

Course Report

1st Pilot On-demand Training Course on Promoting Climate Change Resilient Forestry in Sub-Saharan Africa



Building Capacity of KEFRI Partners



January 2025

KEFRI is ISO 9001:2015 and ISO 14001:2015 certified

COURSE REPORT

1st Pilot On-demand Training Course on Promoting Climate Change Resilient Forestry in Sub-Saharan Africa

@KEFRI /JICA 2025

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Cover photographs captions:

Top: Group photograph during the course opening ceremony

Bottom: Participants happy moments upon receiving certificates during the closing ceremony

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List of Abbreviations and Acronyms

AIRC	Agricultural Information Resource Centre
CIDPs	County Integrated Development Plan
CRGE	Climate Resilient Green Economy
CSA	Climate Smart Agriculture
DERP	Drylands Eco-Region Programme
DLDD	Desertification, Land Degradation, and Drought
FAO	Food and Agriculture Organization
FLR	Forest Land Restoration
GCCA	Global Climate Change Alliance
GDP	Gross Domestic Product
GHG	Green House Gas
GIS	Geographical Information System
GNP	Gross National Product
IUCN	International Union for Conservation of Nature
JFY	Japanese Financial Year
JICA	Japan International Cooperation Agency
KALRO	Kenya Agricultural and Livestock Research Organization
KEFRI	Kenya Forestry Research Institute
KFS	Kenya Forest Service
MAAIF	Ministry of Agriculture, Animal Industry, and Fisheries
MECCF	Ministry of Environment, Climate Change and Forestry
NAFORMA	National Forest Resource Monitoring and Assessment
NaFORRI	National Forestry Resources Research Institute
NAPA	National Adaptation Program of Action
NEMA	National Environment Management Authority
NFA	National Forestry Authority
NFTPA	National Forestry and Tree Planting Act
NRM	Natural Resource Management
PA	Protected Area
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SDGs	Sustainable Development Goals
SFS-CORECC	Strengthening Forestry Sector Development and Community Resilience to Climate Change through Sustainable Forest Management and Landscape Restoration
TAFORI	Tanzania Forestry Research Institute
TCTP	Third Country Training Programme
ToT	Training of Trainers
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change

CHAPTER 1

1.0 Introduction

1.1 Background

Sub-Saharan African (SSA) countries are rich in biodiversity and have diverse ecosystems. However, these countries currently face significant environmental challenges mainly due to climate change and landscape degradation. To accelerate landscape restoration as well as address effects of climate change in SSA, there is need to continually develop and scale up proven natural resource management practices and technologies in addition to building capacity of stakeholders through; knowledge and experiences sharing, raising awareness, skills improvement, and technology transfer.

Kenya Forestry Research Institute (KEFRI) in collaboration with Japan International Cooperation Agency (JICA) has since 1985 continued to undertake research and development, provide information and technologies in forestry and allied natural resources. The research outputs have been shared widely in SSA mainly through capacity building undertaken through Third Country Training Programme (TCTP). However, due to emerging challenges brought about mainly by; climate change, extensive landscape degradation, biodiversity losses and desertification, a need to design a targeted capacity building programme that is responsive to stakeholders needs, country specific and addresses current and emerging environmental challenges has been identified as a means to mitigate identified challenges.

To guide development of on-demand training programme, a technical Training Needs Assessment (TNA) was conducted across nine Sub-Saharan African countries in selected institutions. The TNA findings have been translated into a comprehensive, skills-oriented regional training Programme to promote forestry resilience for SSA countries. The TNA analysis, identified and prioritized key technical needs which were clustered into three themes namely: tree germplasm and tree breeding/improvement, landscape restoration; and dissemination and communication of information. These themes lay the foundation for the development of the programme for first on-demand pilot training aimed at addressing participating regional country identified specific challenges.

1.2 First pilot on-demand training

Title

The course was entitled “Promoting Climate Change Resilient Forestry in Sub-Saharan Africa”

Purpose

The training aimed to bridge identified technical knowledge gaps by sharing knowledge, skills, experiences, and technologies, fostering implementation synergies for sustainable measures against climate change threats at implementation levels.

Themes and Modules

The first on-demand training was delivered through three themes namely;

Theme 1: Tree germplasm and Tree breeding/Improvement

Theme 2: Landscape restoration

Theme 3: Dissemination and Communication of information

The themes were delivered through two modules. Themes 1 and 2 were delivered through Module 1, while Theme 3 was delivered through Module 2.

NB:

- Module 1 focused on knowledge and technical skills enhancement
- Module 2 aimed at enhancing capacity to transfer skills and knowledge through Training of Trainers (ToT) approach

Output

At the end of the training course, the participants were expected to have:

- i. Acquired knowledge and technical skills on high-quality tree germplasm development and tree improvement for effective promotion of landscape restoration.
- ii. Gained knowledge and practical skills in forestry and agriculture climate smart technologies and product development for climate resilient landscapes
- iii. Improved communication skills for effective knowledge sharing and technology transfer

Duration

The duration of the Course was three (3) weeks and was held from **Monday 6th to Friday 24th May 2024**.

Curriculum

The course curriculum covered the three (3) identified themes delivered through the two modules with training areas as indicated in Table 1.1.

Table 1.1. Training clusters per theme

Theme	Training areas
Tree germplasm and Tree breeding/Improvement	• Tree seed (e.g. seed sources establishment, collection, processing) • Propagation and management techniques of forest and fruit trees • Tree health (pests and diseases management)
Landscape restoration	• Soil and water conservation • Climate smart agriculture • Value addition of plant-based products • Pasture/fodder grass farming
Dissemination and Communication of information	• Development of information/extension materials in natural resource management • Participatory forestry extension methodologies

Participating countries

Participants were nominated and drawn from the following seven countries: Burundi, Ethiopia, Kenya, Malawi, South Sudan, Tanzania and Uganda.

Number of participants

The number of participants from the participating countries were ten (10).

Sponsor

The first on-demand training on “Promoting Climate Change Resilient Forestry in Sub-Saharan Africa” was conducted with financial support from Japan international Cooperation Agency (JICA) through SFS-CORECC project.

Implementing Agency

The Kenya Forestry Research Institute (KEFRI) in collaboration with Japan international Cooperation Agency (JICA) through SFS-CORECC were the main implementing agencies of the course.

Diplomatic Representation

Diplomatic representation from High Commission and Embassies of Ethiopia and Uganda participated in the official opening ceremony of the course on 6th May 2024, at KEFRI headquarters, Muguga.

Venue

The course was held mainly at KEFRI Headquarters, Muguga. However, field visits were made to selected study sites across different agro-ecological zones in Kenya which included the highlands and the drylands.

Course delivery

The 1st pilot on-demand training course employed diverse learning approaches and modules, including resource persons presentations through lectures, group work, discussions, learning excursions to themed field sites in Kenya, hands-on practicals, demonstrations, role-play and Action Plan development. A practical-oriented approach was emphasized to facilitate better participant understanding of the knowledge and skills needed to address challenges posed by climate change, and forest and agricultural landscape degradation. Training-of-Trainer module was applied to enhanced participants ability to successfully transfer appropriate technologies in Natural Resource Management (NRM) to stakeholders and end users. Participants also developed and discussed country reports, action plans and various information dissemination materials.

Resource persons

The training drew competent and experienced resource persons from relevant government institution, selected farmers and the private sector, that included:

- Kenya Forestry Research Institute (KEFRI)
- Agricultural Information Resource Centre (AIRC) under the Ministry of Agriculture
- Kenya Agricultural and Livestock Research Organization (KALRO)
- Kenya Forest Service (KFS)
- Selected farmers
- Japan International Cooperation Agency (JICA)/ SFS-CORECC
- Participants

Expectations by participants

At the end of the training, participants expected to acquire knowledge and skills in:

- High-quality tree genetic material development
- Tree improvement
- Climate-smart forestry and agricultural technologies
- Experience exchange with international participants
- Climate resilience, landscape restoration, nature-based solutions, and forest development
- Germplasm/seed collection, treatment, and distribution

- Tree pest and disease management
- Land restoration and technology application
- Common understanding of forests role in climate resilience
- New techniques and approaches for landscape restoration suitable for tropical regions
- Nature-based solutions and forest development
- International exposure and networking with stakeholders
- Promoting community participation in sustainable forestry resource management
- Understanding climate change impacts on forests and agricultural landscapes in Sub-Saharan Africa
- Importance of climate-resilient forestry practices/technologies
- Development practical action plan for climate change, landscape restoration, forestry, and rural development activities
- Writing, communication, and networking skills
- Hands-on training in climate-smart technologies applicable to specific countries
- Geographical Information System (GIS) and remote sensing

CHAPTER 2

2.0 Official Speeches

2.1 Opening Ceremony Speeches and Remarks

Remarks by Ms. Ada Nshemereirwe, the Second Secretary of the Mission, Rep. Charge d’ Affairs Uganda High Commission

Ms. Ada appreciated the course organizers, the JICA team, leadership of the country, guests, and participants. She noted with gratitude the participation to the course of the two Ugandan officers. She acknowledged the presence of Mr Desta, the diplomat from the Embassy of Ethiopia in Kenya. She indicated that Uganda supports its people wherever they are, and that was the reason for her attendance to the opening ceremony. Ms Ada added that, the embassy was glad to attend the ceremony and support the two participants from Nyabyeya Forestry College and National Forestry Resources Research Institute (NAFORRI) and wished them well as they start the training.

She thanked KEFRI, JICA and SFS-CORECC project for empowering Sub-Saharan African (SSA) countries to become better leaders and ambassadors of environmental conservation in the region. She encouraged the participants, particularly those from Uganda, to take the training seriously and to learn as much as they could during their 3-week stay in Kenya.

Remarks by Mr. Workalemahu Desta, the Representative of the Ethiopian Embassy to Kenya

Mr. Desta expressed his appreciation to the Principal Secretary State Department for Forestry, Ministry of Environment, Climate Change and Forestry (MECCF), acknowledged the presence of Ms. Ada the diplomat from Uganda, and participants, noting that it was a great pleasure for him to be invited to commemorate the inauguration and opening ceremony of the training. He thanked KEFRI and JICA for organizing the training, and also noted that JICA is one of Ethiopia’s development partners. He stated that the participants, including Ms. Yeshifana Mengesha from Ethiopia, would gain valuable skills and knowledge that would enable them play significant and prominent roles in afforestation and reforestation programmes in their respective countries.

Mr. Desta mentioned that he was delighted to be invited to such an event, that has great relevancy to environmental conservation, as this is in line with the Ethiopian Government strategy, which has embarked on an initiative to plant around 50 billion trees by 2030 under the Green Legacy Initiative. He expressed his hope that the training would impart skills and knowledge to the participant from Ethiopia, that would in turn support this initiative in Ethiopia.

He concluded by wishing all the participants a successful training.

Remarks by Mr. Saito Katsuro, the Chief Advisor SFS-CORECC Project

Mr. Saito acknowledged the presence of Cabinet Secretary, Ministry of Environment, Climate change and Forest, represented by Administrative Secretary Mr. Evans Mutari, Dr. Jane W. Njuguna, Ag. Director KEFRI, diplomats from Uganda and Ethiopia, Mr. Kenji Hayashi Senior Representative JICA and the participants. He thanked KEFRI for inviting him to the opening ceremony.

He stated that, him and the Ag. Director KEFRI, Dr. Njuguna had in October 2024 visited Japan for a week on a learning tour. He indicated that they visited different forests and forest institutions to learn how forestry is undertaken in Japan.

He further stated that, this type of training for SSA had a long history between JICA and KEFRI and provides a good platform to share knowledge with participants. He encouraged the participants to concentrate and learn from the resource persons, whom he indicated have a great wealth of experienced.

Remarks by Mr. Kenji Hayashi, the Senior Representative JICA

KEFRI-JICA technical collaboration in forestry sector spans almost four decades since 1985. For about 25 years out of the four decades, KEFRI and JICA collaborated on implementing regional course working together with Sub-Sahara Africa countries. Based on the experiences and skills accumulated during the four-decade collaboration with JICA, KEFRI has organized the on-demand training programme which you are going to participate in from today. Training topics of this programme are skills oriented and demand driven, and were carefully identified based on the Technical Needs Assessment conducted in 2023, to address similar environmental challenges within the Sub-Saharan African region.

We expect the participants to fully absorb the skills and knowledge they will be exposed to during the training programme and use the same in their own day-to-day work to solve the environmental challenges. We believe that the skills and knowledge gained through this programme will provide the solution for the region, your country and people in the villages in your country. We also expect that this programme will provide opportunities for interacting with participants from other countries, exchanging experiences, and establishing networks among yourselves to tackle the regional challenges of forest degradation and climate change. We extend our gratitude to the individuals and organizations who supported the planning and execution of this training programme, namely, Ministry of Environment Climate Change and Forestry, Embassy of Japan, Kenya Forestry Research Institute, Japan International Cooperation Agency, Kenya Forest Service, Embassies of participating countries.

