

Kenya's Water Towers Protection and Climate Change Mitigation and Adaptation (WaTER) Programme

# Forestry Research Strategy On Climate Change



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Kenya Forestry Research Institute  
(KEFRI)

# **Forestry Research Strategy on Climate Change**

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P.O. Box 20412 - 00200 Nairobi, Kenya

Tel: +254-722-157 414, +254-722-

259781/2 Email: [director@kefri.org](mailto:director@kefri.org)

Website: [www.kefri.org](http://www.kefri.org)

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## FOREWORD

Climate is an important determinant of geographical distribution of plants and animals. Specifically, climate plays key roles in long term composition and productivity of forests; species diversity and adaptability; population densities, and occurrence of pests and diseases. Over the past century, human activities have released large amounts of carbon dioxide and other greenhouse gases into the atmosphere creating an enhanced greenhouse effect which has contributed to climate change. In the last one decade climate change related issues have become a subject of environmental concern due to its potential economic, health and safety, food production and security concerns. Climate change is expected to have major effects on plant species survival, growth distribution and production. One outstanding evidence of climate change in Kenya is the loss of 92% of the ice mass on Mt Kenya in the past 100 years.

The world has been grappling with mitigation and adaptation to climate change since early 1990s. The role of forests, woodlands and trees in climate change mitigation was recognized during the Earth Summit at Rio in 1992 when parties to United Nations Framework Convention on Climate Change committed to conserve these carbon stocks. At the national level, Kenya has established a national climate office, governance framework and formulated a National Climate Change Response Strategy and a National Climate Change Action Plan.

In line with the national efforts to combat climate change, Kenya Forestry Research Institute has developed a Forestry Research Strategy on Climate Change to mainstream climate change research agenda. This strategy seeks to develop a framework for forestry research in climate change through short-term and long-term mechanisms to address existing gaps. The strategy has identified eight critical areas of climate change research to be undertaken over the next seven years in accordance with the national and international standards.



Ben E. N. Chikamai (PhD)  
**Director, Kenya Forestry Research Institute**

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## ACRONYMS

AMCEN	African Ministerial Conference on the Environment
AU	Africa Union
CBD	Convention on Biological Diversity
COMESA	Common Market for Eastern and Southern Africa
FAO	Food and Agriculture Organization
FRL	Forest Reference Level
GCM	Global Circulation Models
GEF	Global Environmental Facility
GHG	Greenhouse gases
GoK	Government of Kenya
IGAD	Intergovernmental Authority on Development
IGES	Institute for Global Environmental Strategies
NEM	National Forest Monitoring System
IPCC	Intergovernmental Panel on Climate Change
KEFRI	Kenya Forestry Research Institute
NCCRS	National Climate Change Response Strategy
PSP	Permanent Sample Plot
REDD+	Reducing Emissions from Deforestation and Forest Degradation
REL	Reference Emission Level
SDG	Sustainable Development Goals
UNCCD	United Nations Convention to Combat Desertification
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Aid



## **1.0 INTRODUCTION**

### **1.1 Overview of Climate Change**

Climate change is currently a major, overriding environmental issue with economic, health and safety, food production and security concerns. Climate change can be described as any systematic change in the long-term statistics of weather patterns sustained over several decades or longer. Over the past century, human activities have released large amounts of carbon dioxide, methane, nitrous oxide and other greenhouse gases (GHG) into the atmosphere. The majority of these greenhouse gases come from burning fossil fuels to produce energy, industrial processes, and some agricultural practices. Emissions of these gases in the atmosphere act like a blanket around earth, trapping energy in the atmosphere and causing it to warm. This phenomenon is called enhanced greenhouse effect or global warming. The buildup of greenhouse gases can change earth's climate and result in dangerous effects to human health and wellbeing of the ecosystems. Climate change is expected to have major effects on plant species survival, growth distribution and production. For example declining land productivity due to rising temperatures and unreliable precipitation would lead to reduced livelihood options. Taking steps to reduce the build-up of GHG is a strategy adopted to cope with challenges of climate change.

