Ministry of Youth Affairs & Sports, MEMR, Forestry, KFS, NEMA, Devt. Partners, NGOs, CBOs, Private Sector	20 years	0.3	
	"Trees for Jobs" Programme as a way of creating employment for the youth and involves planting and nurturing of seedlings to full growth and paying the youth	Ministry of Youth Affairs & Sports, MEMR, Forestry, KFS, NEMA, Devt. Partners, NGOs, CBOs, Private Sector, Multilateral Organizations	20 years	0.4	
	Mass clean-ups in both village and urban centres, with the aim of achieving proper	Ministry of Youth Affairs & Sports, MEMR, NEMA, Devt.	20 years	0.25	

Sector	Sub-Sector	Description of Specific Activities	Implementing Institutions	Implementation Timeframe	Resource requirement per year (Billion Ksh.)
		waste management to e.g. reduce harmful/toxic gases such as methane emissions from anaerobic degradation	Partners, NGOs, CBOs, Private Sector, Multilateral Organizations		
		Countrywide Environmental Clinics to disseminate and share information with the youth on environmental issues	Ministry of Youth Affairs & Sports, MEMR, NEMA, Devt. Partners, NGOs, CBOs, Private Sector, Multilateral Organizations	20 years	0.5
		Keep Kenya "Klean" (3K) campaign targeting the removal of all harmful including global warming substances like CFCs	Ministry of Youth Affairs & Sports, MEMR, NEMA, Devt. Partners, NGOs, CBOs, Private Sector, Multilateral Organizations	20 years	0.3
		Youth Sensitization Programmes on Environmental Management and Climate Change to e.g. foster sustainable utilization of natural resources; enhance understanding of climate change and what response measures can be taken against it	Ministry of Youth Affairs & Sports, MEMR, NEMA, Devt. Partners, NGOs, CBOs, Private Sector, Multilateral Organizations	20 years	0.6
		Establishment of tree nurseries for the mass tree planting programme as well as for sale to other organization such as KFS that may require tree seedlings for their own tree planting programmes	Ministry of Youth Affairs & Sports, MEMR, NEMA, Forestry, KFS, Devt. Partners, NGOs, CBOs, Private Sector, Multilateral Organizations	20 years	0.4
Sub-total					2.75
Special Programmes	Disaster Risk Reduction improving application of advanced technology (weather and climate information) in risk identification and evaluation	Ministry of Special Programmes, NDOC, KMD, ICPAC, Devt. Partners, and other organizations involved in DRR including NGOs	20 years	3.4	
	Disaster Risk Reduction Implementing the National Disaster Management Policy and establishing the National Disaster Management Authority	Ministry of Special Programmes, NDOC, KMD, ICPAC, Devt. Partners, and other organizations involved in DRR including NGOs, private sector	20 years	0.7	
	Disaster Risk Reduction Enhance communication among scientists, decision/policy makers, NGOs and communities	Ministry of Special Programmes, NDOC, KMD, ICPAC, Devt. Partners, and other organizations involved in DRR including NGOs	20 years	1	

Sector	Sub-Sector	Description of Specific Activities	Implementing Institutions	Implementation Timeframe	Resource requirement per year (Billion Ksh.)
		Disaster Risk Reduction developing structures that facilitate continuity of the National Disaster Management Policy	Ministry of Special Programmes, NDOC, KMD, ICPAC, Devt. Partners, and other organizations involved in DRR including NGOs	20 years	1.75
		Disaster Risk Reduction mainstreaming DRR and adaptation e.g. putting measures to reduce poverty and empower marginal communities and people	Ministry of Special Programmes, NDOC, KMD, ICPAC, Devt. Partners, and other organizations involved in DRR including NGOs	20 years	1.75
		Disaster Risk Reduction promoting flexibility in approaches to disaster risk management	Ministry of Special Programmes, NDOC, KMD, ICPAC, Devt. Partners, and other organizations involved in DRR including NGOs	20 years	0.8
		Disaster Risk Reduction creating financial mechanisms for disaster management and invest in regional partnerships; strategic fund for disaster management	Ministry of Special Programmes, NDOC, KMD, ICPAC, Devt. Partners, and other organizations involved in DRR including NGOs, multilateral organizations	20 years	22.6
Sub-total					32.0
Education	Climate Change Education & Awareness	Mainstreaming climate change education and awareness	Spread across all ministries and departments, but the lead agencies include Min. of Education; MEMR, NEMA, Special Programmes, Gender & Social Services, and Youth Affairs and Sports, NGOs, CBOs, devt. partners and multilateral organizations	20 years	7.9
Sub-total					7.9
ICT	ICT and climate change programmes	Climate-proofing the ICT sector; accelerated development of the sector to help mitigate, e.g. through telecommuting	Min. of Communication, Devt. Partners, Private Sector	20 years	0.7
Sub-total					0.7
Grand Total					235.83



**Comments and Views are invited from the public.
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