Speech by Hon. Soipan Tuya, CBS, EGH, Cabinet Secretary Ministry of Environment, Climate Change and Forestry

Your Excellencies, representatives from High Commissions of Ethiopia and Uganda

The Chief Representative, JICA Kenya Office, represented by Mr. Kenji Hayashi-the Senior Representative JICA

The Chief Conservator of Forests, KFS

The Ag. Director, KEFRI, Dr. Jane Njuguna

Participants

Distinguished Guests

Ladies and Gentlemen

It is with great pleasure that I join you here at Kenya Forestry Research Institute (KEFRI) this afternoon, to officiate the opening of this important on-demand Regional Training course. May I take this opportunity, on behalf of the Government of Kenya, through my Ministry - The Ministry of Environment, Climate Change and Forestry, and on my own behalf, to welcome all the participants to Kenya, and to this training. I note with appreciation that the training is a skills-oriented programme that aims to build capacity of participants on **‘Climate Change Resilient Forestry in Sub-Saharan Africa’**, an appropriate theme given the high level of forest degradation and deforestation in Sub-Sahara Africa. The training is indeed an important platform as it will also provide an opportunity for natural resource managers from within our region, to discuss concerns brought about by climate change, biodiversity loss and the massive degradation of both forestry and agricultural landscapes.

This training initiative is a joint collaboration between the Government of Kenya and Government of Japan implemented through Kenya Forest Research Institute (KEFRI) in partnership with Japan International Cooperation Agency (JICA). I note that this training was developed after a Training Needs Analysis (TNA) undertaken in participating countries represented here today. The commitment of your countries your excellencies, has been demonstrated by nominating and allowing the participants to attend this important training.

Ladies and Gentlemen, this training comes soon after a successful first Africa Climate Change Summit held here in Nairobi in September 2023. The Summit whose theme was **“Driving Green Growth and Climate Finance Solutions for Africa and the World”** was indeed a show of commitment by African governments on charting a continent-led pathway for addressing climate change and bring to a better understanding the nexus between environment, life and livelihoods and economic development in our region. During this summit, the commitment by African leaders on moving forward towards a resilient Africa was amplified through promulgation of the Nairobi Declaration, **“The African Leaders Nairobi Declaration on Climate Change and Call to Action”**, which

was adopted by African Heads of State and Government who committed to various actions which include:

- Developing and implementing policies, regulations and incentives aimed at attracting local, regional and global investment in green growth.
- Strengthening actions to halt and reverse biodiversity loss, deforestation, and desertification,
- Redoubling efforts to boost agricultural yields through sustainable agricultural practices.
- Supporting smallholder farmers and local communities in the green economic transition given their key role in ecosystems stewardship.

The shift in focus to have an African led Climate summit was necessitated by the fact that challenges of climate change, which are unique to Africa, continue to constantly emerge, therefore requiring us to endlessly develop targeted innovations and solutions to counter the new challenges. Though Africa has low carbon emission, it still continues to bear brunt of climate change effects which include: frequent drought that alternate with severe flooding; emergence and increase in plant pests and diseases, invasive plant species, threats which continually lead to intensification in landscape degradation and consequently food shortage, poverty and forced immigration of populations.

This year as forecasted; we continue to experience extreme weather events associated with the El Nino phenomenon. Excessive flooding has already been witnessed in various parts of our continent. Let us therefore be pro-active in promoting climate change mitigation and adaptation measure in a timely manner as well as providing accurate and opportune data to inform policy makers for appropriate action to reduce calamities associated with climate related events. The Africa Climate Summit 2023 was not an event, but a start of a process for Africa to shape its destiny towards a climate resilient continent that can withstand climate shocks. Let us therefore contribute this process through aggressive promotion of; reforestation, afforestation and tree growing, restoration of forests, protection of critical ecosystem in both land and water, and by being part of a community that stimulate investments in the carbon market to in-turn incentivize the youth to take up tree farming.

Ladies and Gentlemen, I note that this training programme had been developed at an opportune time when we urgently need to collectively develop climate change mitigation and adaptation measures. Acknowledging the trans-boundary nature of environmental challenges necessities; multidisciplinary and cross border responses as well as collective thinking and common actions that focus on diverse aspects of the environment. We should take note of the fact that without immediate and concerted efforts of all stakeholders in addressing climate change effects, it will be impossible for us in Africa to achieve sustainable development,

which in turn would threaten livelihood, food security and consequently undermine our efforts to eradicate poverty and hunger. However, the good news is that there are a number of strategies and approaches we can pursue now to lead to a healthy climate-resilient continent through adoption of green growth and technology transfer of practices that have been proven to work in various parts of the continent. Capacity building remains a critical action for building a skilled pool of implementers to enhance the capacity of the continent to mitigate climate change.

Allow me to most sincerely thank the government of Japan for once again accepting to support this training, which will be instrumental for Sub Sahara Africa to share information on sustainable environmental conservation. It is my hope and believe that lessons from this training will be cascaded to the end users and in turn greatly improve the capacity of our people to reduce their vulnerability to climate change.

With those remarks, Distinguished Guests, Ladies and Gentlemen, it is my pleasure to declare the, First On-demand Regional Training Course on ‘**Promoting Climate Change Resilient Forestry in Sub-Saharan Africa**’ officially opened.

Thank you.

Pictorials opening ceremony

	
Figure 2.1: Distinguished guests pay a courtesy call to Ag. Director KEFRI during the official opening	Figure 2.2: Mr. Evans Mutari Administrative Secretary MECCF delivering the opening speech by Cabinet Secretary



Figure 2.3 Mr. Kenji Hayashi, JICA Kenya Office making opening remarks



Figure 2:4 Ms. Ada Nshemereirwe, diplomat from Uganda making opening remarks



Figure 2.5: Mr. Workalemahu Desta, diplomat Ethiopia making opening remarks



Figure 2.6: Participants during the official opening ceremony



Figure 2.7: Guests being addressed by Ag. Director KEFRI during ceremonial tree planting



Figure 2.8: Guests planting a ceremonial tree

2.2 Closing Ceremony Speeches and Remarks

Remarks by Participants during the Official Closing of First on-demand Regional Training Course for Sub-Sahara African Countries

The participants were given an opportunity to give their remarks concerning the course over the three weeks. The remarks were provided as follows:

Ackim Dickson

Ministry of Agriculture, Malawi

Mr Ackim indicated that:

- The training was well structured and organised, as every topic was linked to the next and also to the field visits.
- The field visit was well planned and it played a key role in enriching the entire course.
- He learnt that climate smart/sustainable agriculture was an integrated approach that comprised mainly of tree growing, livestock keeping, fruit farming, and poultry keeping.
- He will apply the acquired knowledge and skills back in Malawi.

Salimah Kyomugisha

Nyabyeya Forestry College, Uganda

Ms Kyomugisha stated that:

- The selection of facilitators was done well.
- All the facilitators delivered their assignments well.
- The facilitators were able to link to what participants do in their area of work.
- The presentations were clear and easy to follow.
- Learnt a lot from the KEFRI Tree Seed Centre (different types of tree seed, testing methods).
- The pathology lab was also another area that she learnt interesting activities; by seeing and undertaking hands on practical
- The Kereita field visit was very informative, learnt how communities through application of benefit from the forest while managing the forest. The user rights, communities are allowed to access some resources from the forest such as water and firewood.
- The visit to Nguriunditu valley made her to learn on how indigenous trees species could be used for rehabilitation of degraded sites.
- The visit to bamboo trial helped her to learn about new bamboo species and

how they perform in different ecological zones.

- Gained knowledge and skills on writing and editing of information materials.
- The field visit to Kitui and Kibwezi made her learn new tree species such as the Baobab.
- The M-STaR long root technology was amazing, which it applied could be a solution to tree growing in the drylands in Uganda.

Phiona Kwaga

National Forestry Resources Research Institute (NaFORRI), Uganda

Ms Kwaga indicated that:

- She gained skills and knowledge on tree seed particularly tree seed handling and processing
- She learnt about:
 - The Gene bank and will introduce the same idea in Uganda.
 - New technology about the M-StaR long rooted technology; she will introduce same idea back in her country.
 - New bamboo species at Nguriunditu.
 - Tree seed for the dryland species which is also relevant for Uganda.
- She socially made new friends and networked.
- Resource persons were very clear and conversant with their assignments.
- The course was well prepared and coordinated.
- She identified new research areas.

Fredy Ndandika

Tanzania Forest Service (TFS), Tanzania

Mr Ndandika stated that he:

- Learnt the importance of communication skills, gained new skills and knowledge on dissemination using various extension materials.
- Gained skills on development of action plans that will enable him plan his activities.
- Noted KEFRI has good working environment
- Learnt the following from the field visit:

Kitui

- Learnt a lot from the integrated farmer who was practising smart agriculture and will adopt poultry farming in his farm.

- Bamboo can be used for rehabilitation noting that back in Tanzania bamboo potentials was not fully utilised, and plans to introduce bamboo for rehabilitation degraded riverbanks.
- Tree Nursery: Exposed on the process of *Melia volkensii* (indigenous species) seed extraction and raising of seedlings

Kereita Forest

- Participatory Forest Management: the idea of allowing community members benefit from the forest through well organised user rights/groups seemed to work well. Tanzania uses paramilitary approach; communities are not allowed in the forest. He indicated that, he will introduce the idea in Tanzania.

Kibwezi

- Learnt some procedures on control and management of invasive plant species

Milkajane Sangiwa

Tanzania Forestry Research Institute (TAFORI), Tanzania

Ms. Sangiwa stated that:

- KEFRI has a rich website populated with a lot of publications.
- The training was very impactful.
- She identified Dr. Omondi as her mentor.
- Learnt about:
 - Pasture farming; she indicated she used to see grasses as just weeds with no importance but she learnt that they can be grown for income and animal fodder.
 - PFM, particularly the user groups that are not very common in Tanzania. She didn't know that community members can benefit, access the forest for instance the water user group that is bottling water in Kereita Forest which may not be happening in Tanzania.
 - M-StaR technology by KEFRI and the Aflasafe at KALRO are crucial technologies for forestry and agricultural development in ASALs.
 - Tree improvement is necessary for tree product development.
 - Communication skills are essential for effective information delivery.

Gabriel Nimenya

Burundian Office for Environmental Protection (OBPE)

Department of Forests, Burundi

Mr. Nimenya indicated his priority learning points included:

- Seed processing and handling.

- Model Farmer Approach: working with farmers in research and conservation as a good idea.
- Bamboo utilization - Use of bamboo as construction material and for rehabilitation of riverbanks; He noted that Bamboo is not fully utilised in Burundi. He plans to create awareness and establish bamboo in Burundi.

Mercy Rutto

Kenya Forestry Research Institute (KEFRI), Kenya

Ms. Rutto indicated to have:

- Learnt communication and writing skills of information materials.
- Identified great research potential and research gaps in the drylands.
- Created network and learnt from shared experiences.

Yeshifana Mengesha

Ethiopian Forestry Development, Ethiopia

Ms. Alemneh indicated that she learnt about:

- Tree improvement as key for effective tree growing in the dryland areas; and indicated interest to undertake research in tree improvement.
- Community engagement through Participatory Forestry Management.
- The M-STaR technology.
- From shared experiences from fellow participants
- She hoped that the participants would form a network for continued information sharing.

Isaac Boaza

Ministry of Agriculture and Food Security, Directorate of Agricultural Research, South Sudan

Mr. Boaza indicated that:

- The course was well organised and coordinated.
- Resource persons were well equipped and experienced.
- He learnt a lot from the field especially;
 - Climate smart agriculture; he will implement the same when back in his country.
 - Soil and water conservation technologies.
- Learnt about land rehabilitation using bamboo.
- Tree improvement especially *Melia volkensii* that is good for the drylands.

Vashit Kivondo
Kenya Forest Service (KFS), Kenya

Ms. Kivondo stated that:

- The choice of course topics was well thought. The topics were linked to each other.
- She learnt a lot about seed extraction and pre-treatment methods.
- She proposed that in the next training, organizers consider.
 - Identifying youth groups for the participants to learn from.
 - Including project management as it is an important topic.

Vote of Thanks by Course Participants Chairperson, Vashit Kivonda

The chairperson Ms. Kivonda appreciated KEFRI as the host who organised and coordinated the course. In her speech, she indicated that the participants had adapted to KEFRI Muguga's environment which made them comfortable and made learning easy. She stated that, field sites offered great learning points.