Trees and forests are important in reducing the build-up of GHG in the atmosphere. Trees and forests act as carbon sinks and can store from 20 to 100 times more carbon than other vegetation types on the same land area, or around 30 to 60 tons of carbon per hectare (Penman, 2003). In addition, forests buffer against changes induced by floods, droughts and temperature fluctuations. Globally, forests store more than one trillion tons of carbon, twice the amount in the atmosphere and contain about 80 % of all aboveground and 40 % of all belowground terrestrial organic carbon (Penman, 2003). Conversely, destruction of forests releases carbon. The annual carbon dioxide released through forest clearing and forest fires is estimated to be about 6 billion tonnes, which is about 17% of the total greenhouse gas (GHG) emissions, equivalent to 13 million ha annual loss of forests and woodlands globally (IPCC, 2006).

The role of forests, woodlands and trees in climate change mitigation was recognized during the Earth Summit at Rio in 1992 when parties to United Nations Framework Convention on Climate Change (UNFCCC) committed to conserve these carbon stocks. The Kyoto Protocol adopted in 1997 and entered into force in 2005 was the first step towards a truly global emission reduction regime to stabilize GHG concentrations at a level that could help avoid adverse trends of climate change. Thereafter, realization of the contribution of forests in addressing climate change lead to adoption of Reducing Deforestation and Forest Degradation (REDD+) in developing countries as part of Bali Action Plan (UNFCCC, 2007). Kenya is actively involved in readiness activities for REDD+ schemes implementation. For example, REDD+ Readiness Preparation Proposal (R-PP) and national REDD+ strategy has been finalized and submitted to UNFCCC. Development of a roadmap to inform establishment of Reference

Emission Level (REL)/Forest Reference Level (FRL) and National Forest Monitoring System (NFMS) have been completed. It is widely accepted that addressing climate change will not be achieved without the inclusion of forest agenda both at the local and international negotiations.

## **1.2 Evidence of Climate Change in Kenya**

Evidence of climate change requires specific links between changes in weather patterns and changes in ecosystem functions. For example, it has been observed that there have been changes in tree and plant species associations, plant habits life cycles, occurrence of forest fires and incidence of pests and diseases. Changes in forest fire frequencies and severity have been observed during years with low rainfall and slightly higher temperatures, including 1971, 1981 and 2012. In addition, tree seed quality and quantity of major indigenous tree species have been decreasing over the years. Other Climatic Change evidences in Kenya include:

- I The minimum temperatures have risen by a range of 0.7 to 2.0<sup>o</sup>C and maximum temperatures by a range of 0.2 to 1.3<sup>o</sup>C (Peters 1992).
- II Mt. Kenya has lost 92% of its ice mass in the past 100 years (NEMA, 2007).
- III Long rains in central Kenya have declined by more than 100 mm since the mid 1970s (Funk, 2010).

## **1.3 Forests and Climate Change in Kenya**

Forest and tree resources in Kenya are important assets that support economic, environmental and social welfare. This is because forests support key economic sectors such as energy, agriculture, water, wildlife and tourism. The country is endowed with various forest types comprising of; natural, plantation, farm, and dryland forests which cover about 7.8 % of land area (FAO, 2015). Forest stability and resilience is dependent on various human and natural factors that are climate-sensitive. The changing climate negatively affect the productive capacity of various forest dependent good and services hence their flow and availability under such conditions.

## **1.4 Policy and Legal Framework on Climate Change**

The Constitution of Kenya (GOK, 2010) and the economic blue print, Vision 2030 (GOK, 2007) places emphasis on sustainable management of the environment and natural resources for the benefit of the Kenyan people. In this regard, Kenya has ratified various international and regional agreements related to climate change. These include; the United Nations Framework Convention on Climate Change (UNFCCC), United Nations Convention to Combat Desertification (UNCCD), Convention on Biological Diversity (CBD), United Nations Sustainable Development Goals (SDG), and initiatives of the Africa Union (AU) and Intergovernmental Authority on Development (IGAD). Through the African Ministerial Conference on the Environment (AMCEN) Kenya has actively participated in high-level continental talks on climate change. At the regional level, through Common Market for Eastern and Southern Africa (COMESA), the country has been involved in climate change discussions and training of negotiators. At the

national level, the country has established a national climate office, governance framework and formulated a National Climate Change Response Strategy (NCCRS) and a National Climate Change Action Plan 2013-2017 for the implementation of NCCRS. Recently, the national assembly enacted. The Climate Change Act (2016) which created National Climate Change Council to coordinate implementation of climate change action plans by the national and county governments. The Council will also provide policy direction on research, training and dissemination of information related to climate change.