She thanked JICA/SFS-CORECC project for sponsoring the course which has enabled them to get what they required for the course. She noted that the resource persons selection was well done, as they were experienced and conversant with activities of the participants, an act that challenged them.

Ms. Kivonda indicated that the visit to KALRO was well thought, well coordinated and organized, KALRO facilitators were equally knowledgeable and participants learnt many things that will benefit them when they go back to their countries. For example, Malawi which is heavily engaged in maize farming could benefit greatly from the technologies from KALRO Katumani.

Ms. Kivonda, the group chairperson further appreciated the Agricultural Information Resource Centre (AIRC) who delivered on communication skills. The facilitators were young but effective and they were able to deliver the required skills and knowledge to the participants.

She concluded by thanking the KEFRI management, facilitators, logistics team, the participants, KEFRI choir, KEFRI house and every staff for the support they got throughout the training.

Remarks by Dr. Jane W. Njuguna the Ag. Director KEFRI

The Principal Secretary, State Department for Forestry Mr. Gitonga Mugambi,
Represented by Mr. Evans Mutari

The Chief Representative, JICA Kenya Office, Represented by Ms. Tae Ose
Participants,

Distinguished Guests,

Ladies and Gentlemen,

Good evening

It is my pleasure to warmly welcome you all to this ceremony, a ceremony that marks an end to a successful 3-weeks Regional Training course on 'Promoting Climate Change Resilient Forestry in Sub-Saharan Africa'. This training drew participants from 7 Sub-Saharan Africa countries which have similar environmental challenges and equally vulnerable to adverse impacts of climate change and land degradation. The regional training was conducted under the Project for Strengthening Forestry Sector Development and community Resilience to Climate Change through Sustainable Forest Management and Landscape Restoration (SFS-CORECC), a five-year project jointly implemented by government of Kenya through the Ministry of Environment, Climate Change and Forestry (MECCF), KEFRI and KFS, in collaboration with Government of Japan through JICA.

This training aimed to bridge identified technical knowledge gaps in Natural Resource Management (NRM) through sharing of knowledge, skills, experiences and innovations, making it a skills-oriented regional training for maximum impact.

I am happy to report that the training objectives have been met through interactive discussions and enriching educational excursions to drylands of South Eastern Kenya namely; Kitui, Makueni and Machakos counties where the participants visited KEFRI Dryland Eco-region Research Programme, Kenya Agricultural and Livestock Research Organization (KALRO) research Institutes of Kiboko and Katumani, as well as model farmers. The learning excursions also saw participants visit indigenous and plantation forests within Kiambu County and take part in the national tree planting by planting trees within KEFRI arboretum. I have no doubt that with such exposure the participants were able to appreciate research output and farmer innovations and involvement in application of climate change adaptation measures that can be adopted in many of the African countries presented here.

In the long term it is expected that skills acquired through this training will greatly contribute to restoration of landscapes through adoption of climate smart and resilience forestry and agricultural technologies.

I extend my appreciation to Japan International Cooperation Agency (JICA), for their invaluable technical and financial support, contribution and commitment to success of this training. I also thank the Government of Kenya, through the Ministry of Environment, Climate Change and Forestry, State Department for Forestry for continued support to KEFRI for research and development, and to this training.

To participating countries, for show of trust in KEFRI to deliver this training. We look forward to continued collaboration as it is through our collective efforts that we can overcome the complex challenges facing our forests and other natural ecosystems.

To the participants, your dedication and commitment throughout the training period has been commendable. I trust that you have gained valuable insights and skills that will enable you to contribute effectively to climate-resilient forestry initiatives in your respective countries. As you return home, I urge you to integrate the knowledge and experiences gained into your daily activities, working closely with your supervisors and while utilizing resources available to you.

Though this training course is coming to an end, let us stay connected and continue to learn from each other's experiences. Let us leverage on our common African heritage of sharing and continue to foster collaboration and mutual support.

Let me also extend gratitude to the KEFRI, SFS-CORECC team and all facilitators who collectively contributed to the success of this training.

Thank you.

Remarks by Ms. Tae Ose, JICA Kenya Office

Good afternoon

My name is Tae Ose from JICA Kenya office. I am a Project Formulation Advisor in the Climate Change Sector. I arrived in Kenya a month ago. This is my first time in Kenya. Before coming to Kenya, I worked and lived in Nigeria. Abuja, the capital of Nigeria, was hot all year round, so I was very surprised at the cool mornings and evenings in Nairobi. I am a little scared now because I hear that Kenya will have winter in the future and it will be colder.

- First, I am very sorry that the Country Representative and Senior Representative of JICA Kenya Office were unable to join this closing ceremony today. In their place, I and Mr. Osindi are pleased to participate in this ceremony on behalf of JICA Kenya Office.
- On behalf of JICA Kenya Office, we would like to extend our congratulations to the 10 participants from 7 countries who have successfully completed this training today. Congratulation! Let's give them a big round of applause (again).
- I would also like to thank the organizers of this training, i.e. SFS - CORECC's Component 4 experts and counterparts for their efforts in organizing and running this training, and KEFRI for providing the training location.
- JICA Kenya Office is aware that each of you made their action plans, and strongly hope that you will use it to share what you have learned and gained through this training to your colleagues/ supervisors and actual implementation when you get back to your respective countries.
- Additionally, JICA Kenya Office would like to continue to actively support trainings like this one in the spirit of promoting regional cooperation through tailored thematic areas and careful selection of trainees from Sub-Saharan Africa countries.

- Dear trainees, how was this training? We would be very grateful if you could give us your impressions and feedback, even after the ceremony.

Speech by Mr. Gitonga Mugambi, EBS, Principal Secretary State Department for Forestry

The Chief Representative, JICA Kenya Office, Represented by Ms. Tae Ose,
The Ag. Director, KEFRI, Dr. Jane Njuguna,
Participants,
Distinguished Guests,
Ladies and Gentlemen.

Good afternoon,

It is with much delight that I join you this afternoon here at KEFRI to officiate at this important ceremony, a ceremony that marks the conclusion of the First on-demand regional training course on “**Promoting Climate Change Resilient Forestry in Sub-Saharan Africa**”. This ceremony is indeed an important occasion as it symbolizes an end to a successful three (3) week training for participants graduating today. It is with much pleasure and commendation that I take this opportunity to sincerely congratulate all the 10 participants, drawn from 7 Sub-Saharan Africa countries, for having effectively undertaken and successfully completed the training.

Ladies and Gentlemen, I am informed that this was a skills-oriented training whose major objective was to provide participants with an opportunity to enhance their capacities to implement Climate Change mitigation and adaptation measures, landscape restoration approaches, livelihood improvement and food security in the dryland as a means to address the challenge of hunger and poverty, resilient livestock keeping in the drylands through fodder development in the drylands and forestry development in the Arid and Semi-Arid lands. I also note that a module on effective communication skills was part of the training programme, an essential skill that is expected to promote effective technology transfer from research and development institutions, to end users who are mainly the farmers.

I am happy to learn that the training objectives have fully been met and participants have now acquired very useful and relevant knowledge and skills from this training which was delivered through interactive discussions with a wide range of our experts from KEFRI, KFS, JICA and other partner institutions, as well as from farmers. I note with much appreciation that during the training, issues on promotion of landscape restoration, resilient landscapes and human well-being were given great prominence coming at an opportune time when the world is currently struggling on how to tackle the most pressing triple environmental crisis namely; Climate Change, Biodiversity loss and Pollution. As we all know these challenges are presently a great threat to sustainable development, and present a real crisis that is interfering with human health, livelihoods and resilient of our region.

Ladies and Gentlemen, for a very long time, we in Africa have left our natural resources vulnerable to degradation, which has created a vicious cycle of hunger and poverty. Just as there is an inherent connection between hunger and unproductive land, there is also a link between land and forest degradation, leading to conflicts as communities compete for scarce resources. However, options that offer great potential and provide diverse choices for elimination of poverty, hunger and conflicts include making our communities more resilient to climate change by promoting implementation of sustainable management of all types of lands and forests, halting deforestation and biodiversity losses, restoring degraded forests and promoting climate smart agriculture.

To collectively address these common challenges, we should lay great emphasize on impactful, effective and sustainable collective actions that can scale up appropriate technologies that can quickly address current and emerging environmental challenges.

Ladies and Gentlemen, we know that climate change effects are more severe in Africa as the continent is more vulnerability to adverse effects of climate change and has limited capacity to deal with climate-induced calamities. Catastrophes currently being experienced in many of our countries include unprecedented heavy rains, which lead to severe flooding, landslides and subsequent displacement of populations, a scenario being witnessed in many parts of Kenya this year. The floods alternate with frequent prolonged droughts which cause crop failure and livestock losses. If we are to save our people from such environmental disasters, we need to take into account that it is no longer an issue of just taking action, but rather how much action we need to take. Indeed, we must take urgent and aggressive climate action now.

I therefore encourage the participants to develop action plans for climate change adaptation according to their specific national circumstances, ultimately implement planned activities for us to all be involved in tackling climate change challenges caused by these weather phenomena. The clarion call is that we must move urgently to build capacity of our communities to cope with such negative effects through promotion of climate change mitigation and adaptation strategies.

Ladies and Gentlemen, reflecting on the Sustainable Development Goals, it is important for us to note that some of the critical goals include ending hunger to achieve food security through sustainable agriculture by especially by small holder farmers productivity of crop and livestock; and goal number 15 which seeks to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss. For us in Africa these goals can only be achieved by improving livelihoods of our people through aggressive promotion, and ensuring adoption of viable natural resource management options that would stop land degradation. Such an approach will no doubt significantly contribute to sustainable development if we are actively involved in; rehabilitation, restoration,

conservation and sustainable management of our natural resources. We are all aware that Africa is highly dependent on agriculture and forestry activities for its economic, social security and ecological service provision. There is therefore a need to empower our communities so that they can play a more effective role in building resilient livelihoods and ecosystems by managing our natural resources sustainably.

Ladies and Gentlemen, let us all keep in mind that climate change effects and challenges transcend geographical boundaries. Therefore, as natural resource managers, we are collectively and individually called upon to manage and protect the environment, we have a responsibility of working together to promote climate action strategies that ensure resilience to a changing climate. The good news is that there are a number of strategies and approaches we can pursue now to lead to a healthy climate-resilient continent through adoption of green growth and technology transfer of practices that have been proven to work in various parts of the continent. To ensure success in environmental sustainability across our borders, I urge you to develop networks that will enable you to continuously share new information, best practices and data on climate change among yourselves.

Distinguished guests, Ladies and Gentlemen, allow me to take this opportunity to express the State Department for Forestry's gratitude to JICA for continued technical and financial support to Kenya for research and development as well as for this training. I note with appreciation such training programme for Sub-Saharan Africa continues to build capacity of participating countries within our region to timely respond to various emerging environmental challenges which go beyond country geographical boundaries.

Let me also acknowledge governments of the countries whose officers have attended this training course. This certainly is a show of their commitment to tackle common environmental challenges facing Sub-Saharan Africa today. It is therefore my hope and belief that lessons from this training will be cascaded to the end users and in turn greatly improve the capacity of our people to reduce their vulnerability to climate change.

With these remarks, Ladies and gentlemen, it is now my pleasant duty to declare the First on-demand Regional Course on “**Promoting Climate Change Resilient Forestry in Sub-Saharan Africa**” officially closed.

Thank you.

Pictorials closing ceremony



Figure 2.9: Dr. Jane W. Njuguna, Ag. Director KEFRI making closing remarks



Figure 2.10: A group photo during closing ceremony



Figure 2.11: Ms. Mercy Rutto, Kenya participant making remarks



Figure 2.12: Ms. Salimah Kyamugisha, Uganda participant making closing remarks



Figure 2.13: A participant from Burundi receiving a certificate



Figure 2.14: A participant from Uganda receiving a certificate

CHAPTER 3

3.0 Course Evaluation

3.1 Introduction

This section presents the analysis of course evaluation feedback on the participants' general perceptions of the course implementation. Analysis include course delivery process, relevance of the training which was indicative of the capacity of the course to enable participants apply lessons learnt. Additionally, the evaluation process took into account field reports, presentations, and group work as crucial components of the evaluation.

Evaluation of the first on-demand training on Promoting Climate Change Resilient Forestry in Sub-Saharan Africa countries was divided into six (6) categories, namely; course objectives, course relevance, course curriculum, administration and management, plans after the training and recommendations. The participants were expected to respond by rating or giving suggestions.

The participants therefore responded to the questions that were rated by ticking against their perceived appropriate choice, where:

1=Very low, 2=Low, 3=Moderate, 4=High, 5= Very High

3.2 Analysis of evaluation feed back

Course objectives

Most of the participants were aware of the course objectives before attending the training (Table 3.1). Knowing the objective beforehand was crucial in anticipating what to learn from the course. Majority of the participants indicated that the objectives and expectations were met to a large extent.

Course curriculum

Time allocated to presentations/lectures, group work, field visits and discussions were mainly rated as high to very high an indication that time allocated was appropriate. However, a few of the participants rated lecture/presentation and discussions moderate since they indicated that the course was intense and there was need for a flexible schedule that allows some free time especially in the evening to give time to relax and refresh. This was noted as an area of improvement in other upcoming trainings. Majority of the participants noted that the training materials provided were of high quality with relevant information. Materials shared included KEFRI brochures, guidelines, manuals, and presentations. This indicates a need for continuous development and production of information materials for use by Sub-Sahara African countries.

Action plans development, dryland forestry technology, climate-smart agriculture,

and tree health were highlighted as the most interesting and beneficial topics whereas Kereita Forest, dryland areas in Machakos, Kitui, and various farms were noted as beneficial field visits.

Administration of the training

Accommodation during field visits was rated as good, communication among the participants was excellent while medical attention was appropriate.

Suggested new topics for inclusion

The course received high ratings (4 and 5) in most categories, indicating general satisfaction with the course objectives, relevance, curriculum, administration, and management. However, the participants suggested new topics for inclusion in future namely; proposal writing, climate change, GIS and remote sensing, carbon credit/climate financing, project planning and management, data analysis, value addition and wood processing technologies as well as Monitoring and Evaluation (M&E).

Table 3.1: Analysis of After-Course Evaluation

No.	Item (s)	Rating (%)					
		1	2	3	4	5	Average (3-5)
I. Course Objectives							
	To what extent were you aware of the objectives of this training course before you came to Kenya?			10	60	30	100
	To what extent do you think the objectives have been met?				60	40	100
	In your opinion, to what extent were your expectations from this course met?			10	30	60	100
II. Course Relevance							
	Is the course relevant to your institution?				30	70	100
	Will the course help you develop professionally?				10	90	100

	What did you like most about this course (Generally)? • The experience noted in Kitui on how to promote Bamboo in the fight against flooding and the promotion of bamboo products • Practicals on seed health tests in the lab • The networking for future working • Long rooted seedling production technology • Resourceful trainers • Unique dryland species • Commercial forestry development in the drylands • Action plan development • Improvement of communication skills • Restoration and rehabilitation of landscapes						
III. Course Curriculum							
	Ratings	1	2	3	4	5	Average (3-5)
	Coverage of the topics			10	20	70	100
	Time allocation to						
	a) Lecture/ Presentation			30	40	30	100
	b) Group work			10	50	40	100
	c) Field visits				30	70	100
	d) Discussions			20	20	60	100
	Course Intensity			10	20	70	100
	Training materials provided/acquired				30	70	100
	Quality of training materials provided/ acquired				10	90	100
	Total course duration		10	10	30	50	90

IV.	Please list most interesting and beneficial topics to you in the training programme • Development of action plan • Dryland Forestry technology • Indigenous tree Improvements and breeding • All trainings are interesting and beneficial to me • On-farm Melia growing and its value chain • Climate Smart Agriculture • Tree seed testing • Dynamics of tree diseases/Tree health • Communication/facilitation and presentation skills • Participatory forest management by user groups • Long rooted seedling production using M-staR technology						
V.	Please list the most interesting and beneficial field visits to you in the training programme • Kereita Forest • Dryland areas, particularly Machakos (KALRO AMRI and ARLRI) • Mr. Rodgers Kaleve’s farm • Dryland Eco-region Research Programme-Kitui • KEFRI Tree seeds Centre • Melia seed orchard at Tiva • Mr. Jonathan Kituku’s farm • All the field visit sites were good						
Ratings		1	2	3	4	5	Average (3-5)
	To what extent do you think the techniques and knowledge you have attained in this course will be applicable in your country/institution				20	80	100
VI. Administration and management							

How would you evaluate the general administration and management of the course in terms of:																									
Ratings		1	2	3	4	5	Average (3-5)																		
	Pre-course information (General Information, briefing orientation and communication)			10	10	80	100																		
	What is the minimum period you would require for preparation of the course after the receipt of the invitation letter?																								
	<table><tr><td>PERIOD</td><td>Frequency (n)</td><td>Frequency (%)</td></tr><tr><td>2 weeks</td><td>3</td><td>42.9</td></tr><tr><td>1-2 months</td><td>2</td><td>28.6</td></tr><tr><td>1 week</td><td>1</td><td>14.3</td></tr><tr><td>1 month</td><td>1</td><td>14.3</td></tr><tr><td>Total</td><td>7</td><td>100.0</td></tr></table>							PERIOD	Frequency (n)	Frequency (%)	2 weeks	3	42.9	1-2 months	2	28.6	1 week	1	14.3	1 month	1	14.3	Total	7	100.0
	PERIOD	Frequency (n)	Frequency (%)																						
	2 weeks	3	42.9																						
	1-2 months	2	28.6																						
	1 week	1	14.3																						
	1 month	1	14.3																						
Total	7	100.0																							
Ratings		1	2	3	4	5	Average (3-5)																		
	General Coordination of the course conduct (course organization)				40	60	100																		
	Selected organizations, and farmers visited during field visits				44	56	100																		
	Accommodation during field visits				40	60	100																		
	Communication among participants				10	90	100																		
	Medical attention		10			90	90																		
	Plans after Course																								

VII.	What technologies/skills do you plan to promote or utilize from this training?		
	Technology/ skill	Frequency (n)	Frequency (%)
	Long root seedlings M-star Technology	5	21.7
	Forest landscape restoration	4	17.4
	Soil and water conservation	3	13.0
	Promotion of bamboo in the stabilization of banks	3	13.0
	Dryland agriculture or climate smart agriculture	2	8.7
	Utilization of Acacia	1	4.3
	Intercropping pasture with trees	1	4.3
	Editing and writing skills	1	4.3
	The use of user groups in PFM	1	4.3
	Seed handling and production	1	4.3
	Tree health	1	4.3
	Total	23	100.0
VIII.	Suggest additional topics that may not have been covered during course		
	• Evaluation of resources • Proposal writing course • Climate change • GIS and remote sensing • Carbon Credit • Project planning and management • Data analysis using different softwares • Monitoring and Evaluation		

	What are the new findings you got during the training period (General)? • The approach of involving farmers to adopt tree growing • Soil conservation technologies • Better/advanced technologies for restoration of ASAL'S • Motivation to develop research proposals • Learnt new dryland tree species unique to Kenya • Different adaptations techniques to climate in dryland area's using species like (<i>Melia volkensii</i>) • New innovative ways people apply to cope with changing climate • Facilitators were well equipped and organized • Tree seed improvement techniques					
	Recommendations					
Ratings	1	2	3	4	5	Average (3-5)
Would you recommend this course to others?				10	90	100
	Additional Comments and Suggestions for Improvement? • Duration of the training to be increased to at least 4 weeks in-order to incorporate more content • I have appreciated Kenya's experience in designing a training programme that meet changing needs • Additional course modules on project monitoring and management and also data processing					

Pictorial in-house



Figure 3.1: In-house session in Muguga



Figure 3.2: In-house session in DERP Kitui

CHAPTER 4

4.0 Field Visits Report

4.1 Introduction

Field visits were an essential component of the training programme. The visits were designed to augment theoretical knowledge covered during lecture sessions. The field visits undertaken during this training aimed at enhancing participants understanding of climate change resilient forestry in Sub-Saharan Africa, through observations of innovative practices and technologies in the field. The visits were carried out at various sites that included: KEFRI Central Highlands Eco-Region Research Programme-Muguga (CHERP); Kereita Forest in Limuru, Kiambu County; Dryland Eco-Region Research Programme (DERP)-KEFRI Kitui and Tiva; Kenya Agricultural and Livestock Research Organization (KALRO) at Arid and Rangelands Research Institute (ARLI) - Kiboko and Agriculture Mechanization Research Institute (AMRI) - Katumani, as well as in selected farmers fields. During the visits participants were exposed to various natural resource management technologies, techniques, practices and demonstrations being undertaken both at research stations and on farms sites visited.

4.2 Sites visited

KEFRI Central Highlands Eco-Regional Research Programme - Muguga

- Nguriunditu Valley Forest
- Muguga National Bamboo Trial Plot
- KEFRI Tree Seed Centre
- KEFRI Entomology and Pathology Laboratories

Kereita Forest Reserve

- Participatory Forest Management (PFM) by Kijabe Environment Volunteers (KENVO) CFA in Kereita Forest

KEFRI Dryland Eco-Region Research Programme (DERP)-Kitui

i. KEFRI On-station Research and Development (R&D)

- Research and Development: Overview of KEFRI activities, achievements and challenges at KEFRI DERP
- Demonstration on long-rooted seedlings production
- Indigenous tree improvement and breeding: The case of *Melia volkensii* and *Acacia tortilis* at KEFRI Tiva

ii. On-farm

- Technology transfer through model farmer approach in Kitui

- On-farm commercial forestry development in the drylands of Kibwezi, Makueni County

KARLO: ARLRI-Kiboko and AMRI-Katumani

- Rehabilitation of pasture land for sustainable livelihood in drylands: Demonstration of improved natural pasture growing for sustainable livelihood in drylands.
- Dryland agriculture for community and climate resilience: Demonstration of dryland agriculture for community and climate resilience.

4.2.1 KEFRI Central Highlands Eco-Regional Research Programme -Muguga

Visit 1: Rehabilitation of Nguriunditu Valley Forest

Introduction

Nguriunditu Valley forest is a semi-natural forest of mixed indigenous species located in Kiambu County. KEFRI initiated the forest rehabilitation in 1989 to demonstrate forest restoration technology. The adjacent communities including local primary schools were involved in tree planting for rehabilitation of the forest. The aim of rehabilitation was to restore the forest to as close as possible to the original structure including species composition. It was expected that the restored forest would result into increased level of portable water supply from the boreholes dug in the valley. The forest would also be a source of other services such as forest research, biodiversity conservation, and eco-tourism activities.

Tree planting in the forest was carried out in phases from 1989 to 1999. A total of 56 indigenous tree species were planted in 7 plots. The tree species planted included: *Celtis africana*, *Markhamia lutea*, *Prunus africana*, *Rapanea melanophloeae*, *Croton megalocarpus*, *Polycias fulva*, *Albizia gummifera*, *Vitex keniensis*, *Cordia abbyssinica*, *Juniperus procera*, *Olea europea ssp. africana*; *Olea capensis*, *Podocarpus falcatus*, and *Warbugia ugandensis*.

Objective

The objective of the visit was to learn the:

- Importance of forest landscape restoration through tree planting by active restoration.
- Techniques used in rehabilitation of degraded forest sites.

Activities

- Demonstration of rehabilitation of degraded sites using indigenous tree species.
- Management and maintenance of established tree plots.

Lessons learnt

- There is need for careful planning before any rehabilitation activities begin.
- Establishing clear, realistic goals from the beginning helps guide the rehabilitation process and ensures that efforts are aligned with desired outcomes.
- Different indigenous tree species can be used for rehabilitation.
- Indigenous species are usually better adapted to local conditions and best suited for rehabilitation as they contribute to long-term sustainability.
- Different indigenous tree species provide varied uses e.g. *Brachylaena huillensis* is used for carving and *Prunus africana* for treatment of prostate cancer.
- Successfully rehabilitated sites often serve as educational sites, demonstrating the importance of raising awareness about environmental conservation and sustainable forest utilization.
- Indigenous tree species are good for restoration and conservation of water tables compared to exotic tree species.
- Through selection of suitable indigenous species, the Nguriunditu valley forest has attained structure of a natural forest that include; upper canopy layer, middle canopy layer and lower canopy layer, as well as undergrowth.



Figure 4.1: Participants taking a walk in Nguriunditu valley forest

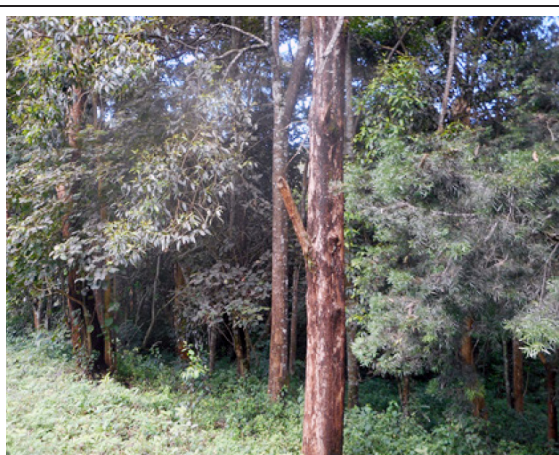


Figure 4.2: Rehabilitated Nguriunditu valley forest

Challenges

- Dumping of waste in the forest by local community.
- Theft of forest products by adjacent communities.