Some of these legal and policy instruments are being implemented through the following forestry related climate change mitigation and adaptation initiatives:

- National Climate Change Act 2016
- National REDD+ Readiness Initiatives
- SLEEK-System for Land Based Emissions Estimations in Kenya
- The Kenya Water Towers Protection and Climate Change and Mitigation (WaTER) Programme in Mt. Elgon and Cherang'any Hills
- Country-wide Kenya Climate Change Adaptation Fund Program
- Development of Drought Tolerant Trees for Adaptation to Climate Change in Drylands of Kenya

### **1.5 Need for a Climate Change Research Strategy for the Forest Sector**

Most of the on-going climate change response initiatives such as SLEEK and REDD+ have identified major research gaps in accounting for forest carbon emission in Kenya. The major gaps include; inadequate tree/forest-type country-specific biomass and carbon equations and unreliable data for carbon estimation models. The Intergovernmental Panel on Climate Change (IPCC) is the international body mandated to undertake scientific assessments of climate change. However, its contributions on Global Circulation Models (GCM), regional models and other outputs are general in nature and they cannot effectively guide policy makers at national level. Kenya Forestry Research Institute has developed a Forestry Research Strategy on Climate Change to address the gaps and mainstream climate change in its research agenda. The Strategy is in line with Kenya's Vision 2030 and the National Climate Change Response Strategy. The implementation of the Strategy will provide the best-bet options for mitigation and adaptation to climate change. In addition, accuracy in international reporting of carbon emission and removal will improve through refining of existing methodologies and development of new models.

## **2.0 SCOPE AND FOCUS OF THE FORESTRY RESEARCH STRATEGY ON CLIMATE CHANGE**

### **2.1 Scope**

This strategy seeks to develop a framework for forestry research in climate change through short term and long term mechanisms to address existing gaps. The strategy identifies critical areas of climate change research to be undertaken over the next seven years in accordance with the national and international standards. The strategy has been aligned with the current KEFRI Strategic Plan (2013-2018).

#### **2.1.1 Short term plan (2017-2019)**

During this period, KEFRI will review existing gaps in forestry research in regard to climate change, and provide strategies to develop and implement short-term research in key climate change areas.

#### **2.1.2 Long term plan (2020-2024)**

The scope will involve undertaking research to develop forestry technologies for mitigation of, and adaptation to climate change. This will mainly be done through data collection on key indicators of forest ecosystem functioning and resilience. The Strategy will be monitored, evaluated and reviewed at the end of the period.

### **2.2 Focus of Forestry Research Strategy on Climate Change**

The main focus of this strategy are to:

- Determine the impact of climate change on trees and forests in Kenya
- Support development of methodologies for national forest carbon accounting and modelling
- Develop mechanistic models for understanding how trees and forests function under different climatic conditions
- Link climate change research to livelihoods of forestry dwellers, forest adjacent communities and other stakeholders
- Build collaboration and partnerships in climate change research
- Resource mobilization
- Strengthen human resource and institutional capacity to cope with climate change effects
- Disseminate of climate change specific research findings and technologies

### **3.0 IMPLEMENTATION OF FORESTRY RESEARCH STRATEGY ON CLIMATE CHANGE**

#### **3.1 Research and Development**

##### **3.1.1 Determine impact of climate change on trees and forests in Kenya**

This will entail collecting baseline data to determine the impact of climate change on Kenya's trees and forests by reviewing of secondary information and data on impact of climate change on tree and forest ecosystems. The research will also involve long term data collection from Permanent Sample Plots (PSPs) in representative forest ecosystems and other sources.