Impact

The impacts of the rehabilitation are both ecological and social:

a) Ecological impacts

- Improved biodiversity.
- Increased tree cover.
- Gene conservation of indigenous trees.
- Increased underground water levels.
- Climate change mitigation: The forest act as carbon sink, helping to mitigate the impact of climate change.
- Species richness and structural diversity.
- Increase in fauna such as birds.

b) Social impacts

- Better health: Muguga forest contribute to cleaner air and more underground water which are essential for surrounding community health.
- Increased resilience: Forest protects communities from natural disasters such as floods as they absorb rain water and control erosion, thereby increasing their resilience.
- Social cohesion: Water supply by KEFRI to the community, which is sourced from the forest valley strengthens social bonds.

Technique

Technique discussed during the visit:

- Active restoration technique.

Technique definition

- Active restoration refers to the intentional and direct human intervention to restore or rehabilitate ecosystems, that have been degraded, damaged, or destroyed. This approach contrasts with passive restoration, where ecosystems are allowed to recover naturally without human intervention.
- For Nguriunditu Valley Forest, active restoration was done through planting 56 indigenous tree species through a period of 11 years.

Purpose

- To restore Nguriunditu Valley Forest to its natural state for improved forest cover and underground water conservation.

Advantages

- Restoration of critical ecosystem service through; water infiltration, soil stabilization, and carbon sequestration, contributing to overall environmental health.

- Reintroduction of indigenous tree species, thereby increasing biodiversity as well as gene conservation.
- Climate change mitigation.

Disadvantages

- Costly investment: Requires a lot of time and finances for establishment and maintenance of the rehabilitated site.

Procedures

1. Evaluate the state of the site e.g. degree of degradation.
2. Identify indigenous tree species endemic to the site or suitable for the agro-ecological zone.
3. Develop a restoration plan including acquiring seed and raising seedlings.
4. Prepare site which includes removal of any exotic species.
5. Prepare the planting sites e.g. delineate the different plots and dig planting holes as appropriate.
6. Plant the identified tree species seedlings.
7. Plant tree in different plots e.g. the Nguriunditu forest has 7 plots planted at different years from 1989 to 1999.
8. Undertake survival count.
9. Assess growth performance of the trees in terms of height and diameter (DBH).
10. Record and monitor occurrence of any tree species not planted.

Do's

- Ensure high quality seeds for raising planting stock.
- Ensure high quality and healthy seedlings are planted.
- Select the right trees species and use only indigenous tree species that are well-adapted to the environment and have a higher chance of survival.
- Involve stakeholders by engaging local communities, including schools, and government agencies in planning and implementation process.
- Plant during rainy season when the soil has enough moisture.
- Undertake regular assessment and monitoring.

Don'ts

- Do not rehabilitate a degraded site with exotic tree species.
- Do not use unqualified personnel.

Recommendations

- Document and share the successes and challenges of the rehabilitation process to inform restoration of other areas.
- Adapt and adopt the techniques used in restoration of Nguriunditu to other similar ecosystems.
- Integrate livelihood opportunities for local communities such as beekeeping or eco-tourism, to ensure long-term economic viability of the forest.
- Continue forest monitoring to gather data and to address any emerging issues.
- Introduce eco-tourism to generate revenue that that can be ploughed back for protection of the forest.
- Explore ways of utilizing the forest for carbon trading.

Visit 2: Bamboo Trial: Muguga National Bamboo Trial Plot

The Muguga National Bamboo trial plot was established in 1987 by KEFRI. The trial plot is composed of 16 exotic Bamboo species introduced from Asia. Fifty seedlings of each species were planted and replicated in two plots each of twenty-five seedlings. The bamboo species planted in the trial plots included; *Dendrocalamus asper*, *Bambusa vulgaris* (*vitata* – culms with yellow green strips), (*Vulgaris* – green culms), *Dendrocalamus membranaceus*, *Dendrocalamus brandisii*, *Bambusa tulda*, *Dendrocalamus giganteus*, *Oxitenanthera abyssinica* and *Bambusa bambos*.

Objectives

The objectives of the visit were to:

- To gain knowledge on bamboo growing practices, including planting, maintenance, and harvesting techniques.
- To learn about the different species or varieties of bamboo introduced in Kenya.

Activities

- Establishment of different bamboo species.
- Height and diameter measurement of culms (stems) and clump (cluster).
- Management practices-silvicultural management such as harvesting by applying horse shoe technique. The technique involve creation of a path in the centre of the clump to facilitate harvesting of culms as harvesting is done from the inner culms outwards.

Lesson learnt

- Bamboo is a high value crop which is fast growing, hence can provide income within a short period.

- Vegetative propagation is the best option for establishing bamboo as the species takes long time to produce seeds and the seeds have low germination potential.
- Bamboo has different uses of ecological and economical nature, making it attractive for adoption by farmers.



Figure 4.3: *Bambusa vulgaris*



Figure 4.4: *Oxytenanthera abyssinica* a semi-solid bamboo



Figure 4.5: *Dendrocalamus giganteus* (Giant bamboo) clump



Figure 4.6: Participants observing bamboo clump

Challenges

- Disease infestation- e.g. die back on *Dendrocalamus brandisii*.
- Theft of bamboo by community members.
- Slow adoption of bamboo growing by the local community as there is no established formal market for the species.

- Some propagation methods such as tissue culture are costly and expertise is required for its application.

Impacts

The bamboo trial has impacted the area ecologically and socially:

a) Ecological impacts

- Climate amelioration.
- Water table rising.
- Soil and water conservation.
- Carbon sequestration as the species is fast growing.

b) Social impacts

- The trial plot offers training opportunities in bamboo cultivation and product development, empowering local people with skills.
- Source of products, e.g. provision of firewood to community members.

Pending Issue

- Lack of established formal markets for bamboo.

Recommendations

- Create awareness to the public on importance of bamboo.
- Undertake continuous research on bamboo seeding.
- Explore utilization of the bamboo crop for carbon trading.

Techniques observed

The techniques observed included:

- Establishment technique.

Purpose

- To study the growth, adaptability, and performance of different species or varieties in specific environmental conditions.

Advantages

Bamboo growing promotes:

- Carbon sequestration.
- Soil conservation.
- Water management.
- Economic benefits.

Disadvantages

- Bamboo may be invasive; controlling the spread of running bamboo species can be difficult and labour-intensive.
- Costly investment: Requires a lot of time and finances for establishment and maintenance of the crop.

Procedures

1. Site selection: Choose a suitable site. Bamboo generally prefers well-drained soil and plenty of sunlight.
2. Land preparation: Prepare the land identified for planting.
3. Selection of Bamboo species: Choose the appropriate bamboo species or varieties suitable for the site. The variety selection depends on climate, soil type, and the purpose (e.g. timber production, erosion control).
4. Source or raise seedlings of desired variety/species.
5. Prepare the planting site by clearing of bushed, grasses and other unwanted vegetation.
6. Decide on planting design and layout. Small culm bamboo can be planted at a spacing of 4.5m to 5m, while large species can be spaced at 10m.
7. Dig planting holes measuring about 60cm by 60cm. However, in low rainfall areas holes measuring 1m by 1m can be dug.
8. Plant the bamboo seedlings.
9. Management and maintenance include mulching, weed control, pest and disease management.
10. Data collection: to include number of culms per clump, height of tallest stem in the clump.
11. Harvest the bamboo by selection of culms that will be cut, rather than clear felling. Harvesting of bamboo should be from the centre outwards.

Do's

- Select the right bamboo species.
- Plant during rainy season when the soil has enough moisture.
- In dry areas dig large enough planting holes to enable rain water harvesting.
- Undertake regular assessment and monitoring to collect relevant data.

Dont's

- Plant bamboo at close spacing as most varieties in Kenya are clumping type.
- Don't overlook regular data collection.

Recommendation

- Policy support: Advocate for policies and incentives that support bamboo cultivation, research and utilization.
- Advocate for a favourable environment for bamboo development.
- Community engagement: Create awareness to local communities to promote adoption of bamboo for social and economic benefits.

Visit 3: Kenya Forestry Research Institute (KEFRI) Tree Seed Centre

Introduction

A tree seed centre plays a crucial role in conservation, management, and production of tree seeds, which are essential for reforestation, afforestation, and sustainable forest management. Kenya Forestry Seed Centre at KEFRI was established in 1985 through the support of German Agency for Technical Cooperation (GTZ) to provide high-quality, site appropriate tree seed in sufficient quantities to meet the rising demand for tree seed. The Centre is also mandated to undertake research, collect, process, test and distribute tree seeds locally and regionally. Tree seed collection is carried out in all the KEFRI research eco-regions in Kenya. Tree seed collection is done by trained tree seed collectors supervised by foresters. Tree seeds are collected from selected and established seed stands/sources of both indigenous and exotic species.

Objectives

The objectives of the visit were to learn about operations of KEFRI Tree Seed Centre that include tree seed production, processing, testing, storage and quality control.

Activities

The KEFRI Tree Seed Centre is involved in;

Seed Collection

- Selection and establishment of seed sources.
- Conducting field surveys to identify and select appropriate tree species for seed collection.
- Harvesting seed from mother trees. Mature healthy trees are identified and mature seed collected while wearing protective gears. Collection of such seed ensures seeds are of high quality and have good genetic characteristics.

Seed Processing

- Cleaning by removing debris such as; leaves, twigs and soil, from collected seeds to ensure purity and quality.
- Drying seeds to reduce moisture content, which helps prevent mold growth and extends seed viability.

Seed Storage

- Packing seeds in suitable containers or packaging materials to protect them from environmental factors and pests. Seeds are packed, labelled and stored in cool/cold dry place. Labelling involves indicating the seed name, provenance, collection date and batch number.
- Storage management by maintaining proper storage conditions (temperature, humidity and light) to keep seeds viable for long periods.

Seed Quality Testing

Quality testing involves 4 key tests namely; Purity analysis, Weight determination, Moisture content determination and Germination test.

- Purity Testing: Checking for seed purity to ensure that seeds are free from contaminants and mixed species
- Weight determination: This is to determine the number of seeds per kg.
- Moisture content determination: To determine if seeds are at the recommended seed moisture content for storage purpose.
- Germination Testing: Testing seed samples to determine germination rates and viability, ensuring that only high-quality seeds are used for planting. It is used to determine the number of seeds that can germinate per given time.

Seed Bank Management

- Cataloguing: Maintaining a detailed inventory and catalogue of seed species, including information on origin, collection date, and storage conditions.
- Monitoring: Regularly monitoring seed conditions and updating records to track seed viability and make necessary adjustments in storage.

Research and Development

- Seed Improvement: Conducting research to improve seed quality, such as enhancing germination techniques.
- Conservation Research: Researching methods for conserving rare or endangered tree species and their seeds.

Capacity Building

- Workshops and Seminars: Organizing training sessions and workshops for interested partners and community members on seed collection, processing, and management techniques.

Distribution and Supply

- Seed Sales and Distribution: Supplying seeds to government agencies, non-governmental organizations (NGOs), and individual for plantation development, reforestation and afforestation activities.

Lessons learnt

- Not every tree seed source can provide good quality seed. There is therefore need for identifying and selecting trees for seed collection (mother trees) based on criteria such as health, maturity, and genetic quality.
- Seed quality should be enhanced through tree improvement and breeding.
- High quality tree seed is essential for sustainable conservation and forest development.
- Germination trials are important in testing seed viability, and for understanding factors that affect seed germination rates.
- It is important to engage and create awareness to local communities, and general public on need to use quality tree seed and species site matching.



Figure 4.7: Tree seed drying bed



Figure 4.8: Learning about germination test

Challenges

- Climate change affects tree seed centre activities by affecting tree seeding patterns.
- Poor quality and low viability of tree seed.
- Difficult in storing recalcitrant seeds.
- Pest and disease attack on tree seed.
- Lack of modern/advanced technology and infrastructure.
- Lack of tree seed certification.
- Limited genetic diversity.

Impacts

The Tree Seed Centre has impacted the country ecologically, economically and socially as follows:

a) Ecological impacts

- Increased forest and tree cover: Tested quality tree seeds are distributed across the country and region for stakeholder to raise seedlings for planting, hence contributing to increased forest/tree cover.

b) Economic impacts

- Increased income for institution from seed sale.

c) Social impact

- Trained stakeholders on seed collection, handling and how to raise own seed sources.

Pending Issue

- Continuous research on agroforestry and indigenous tree species.
- Upgrading equipment of tree seed centre.

Recommendation

- Strengthen collaboration and multi-agency sharing for better research.
- Seek for more donor funds for improvement of infrastructure and institution operation.
- Incorporate advanced technologies.
- Undertake dissemination of tree seed technologies.

Conclusion

To ensure high productivity of trees being planted, there is need to collect seed from superior tree seed sources. Collected seed should be well managed through proper seed handling and storage to ensure viability.

Visit 4: KEFRI Pathology and Entomology Laboratory

Introduction

All living things including trees, are susceptible to infection by various disease-causing organisms as well as pests. The whole tree value chain is susceptible to attack by pests and diseases at various stages that include; seed, seedlings, growing trees and harvested materials. Kenya Forestry Research Institute pathology and entomology laboratories established in 1986, have a mandate to identify and address tree pest and disease challenges. The entomology laboratory has a total collection of about 60,000 insect species many of which are beetles (Coleoptera). Out of the specimen collected, 6,000 insect species have been identified.

Objective of the laboratories

- Management of forest related pests and diseases.
- To develop an insect reference collection.
- To train stakeholders in pest and diseases identification and management.

Activities of the laboratories

Entomology laboratory activities

- Field surveys to monitor pest outbreak.
- Insect identification and classification.
- Pest behavioural studies.
- Pest monitoring and surveillance.
- Pest trapping.
- Development of Integrated Pest Management (IPM) strategies.

Pathology laboratory activities

- Field research that includes; field surveys and sampling in selected areas for screening.
- Isolation of micro-organisms following standard isolation techniques.
- Pathogenicity tests of collected fungi on healthy hosts.
- Disease mapping that includes disease monitoring and surveillance.
- Development of disease management strategies that may include:
 - (i) Chemical control.
 - (ii) Biological control.
 - (iii) Cultural practices.

Lessons learnt

- Use of biological methods is effective in control of pests e.g. control of cypress aphid.
- Ethanol has long-term preservative potential in preservation of reference insects.
- Quarantine facilities are important in study of issues such as biological agent studies for pest control.
- Undertake tree seed testing before sowing to ascertain its quality for better and healthy seedlings/trees.
- Agar plate isolation method is the best method for testing the health of seeds.
- A diseased tree must be managed urgently either through cutting or use of chemicals to control spread of disease.

Challenges

- Lack of funding for DNA testing for pests that are not in the insect reference collection.
- Inadequate funding to further work on detection of seed borne pathogens in tree seeds.

Impacts

The impacts through pest and disease control and management include ecological, economic and social impacts.

a) Ecological

- Reduce susceptibility of trees to pests and diseases.
- Improve ecological balance.

b) Economical

- Enhance value of timber and non-timber products.

c) Social

- Increased community awareness of pests and disease control.

Recommendation

- Increase the number of identified insects in the reference collection.
- Collaboration with other partners to improve the insect reference.
- Digitize information for ease of referencing in future.

Technique observed

- Identification and preservation methods of insect pests.

Technique definition

- Wet collection: Done for soft bodied insects or at the larva stage e.g. caterpillar. The reagent used is 70% ethanol with 30% water which is occasionally refilled.
- Dry collection: Done for hard bodied insects such as goliath beetle mostly preserved with chloroform and pinned in a cage.

Purpose

The purpose of the visit was:

- To learn about pest identification and preservation in entomology laboratory.

Advantages

- Prevent decay of insects.
- Ease of reference of the insects.

Disadvantages

- Its time consuming and costly.
- It requires technical skills.

Procedures

- Collect and label insect pest by date collected, where found, name of host etc.
- Identify the insect in the laboratory using a key.
- Label pest to species level.
- Store and preserve the specimen as appropriate.

Do's

- Good labelling.
- Use of appropriate preservation method.

Dont's

- Never use photographs for identification.
- Never make assumptions until proper identification has been carried out.
- Do not mishandle the specimen e.g. breaking of wings/antenna.

Recommendations

- Continue identifying new insects.
- Embark on training communities on pest management.



Figure 4.9: Goliath beetle collected in 1953



Figure 4.10: Wet collection in the Entomology laboratory



Figure 4.11: Specimen of diseased trees



Figure 4.12: Participants carrying out specimen preparation in pathology lab

Visit 5: Participatory Forest Management by Kijabe Environment Volunteers CFA in Kereita Forest

Introduction

Participatory Forest Management (PFM) in Kenya is a collaborative approach that involves local communities, government agencies, and other stakeholders in sustainable management and conservation of forests. The approach aims to balance the ecological, economic, and social benefits of forest resources while empowering local communities to take an active role in forest management. Kereita forest is one such forest where PFM is being undertaken. The Kereita Forest is 4700 ha with only a third of the forest being planted forest, while the rest is natural forest. The Kereita Community Forest Association (CFA) was formed in 2010 involving communities adjacent to the forest at a radius of 5 km. The PFM was initiated by a youth group called Kijabe Environment Volunteers (KENVO) which organized communities and identified gaps between the then Forest Department and the community. KENVO organized village meetings to discuss joint forest management participants farmers were grouped into groups, from the user groups they organized training through several exchange programmes. The Forests Act, 2005 (Reviewed The Forest Conservation and Management Act, 2016) promoted community involvement through PFM hence the formation of CFA. The CFA developed the Participatory Forest Management Plan of 2010 that guided the activities of the CFA in the forest.

Objective

The objective of the field visit was to:

- Observe and learn CFA activities implemented in Kereita Forest.
- Learn about the PFM process.
- Learn how CFAs engage local communities in forest management.

Activities

The CFA is involved in the following activities

- Plantation Establishment and Livelihood Improvement Scheme (PELIS) - Shamba system.
- Bee keeping.
- Water bottling.
- Collection of herbs.
- Tree seedling production.
- Eco-tourism (horse riding, hotel-outdoor fun activities e.g. zip lining).
- Community sensitization on forest conservation.

Impacts

PFM has impacted the community ecologically, socially and economically as follows:

a) Ecological

- Natural regeneration of the forest.
- Increase in biodiversity.
- Climate change mitigation.
- Water and soil conservation.

b) Social

- Availability of clean water for domestic use by the community.
- Clean and healthy environment.
- Recreation activities.
- Reduced conflicts through the conflict resolution committee that addresses emerging issues.

c) Economical

- Source of income e.g. through bee keeping.
- Livelihood diversification through various use groups activities.
- Employment creation i.e. for youth through eco-tourism.

Challenges

- High expectations from the community.
- Over exploitation of the forest resources by non-CFA members.
- Conflict over forest leadership by CFA and among the communities.
- Climate change has led to increased tree pests and landslides incidences.
- Frequent changes in forestry related policies.
- Inadequate funds to implement the Participatory Forest Management Plan.

Procedure of CFA formation

The formation of a Community Forest Association (CFA) in Kenya is guided by the Forest Conservation and Management Act of 2016 and related regulations provided by the government and guidelines provided Kenya Forest Service (KFS). The process involves several key steps to ensure that the CFA is legally recognized and operates effectively in the sustainable management of forest resources. The KENVO CFA was formed adhering to the following procedures:

1. Community mobilization and awareness: Awareness campaigns to educate the local community about the benefits and objectives of forming a CFA.
2. Stakeholder analysis who includes community members and government agencies.
3. Formation/strengthening of CFA structure.
4. Formation of an Interim Committee.
5. Registration of the CFA.
6. Identification of forest resources.
7. Assessing forest area and identification of the resources by community.
8. Identification of Income Generating Activities (IGAs).
9. Development and implementation of a Participatory Forest Management Plan (PFMP).
10. Preparation and launch of forest management plan.
11. Negotiating and signing forest management agreement.
12. Implementation of forest management plan.
13. Review and revision of the Plan on the basis of experience.
14. Development and implementation of evaluation and monitoring plan.

Do's

- Involve the community fully for effective PFM implementation.
- Promote transparent process in Participatory Forest Management Plan (PFMP) implementation.
- Undertake timely review of forest management plans.

Don'ts

- Do not manipulate PFM implementation process.
- Do not make decisions on behalf of the CFA members. Always make decisions through a participatory approach.

Advantages

Advantages of Participatory Forest Management (PFM) include:

- Empowers local communities by involving them in decision-making processes related to forest management.
- Communities have stronger sense of ownership and rights over forest resources.
- Promotes sustainable use of forest resources through user groups.
- Promotes forest conservation and protects ecosystems from degradation and deforestation as the community is involved.
- Improved livelihood of forest adjacent community through eco-tourism, beekeeping, and sale of Non-Timber Forest Products such as medicinal plants hence reduce pressure on the forest due to alternative income generating activities.
- Positive social impact, especially women and youth empowerment.
- Strong working relationship and networking between communities, government and external stakeholders.

Disadvantages

- PFM is time-consuming processes since it requires extensive consultations, consensus-building, and participatory decision-making, which can be time-consuming.
- Inadequate technical capacity by the community to implement the Participatory Forest Management Plan (PFMP).
- Lack of clear policy on benefit sharing for proceeds from the forest.
- Inadequate funds to implement Participatory Forest Management Plan (PFMP).

Lessons Learnt

- PFM has promoted management and conservation of Kereita forest.
- Community can sustainably manage forest resources when empowered.
- There is need to develop clear benefit sharing mechanisms to achieve sustainable PFM.
- Integrity among the key stakeholders involved in PFM wins trust by communities.
- PFM promotes improved livelihood through different activities by the various user groups.

- PFM promotes gender roles in forest utilization and protection.
- PFM promotes capacity of local communities through training and education on sustainable forest management, agroforestry and alternative livelihoods activities.
- PFM enhances collaboration between CFAs and stakeholders such as Kenya Forest Service (KFS), NGOs, and other stakeholders which is key to the success of PFM.

Pending issues

- Incomplete execution of the Participatory Forest Management Plan (PFMP).
- Establishment of the botanical garden for learning purposes.

Recommendations

- Identify other income-generating activities.
- Increase number of user groups for more comprehensive community participation.
- Invest in continuous capacity building programmes for Community Forest Associations (CFAs).
- Undertake resource mobilisation to boost funding for various activities.
- Enhance marketing strategies for eco-tourism and non-timber forest products.

	
Figure 4.13: Participants learning about beekeeping	Figure 4. 14: View of Kereita forest

Visit 6: KEFRI Dryland Eco-Region Research Programme (DERP) - Kitui

The visit was carried out in KEFRI Dryland Eco-Region Research Programme (DERP) Kitui where Research and Development (R&D) activities, achievements and dryland forestry research challenges at KEFRI DERP were shared. In the Eco-region, visits were made to the tree nursery to learn about long-rooted seedlings for enhanced tree survival in the drylands and *Melia* seed dormancy breaking, and field site at Tiva to learn about indigenous tree improvement and breeding, the case of *Melia volkensii* and *Acacia tortilis*.

Overview of Research and Development activities, achievements and challenges at KEFRI DERP

Introduction

About 84% of Kenya is arid and semi-arid in nature. The dryland ecosystems are endowed with a rich diversity of flora and fauna that local communities have depended upon for several generations. However, due to heavy reliance on these natural resources, the drylands continue to suffer: degradation and deforestation of woodlands; riparian ecosystems and hill-top forest; biodiversity loss; and low land productivity; poor regeneration potential of dryland plant species; and threat from invasive plant species.

KEFRI through Dryland Eco-Region Research Programme (DERP) is currently undertaking research on tree species adapted to dryland with potential for conservation and re-introduction. The dominate species include; *Melia volkensii*, *Acacia spp*, *Terminalia spp*, *Bamboo spp*, *Gmelina arborea*, *Azadrachta indica*, *Delbergia spp*, *Osyris lanceolata*, *Senna siamea*, *Adansonia digitata*, and *Sclerocarya birea*. Research is also being undertaken on control and management of invasive plant species such as *Prosopis*.

Objectives

The objective of the visit to KEFRI DERP-Kitui was:

- To learn about forestry research and development activities undertaken in the dryland region of Kenya.

Activities

KEFRI DERP - Kitui is involved in several activities which include:

- Domestication and conservation of dryland tree species.
- Management and control of invasive plant species.
- Rehabilitation and management of drylands ecosystems.
- Development of technologies for rehabilitation/restoration of forests and allied natural resources.
- Production, utilization and marketing of wood and non-wood forest products.
- Dissemination of forest technologies and information to stakeholders.

Challenges

The eco-region experiences challenges which include:

- Water shortage due to unreliable rainfall.
- Increased incidences of tree pests and diseases.
- Low adoption of forestry technology.
- Poor market for wood and non-wood forest products.
- Livestock damage to plantations especially those of *Melia volkensii*.