##### **3.1.2 Support development of methodologies for national forest carbon accounting and modeling**

Support to national forest carbon accounting and modeling will entail estimating the potential for Kenya's trees and forests to mitigate climate change through carbon sequestration. The research focus will be on:

- Reviewing existing methods for estimating aboveground and belowground biomass for determining carbon stocks in various tree species and forest types in Kenya and developing new methods as necessary
- Modeling trends on growth of biomass/carbon stocks in various forest types and land use systems
- Reviewing existing methods for estimating soil carbon stock in various forest types in Kenya and develop new methods as necessary
- Supporting development of reliable emission factors for estimating GHG emissions under different forest management practices and land use changes

##### **3.1.3 Develop mechanistic models for understanding how trees and forests function under different climatic conditions**

The research will involve:

- Establishing long-term forest ecosystem monitoring plots in various forest types
- Developing models for determination and quantification of changes in forest ecosystem function and structure due to changes in weather patterns; and
- Developing models for forecasting changes in tree species distributions, including occurrence of forest pests and diseases, and beneficial organisms due to changes in weather patterns

**3.1.4 Link climate change research to livelihoods of forestry stakeholders** Research will involve investigating costs and benefits of climate change to stakeholders dependent on forest resources in the country. Some of the research and development initiatives will include motivating stakeholders to participate in climate change mitigation and adaptation activities in the forestry sector that minimizes carbon emissions through support from local and climate change financing mechanisms.

### **3.2 Build and Maintain Collaboration and Partnerships in Climate Change Research**

Kenya Forestry Research Institute will establish partnership and collaboration in joint development and implementation of forestry research on climate change. The partners and stakeholders will include the following:

- Kenya Forest Service (KFS)
- Kenya Wildlife Service (KWS)
- Kenya Water Tower Agency (KWTA)
- Water Resource Management Authority (WRMA)
- Regional Centre for Mapping of Resources for Development (RCMRD)
- National Environment Management Authority (NEMA)
- Department of Resource Surveys and Remote Sensing (DRSRS)
- Kenya Marine Fisheries Research Institute (KEMFRI)
- Kenya Agricultural and Livestock Research Organization (KALRO)
- Kenya Meteorological Department (KMD)
- Government Ministries
- Michigan State University
- Other institutions of higher learning
- National Museums of Kenya (NMK)
- World Agro-forestry Center (ICRAF)
- Indiana University
- Centre for International Forestry Research (CIFOR)
- African Center for Technological Studies (ACTS)
- Centre for Training and Integrated Research in ASAL Development (CETRAD)
- The Intergovernmental Panel on Climate Change (IPCC)

### **3.3 Resource Mobilization**

Climate change is a cross cutting issue that involves many stakeholders including public, development partners, private sector and civil society. Kenya Forestry Research Institute and its partners will undertake resource mobilization from government, its collaborators and donors to implement the strategy through development of joint project proposals. Funding will be solicited from potential agencies including, but are not limited to, the World Bank, GEF, UNEP, USAID, and Bill and Melinda Gates Foundation.

### **3.4 Strengthen Human Resource and Institutional Capacity**

In order to effectively conduct research to measure, monitor and model the impacts of climate change on Kenya's trees and forests, KEFRI and its partners will expand the current staff and institutional capacity to enable them respond effectively to issues related to climate change. A critical step will be to conduct an analysis of current human and institutional strength to determine where capacities must be increased across the forest sector.