Impacts

The eco-region research and development activities have impacted the region ecologically, socially, and economically. The impacts include the following:

a) Ecological impacts

- Increased forest and tree cover: Tested quality tree seeds are distributed across the country/region for stakeholder to raise seedlings for planting hence contributing to increased forest/tree cover.
- Climate change mitigation.
- Tree biodiversity increase and conservation.

b) Social impacts

- The eco-region has created employment opportunities to the local population hence improved social cohesion.

c) Economic impacts

- Improved livelihood among farmers through the adoption of technologies and sale of tree seedlings, tree and tree products.

Pending issues

- Further research on agroforestry and other indigenous tree species.
- Adoption of an advanced technology on seed extraction especially for *Melia volkensii*.

Recommendation

- Undertake resource mobilization to support continued research.
- Form community groups where farmers share knowledge on various technologies.
- Strengthen collaboration and multiagency sharing for better research finding.
- Intensify dissemination of forestry technologies.

Visit 7: Long rooted seedlings production to enhance tree survival in drylands

Introduction

The arid and semi-arid lands (ASALs), are characterized by low, erratic and unreliable rainfall, frequent droughts, high temperatures, and generally, poor and shallow soils that are highly erodible. These factors contribute to lowland productivity resulting in high poverty levels hence exerting extreme pressure on natural resources, which further contribute to severe environmental degradation. To restore degraded lands in ASALs there is need to promote forestry and agricultural technologies that are adaptable to the region. For successful tree growing in such areas, there is need to plant quality and adaptable tree seedling. The M-StAR long rooted seedlings production technology, introduced in Kenya through KEFRI-Japan International Forestry Promotion and Cooperation (JIFPRO) partnership, has been identified as a technique with great potential for producing seedling that will ensure high tree survival and growth in the drylands of Kenya.

Objective

The objective of the visit was:

- To learn about long-rooted seedling production technique for enhances tree establishment and survival in dry areas.

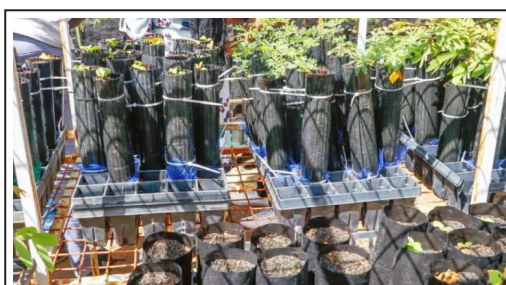
Activities

The following activities are carried out to ensure promotion and adoption of long-rooted seedling production technology:

- Raising of tree seedlings through long-rooted technique using M-StAR containers.
- Establishment of demonstration plots using the long-rooted seedlings.
- Data collection of seedlings in the nursery and trees planted in the demonstration plots.

Lessons learnt

- M-StAR container encourages growth of longer tap root, which favours penetration to deeper soil horizons.
- The deeper positioned root system is likely to reduce competition between the seedlings and herbaceous plants for water in the top soil horizons.
- The root system of seedlings grown in long M-StAR containers are likely to quickly reach deeper soil horizons, where the soil moisture is more stable.
- M-StAR container encourages non-restricted development of the root system.
- M-StARs are re-usable up to 10 times.

	
Figure 4.15: Tree seedlings raised in M-StAR container	Figure 4.16: Demonstration on seedling raised using an M-StAR container
	
Figure 4.17: Demonstration on using a drilling auger machine	Figure 4.18: A Kenyan participant with KEFRI scientist discussing long-rooted seedlings

Challenges

- Need to dig deep planting holes especially for farmers as they do not have access to drilling auger.

Pending issue

- Undertake more research on the technology.

Technique: M-StAR technology

Technique observed

- The use of M-StAR technology; an innovative technique for propagating long rooted tree seedlings in the drylands.

Purpose

- Enhance survival rate of planted tree seedlings in the Arid and Semi-Arid Lands (ASALs).

Advantages (benefits)

- Increase tree/forest cover in the drylands.

Disadvantages

- M-StAR materials are not locally available.

Procedure

- Identify tree species to be raised using M-StAR technology.
- Raise seedlings in a seedbed.
- Pot M-StAR tubes with appropriate potting soil such as coco-peat.
- Prick out the seedlings from seedbed to the potted M-StAR tubes.
- Water and leave potted seedling in the nursery as appropriate.
- Identify sites for establishment of demonstration plots including farmers fields.
- Prepare land for establishment of demonstration plots or woodlots.
- Dig deep holes using an auger machine for planting the M-StAR raised seedlings.
- Collect data including survival count and growth parameters such as height and diameter.
- Monitor the trees.

Do's

- Use M-StAR materials for better results.
- Dig a deep enough planting hole to accommodate the long root system.

Recommendations

- Undertake more research on the M-StAR technology.
- Make M-StAR available and affordable to farmers.
- Disseminate the technology to farmers for adoption once research is complete.
- Promote creativity/innovation towards the technology e.g. use of local materials.

Visit 8: Indigenous tree improvement and breeding- The Case of *Melia volkensii*

Introduction

Melia volkensii is an indigenous tree found in drylands of Kenya. The population in the wild has continued to decline due to overexploitation from the natural habitats. *Melia* being a high value tree species whose products especially timber is highly sought, combined with its fast growth, makes it a species of high priority for domestication.

To maximize gains from domestication process of *Melia*, selection of good quality trees, their ex-situ conservation and breeding were identified as the most promising intervention towards sustainable development of *M. volkensii*. KEFRI-DERP begun tree improvement activities in 2012 where by seed orchards and consequently progeny trials were established for high quality seed production.

The tree is being improved for drought tolerance and fast growth.

Objectives

The objective of the visit was to:

- Learn on tree improvement and breeding of dryland species.

Activities

The activities undertaken for indigenous tree improvement and breeding include:

- Plus tree identification as propagation material sources e.g. seed and scions sources.
- Tree seed collection and processing.
- Seed orchard establishment.
- Data collection and monitoring of seed orchard.
- Establishment of progeny trials.
- Data collection and monitoring of seed orchard progeny trials.

Lessons Learnt

- Optimal spacing and pruning regimes are necessary to maximize seed production.
- *M. volkensii* seed pods, leaves and seed can be used as pesticides.
- Improved *M. volkensii* grows faster than local landraces.

	
Figure 4.19: Demonstration on Melia seed extraction	Figure 4.20: Learning on tree nursery
	
Figure 4. 21: Discussion on extracted Melia seed	Figure 4. 22: <i>Melia volkensii</i> seed source in Tiva Kitui

Challenges

The challenges experienced include:

- Melia seed processing such as cracking and slitting technique, careful germination process, is laborious, time consuming and requires skilled personnel.
- Inadequate market information on *Melia volkensii*.

Impacts

The impacts experienced include:

a) Ecological impacts

- Conservation of biodiversity by bringing Melia into cultivation.
- Improved soil and water conservation.
- Climate change mitigation.
- Carbon sequestration.

b) Economic impacts

- Seeds and seedlings are a source of income.
- Source of fuel wood from thinnings and prunings.
- Source of fodder.

c) Social impacts

- Livelihood improvement.
- Source of employment.

Pending issues

- Availability of improved *Melia volkensii* seed to farmers.

Recommendations

- Improve *Melia volkensii* value chain.
- Create awareness on importance of *Melia volkensii* in other ASAL areas.
- Enhance adoption of *Melia volkensii*.

Technique

- Tree improvement and breeding.

Technique definition

- Tree improvement and breeding refers to the application of genetic principles and reproductive biology to genetically enhance forest trees for desirable traits such as growth rate, wood properties, pest and disease resistance and adaptation to specific conditions.

Purpose

- Develop Melia tree that is drought resistant and grows fast.
- To enhance dryland afforestation and biodiversity conservation.

Advantages

- Shortened rotation age for *Melia volkensii*.
- Utilization of superior genetic material.
- Production of drought and pest resistant tree species.

Disadvantages

- The tree improvement process takes long time and requires expertise technical skills.

Procedures

1. Identify superior plus trees from wild population and farmers field as source of scions.
2. Raise seedling for root stock material. Seed is sourced from general collection.
3. Collect scions from the identified plus trees.
4. Graft the scions onto ready root stock.
5. Maintain grafts in the nursery until they are ready for planting out.
6. Prepare site for Melia clonal orchard establishment through ploughing and hole digging.
7. Establish seed orchard in design that maximizes crossing pollination among various clones.
8. Manage the orchard through weeding, pest and disease control, and pruning.
9. Collect relevant data and monitor the seed orchard.
10. Collect seed from the orchard for progeny trial.
11. Establish progeny trials using seed from the orchard.
12. Collect data and monitor the progeny trials on height, DBH, straightness of stem and wood properties.

Do's

- Consider important uses and benefits as well as adaptability of the species before commencing tree improvement process.

Don'ts

- Use unqualified personal during seed and scion collection.

	
4.23: Melia seed orchard	4.24: Improved Melia

Recommendations

- Introduce other indigenous species in tree improvement and breeding programme.
- Create awareness on the value of improved tree species.

Model Farmer Visits

The participants visited farmers who were involved in climate smart agriculture in Kabati, Kitui County, Kibwezi and in Makueni County. The farmers were also involved in technology transfer in their respective areas.

Farm visit 1: Climate Smart Agriculture by Mr. Rodgers Kaleve, Kabati-Kitui County

Introduction

Mr. Rodgers Kaleve based at Kabati; Kitui County practices integrated farming. Mr. Rodgers is involved in diverse farming practices that include; tree growing, livestock keeping and crop farming.

Objectives

The objective of the visit was to:

- Learn the importance of climate smart agriculture in the drylands of Kenya.

Activities

The farmer is involved in the following activities:

- *Melia volkensii* growing.
- Poultry farming that includes; hybrid chicken for egg production, indigenous chicken for meat, ducks rearing.
- Food crop farming including; maize, green grams, and cassava.
- Pasture growing.

- Dairy farming.
- Soil and water technologies using terraces, and of cover crops.
- Water harvesting technologies - rainwater harvesting.

Lessons learnt

- Farming is possible in the drylands.
- Farming is profitable in the drylands by applying climate smart agriculture approaches.

	
Figure 4.25: Pasture farming under Melia trees	Figure 4.26: Poultry farming-layers
	
Figure 4.27: Fruit farming	Figure 4.28: Melia growing

Challenges

Following are challenges experienced by the farmer:

- Water shortage.
- Inadequate funds for expansion of activities.

Impacts

The farmer witnessed the following impacts:

a) Ecological impacts

- Improved soil fertility and water conservation.
- Improved biodiversity.
- Increased tree cover.
- Increased land productivity.

b) Social impacts

- Improved livelihood and income.
- Improved family health due to availability of food and fruits.
- Use of farm as a learning site for other farmers.

c) Economic impacts

- Increased income obtained from the sale of farm produce.

Pending Issue

- Scaling out farming activities on other farm sites.

Recommendation

- Invest more on climate smart agriculture.
- Disseminate the technologies to other farmers for adoption.

Case study

• Model Farmer Approach

Model Farmer Approach is a concept that involves identifying and promoting a model farmer who exemplifies best practices in forestry to serve as a role model for other farmers in the community.

Purpose

- To demonstrate advantages of climate smart agriculture in drylands.

Procedures

- Evaluate the farm in terms of soil conditions water harvesting potential, to determine the suitability farming activities to undertake.
- Develop a farm plan that includes various agricultural components, such as crops, livestock, woodlot and fruit farming activities.
- Design water harvesting technologies.
- Choose crops that are suited to the area.
- Select livestock breeds that are well-adapted to area.
- Incorporate tree growing by incorporating tree species adapted to that area.
- Integrate pest management practices, such as biological control, crop rotation.
- Maintain records of farming activities, inputs, outputs and animal performance.
- Make adjustments based on evaluation. This may involve changing crop varieties, altering livestock management practices, or modifying water and soil management strategies.
- Disseminate information to other farmers.

Do's

- Establish market for products before they are ready for harvesting.

Don'ts

- Don't venture in climate smart agriculture if there is no adequate funds and skills.

Recommendation

- Expand the farming.
- Promote creativity/innovation towards the approach.
- Extension workers, and researchers to continuously improve integrated farming practices.

Farm Visit 2: Commercial Forestry Development in the Drylands: Case study of Melia growing on-farm by Mr Jonathan Kituku

Introduction

Mr. Jonathan Kituku, a farmer in Makueni County, Kibwezi sub-county is involved in large scale on-farm Melia tree and fruit farming. *Melia volkensii* was selected for woodlot development as the species is drought tolerant, grows fast, and is termite resistant. The farmer started tree farming in 1999 after receiving advice and training from KEFRI on Melia propagation procedures as well as tree nursery establishment and management.