KEFRI will improve its research staff skills through postgraduate training on areas related to climate change. In particular scientists and technical staff will require specific training

in basic elements of climate change research, quantitative data collection and analysis using modern technologies and computational software. In addition, the following will be undertaken:

- Profiling research staff training and infrastructure needs
- Developing and implementation of specific climate change related short courses/modules, workshops and seminars
- Enhancing application of geographical information systems (GIS) and remote sensing in monitoring changes in forest ecosystems and linking results to dynamics of forest structure and livelihoods
- Enhancing coordination of the strategy by establishing and equipping climate change research facilities at Eco-region Research Programmes. In addition, KEFRI will appoint climate change research coordinator

### **3.5 Dissemination of Research Findings and Technologies**

Climate change is multifaceted and affects multiple actors who are the beneficiaries of the research and development outcomes. To reach the target audience, KEFRI will use appropriate information sharing platforms to disseminate its research findings. This will include:

- Sharing information on climate change through technology transfer and capacity improvement of stakeholders; and
- Dissemination of climate change technologies through; demonstration plots, publications, field days/seminars and print and electronic media

#### **4.0 MONITORING, EVALUATION AND REVIEW**

Monitoring and evaluation (M&E) will be undertaken periodically to assess the implementation of the strategy. The M&E will aim to assess accomplishments of tasks and detect any variation and where there is need for adjustments to advise accordingly. The strategy will be subjected to mid-term and end-term reviews to gauge the extent of achievement of intended results. The end-term review will take into account emerging issues and new targets to move climate change research to next level.



### 5.0 FORESTRY RESEARCH ON CLIMATE CHANGE ACTION PLAN

The forestry research on climate change action plan will be implemented over duration of seven years (Table 1)

Table 1: KEFRI climate change-strategy action plan for the next 7 years (2017-2024)

Activities	Objectively verifiable indicators	Means of verification	Timeline						
			2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
<b>1.0 Determine the impacts of climate change on forest and forests in Kenya</b>									
1.1 Establish a baseline protocol for monitoring changes in forests and tree cover in response to climate change	Clear protocol developed	Reports							
1.2 Review existing data and create a national's master database of forestry data suitable for assessing impacts of climate change on trees and forests	Database developed	Database and report							
<b>2.0 Support development of methodologies for national forest carbon accounting and modelling</b>									
2.1 Develop methodology for forest biomass and carbon assessments	Method developed	Reports							
2.2 Review existing models and develop new models for estimating forest biomass and carbon stock	Models developed	Reports							
2.3 Review existing models and develop new models for estimating forest soil carbon stock	Models developed	Reports							
2.4 Support development of national factors for estimating GHG emissions in forests	Emission factors developed	Reports							
<b>3.0 Developable models for understanding how trees and forests function under different climatic conditions</b>									
3.1 Establish long term monitoring plots for monitoring changes in tree and forests response to climate change	Monitoring plots	Reports							

Activities	Objectively verifiable indicators	Means of verification	Timeline						
			2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
3.2 Develop models for determining changes in forest ecosystems due to changes in weather patterns	Models developed	Reports and Computer models, maps							
3.3 Develop models for forecasting changes in major tree species distributions and fire risks due to changes in weather patterns	Models developed, species distribution maps	Reports and Computer models, maps							
<b>4.0 Link climate change research to livelihoods of forestry stakeholders</b>									
4.1 Investigate the impact of climate change to forest adjacent communities	Impacts and local adaptation strategies documented	Reports							
4.2 Undertake cost benefit analysis of climate change and initiate financing mechanisms in forest sector for livelihood support of relevant stakeholders	Cost-benefit analysis undertaken	Reports							
<b>5.0 Build relationships and partnerships in climate change research</b>									
5.1 Nurture strong linkages and network with relevant organizations	Participatory events hosted	Reports							
5.2 Collaborate with relevant local and international organizations	Participatory events, Operational MOUs and MDAs implemented	Reports							
5.3 Undertake consultations on climate change activities	Participatory events hosted	Reports							
<b>6.0 Resource Mobilization</b>									
6.1 Secure additional funds from Government of Kenya	Negotiation meetings held	Financial report							
6.2 Secure funds from donors and partners	Negotiation meetings held	Financial report							
<b>7.0 Empower human resource and institutional capacity</b>									

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Kenya Forestry Research Institute P.O. Box  
20412 - 00200 Nairobi, Kenya Tel: +254 - 722-  
157 414, +254 - 0722-259 781/2 Email:  
director@kefri.org Website: [www.kefri.org](http://www.kefri.org)