The farmer currently has over 17,000 Melia trees planted on his farm. Melia woodlot is long term enterprise but the tree provides intermediate products such as seed and firewood from prunnings. *Melia* seeds collected on-farm are sold to other farmers and companies who require it. The farmers also use the seeds to propagate Melia seedlings for sale and own use. Mr. Kituku has developed tree planting culture at least every year, he plants additional trees. Due to his efforts in tree growing, Mr. Kituku received a presidential award, the Head of State Commendation. To ensure sustainability Mr. Kituku has incorporated his son as one of the farm managers.

The farmer harvests natural grass under the Melia plantations, bales, stores and sells to other farmers during the dry season. The farmer ensures the hay is well stored till the next dry season and has therefore built a store room for this purpose.

Objectives

The objective of the visit was:

- To learn about dryland commercial forestry technologies practises on-farm.

Activities

The farmer is involved in the following activities:

- *Melia volkensii* woodlot development.
- Mango fruit tree farming.
- Agroforestry.
- Improved livestock farming.
- Pasture production.
- Rainwater harvesting.
- Soil and water conservation.
- Tree seedlings production.
- Melia seed harvesting, processing and sale.

Lessons learnt

- Differences in growth characteristics between the improved and unimproved *Melia volkensii* is visually distinct, thereby serving as learning point for the farmer on need to use improved seed.
- Integrated farming provides mutual benefits to crops and livestock activities
- Integrated farming offers economic gain and livelihood improvement to farmers.
- Information dissemination and technology transfer from father to son promotes sustainability of the practice as adoption from one generation to the next is guaranteed.
- Information dissemination to other farmers promotes scaling out and adoption of technologies and land restoration on a large scale.
- Through continues knowledge acquisition, farmers can become trainers of other farmers as well as offer consultancy services at a fee therefore diversifying income sources.
- Melia grown for timber products, can also provide other environmental-friendly products such as pesticides from Melia leaves.



Figure 4.29: Mr. Daniel Kituku briefing participants on the various interventions on the farm



Figure 4.30: *Melia volkensii* woodlot on Mr. Kituku's farm

	
Figure 4.31: Briefing on <i>Melia volkensii</i> growing	Figure 4.32: Mr. D. Kituku estimating <i>Melia</i> DBH
	
Figure 4.33: Improved dorper sheep on Mr. Jonathan Kituku's farm	Figure 4.34: Participants learning about pasture storage on-farm

Challenges

The farmer experiences the following challenges:

- Inadequate water due to low rainfall.
- High cost of production as activities are capital and labour intensive.
- Inadequate technical know-how on *Melia* especially use of improved seed.
- Inadequate information/knowledge on market value chain.
- Poor market linkages.

Impacts

The following impacts have been observed by the farmer:

a) Ecological

- Landscape restoration.
- Improved soil structure and texture.
- Soil and water conservation.
- Improved soil fertility.
- Improved tree cover.
- Micro-climate improvement -cooler environment due to tree shade.
- Resilience and adaptation through climate-smart forestry.

b) Social

- Increased nutrition and food security due to improved land productivity.
- Community integration and cohesion as more farmers adopt Melia tree growing.
- Improved social status.
- Prestige from presidential award.
- Mentorship and capacity building of the youth.
- Networking with other farmers and organization in Natural Resource Management (NRM).
- Continued capacity building from knowledge and skills shared by visiting groups.
- Certainty in continuation in tree farming due to incorporation of family members in farming activities.

c) Economical

- Livelihood improvement and diversity.
- Improved income.

Observations lesson learnt

- There is need for the farmer to access improved Melia seeds from KEFRI to improve tree production.
- Through training and advice from KEFRI, the farmer has managed to turn his once low production land to high productivity through application of the various technologies and adoption of good practises acquired over the years.
- Though the procedure for breaking Melia seed dormancy is complex, the farmer has mastered the art and now supplies processed seed to farmers and companies who require the seed.
- The neighbours are also taking keen interest in tree farming which is an advantage as this will improve bargaining power in the market therefore avoiding exploitation by middlemen, especially in the sale of timber.

Do's

- Identify market for products before they are ready.

Don'ts

- Don't venture in integrated farming if there is no enough funding and skills.

Recommendations

- Create awareness and encourage more farmers to take up Melia farming.
- Train more farmers on tree growing in ASALs for climate change mitigation.
- Establish cooperatives for easier market linkage.

- Empower farmers by providing access to credit facilities, quality seeds, markets and frequent trainings.
- Explore how farmers can benefit from carbon market.

Dryland Agriculture by Kenya Agricultural and Livestock Research Organization at Kiboko and Katumani

Kenya Agricultural and Livestock Research Organization (KALRO) institutions namely; Arid and Rangelands Research Institute (ARLI)-Kiboko, and Agriculture Mechanization Research Institute (AMRI)-Katumani undertakes agriculture research and development in the drylands of Kenya. Activities at ARLI include; rehabilitation of pasture land for sustainable livelihood in drylands, demonstration of improved natural pasture growing in drylands, while those at AMRI include dryland agriculture for community and climate resilience.

KALRO visit 1: Rehabilitation of Pasture Land and Improved Natural Pasture Growing for Sustainable Livelihood in Drylands; Case of Arid and Range Lands Research Institute (ARLI)-Kiboko

Introduction

ARLI- Kiboko is located at Kiboko in Makindu Sub-County of Makueni County. The Institute is located arid and semi-arid lands an area suitable for production of cattle, goats, sheep and camels. The institute is involved in range research, promotes pasture and forage research (pasture improvement), pasture sustainability, soil and water conservation, grass/pasture growing: seed production, seed bulking, hay bulking, livestock nutrition, breeding, health, as well as capacity building and dissemination activities. The Institute works closely with the County Governments who are the major market for the grass seeds.

Farm visit 3: Case study of Mr. Michael

Objectives

The objective of the visit was:

- To learn about rehabilitation of rangelands using pasture.

KALRO-ARLI-Kiboko is involved in dissemination of research findings and technologies for adoption by farmers. The institute therefore works with farmers in pasture technology adoption. The participants visited Mr. Michael's farm, a farmer who is involved in pasture farming supported by the ARLI. Mr. Michael, adopted pasture farming from KARLO-ARLI after experiencing pasture shortage from his farm and area. The farmer is involved in growing various grass species such as African foxtail, Horsetail grass, Maasai love grass, Bush rye, *Punica maxima* for domestic use and sale.

Lessons learnt

- Grass pastures adaptable to drylands should be promoted e.g. African. foxtail,

Horsetail grass, Maasai love grass, Bush rye, *Punica maxima* to sustain livestock farming in ASALs.

- In the pasture crops, weed control may be done manually by uprooting the weeds.
- For control of pests, it is best to apply integrated pest management e.g. destroying or burning affected plants.
- Grass seed harvesting methods include; stripping, cutting the stalk, which can be done manually or mechanically.
- Sugar greys fodder should be dried before being fed to livestock



Figure 4.35: Pasture growing on farm



Figure 4.36: Model farmer explaining management of different pasture grass species



Figure 4.37: Briefing on sugar grey growing



Figure 4.38: Briefing on pasture growing



Figure 4.39: Participants at KALRO-ARLI-Kiboko



Figure 4.40: A group photo with the pasture farmer

Challenges

- Water scarcity in the region exacerbated by climate change.
- Fluctuating market prices for milk due to milk glut during the rainy season.
- High cost of production.
- Lack of seed harvesting machine.

Impacts

Following are the impacts of pasture farming:

a) Ecological impacts

- Improved soil fertility.
- Reduced soil erosion.

b) Social impacts

- Improved aesthetic beauty due to greenery of grass.
- The availability of fodder on farm saving time for farm families, allowing them to engage in other activities.
- Social cohesion through reduced grazing land conflict.

c) Economic impacts

- Increased income from sale of farm produce such as milk and pasture.
- Creation of employment opportunities.

Pending Issue

- Increase agricultural extension service to the community.
- Awareness creation on improved pasture farming technologies and use of improved pasture grass seeds.

Recommendation

- Promotion and support of water harvesting technologies for farmers.
- Formation of cooperatives to assist in marketing of farm produce.
- Encourage certification of grass seeds.

KALRO visit 2: - Dryland agriculture for community and climate resilience: case of Agricultural Mechanization Research Institute (AMRI)-Katumani

Introduction

Agriculture Mechanization Research Institute (AMRI) Katumani is located in Machakos County and is mandated to carry out research in agricultural mechanization as well livestock and crops value chains for increased productivity, commercialization and competitiveness of the agricultural sector. The Institute

also has a mandate of generating and disseminating agricultural mechanization technologies and innovations across agricultural value chains in Kenya. Mechanisation involves machines such as; multipurpose grain thresher, cassava crater/chipper and oil extractor.

Objectives

The objectives of the visit were to:

- Learn about dryland agriculture.

Activities

- Agricultural Mechanization Program.
- Sorghum and Millets Program/Teff.
- Maize.
- Crop Health Program.
- Improvement/Agronomy Program.
- Aflasafe Modular Plant.
- Grain Legumes Program.
- Root and Tuber Program.
- Horticulture Program.
- Livestock Program.
- Oil Crop Program.
- Natural Resource Management Program.
- KALRO Seed (15 hubs).
- Farm Management.
- Agroforestry.

Lessons learnt

The participants learnt:

- Different climate smart agriculture technologies including; cereals (maize, sorghum and teff), legumes (beans, green grams, pigeon peas, cow peas) and Amaranth, sweet potatoes, and oil crops (linseeds, sunflower, soya beans).
- Soil and water conservation technologies such as drip irrigation and tied ridges for water harvesting.
- Adding value to crops, improves nutrition for communities, e.g. nyota bean which is fortified with minerals such as zinc and iron.
- By producing open pollinated crops, the institute offers opportunity for farmers to reuse/re-cycle seed for 3 seasons.
- Research in sorghum has produced smart sorghum that is not eaten by birds

at milk stage due to high tannin content when crop is more susceptible to bird damage.

- Development of Aflasafe for control of aflatoxins in crops such as maize, green gram and cassava.
- The precision of weather forecasting in crop productivity enhancement through use of Participatory Scenario Planning.



Figure 4. 41: Brief about KALRO-AMRI-Katumani



Figure 4.42: Brief at the Aflasafe factory



Figure 4. 43: Discussion about Aflasafe



Figure 4.44: Participants taken through drip irrigation technologies



Figure 4.45: Fruit nursery at AMRI - Katumani



Figure 4.46: Seed processing at AMRI - Katumani



Figure 4.47: Mulching under maize crop



Figure 4.48: Water conservation technology

Challenges

Challenges within the farming community within the region include:

- Water scarcity.
- Low soil fertility.
- Pests and diseases.
- Post-harvest losses due to poor handling by farmers.
- Poor market linkages.
- Inadequate knowledge by farmers on value addition to enhance productivity and profitability.

Impacts

a) Ecological

- Soil and water conservation.
- Soil fertility improvement.
- Reduce aflatoxins in the soil.
- Pest and disease management .

b) Social

- Improved food and nutrition security.
- Improved wellbeing.

- Reduced exposure to aflatoxins.
- Climate change adaptation by growing climate smart crop variety.

c) Economical

- Increased yields through proper land management such as water harvesting and use of improved seed.
- Increased income.

Way forward

- Continued dissemination of technologies for wider adoption.
- Capacity building on mechanized agricultural equipment by smallholder farmers.

Advantages

- Rehabilitation of degraded land.
- Proper utilization of water.
- Maintain soil moisture.
- Integrated pest management.
- Improved yields.
- Increased agro-biodiversity.

Disadvantages

- Capital intensive.
- Crop failure due to prolonged drought.

Do's

- Proper land preparation and tillage.
- Utilize weather forecasting data before planting.
- Put water harvesting system in place.
- Conserve soil moisture e.g. by mulching.
- Technology to be developed should be demand-driven.

Don'ts

- Avoid planting drought intolerant crops.

Way forward

- Increase availability of drought resistant agricultural seeds to the community.
- Continually provide technical backstopping for community groups.

Farm visit 4

Technology Transfer through Farmer Groups: Case of Green Shade Self-Help Group

Introduction

The Green Shade Self-help Group, located in dryland Machakos County was formed in 2005 with support of researchers from KALRO-Katumani. The researchers aimed to use the group as a platform for passing information on new technologies to the community by testing site-specific innovative farming practices. To form the group, willing farmers were brought together and trained on natural resource conservation and management on-farm. The farmers were trained on seedling production and handling, tree growing, rain water harvesting and soil moisture conservation.

Adoption of climate-smart farming technologies has helped the community adapt to climate change, such as high temperatures and erratic rainfall that often cause crop failure in the area. The farmers have also contributed to landscape restoration. The Green Shade Self Help Group farm site is used as a learning ground. Activities which members practice as a group are cascaded to individual farms. These practices adopted by group members have been emulated by other farmers overtime, leading to climate change resilience by large pool of community members.

Criteria for host farmer selection

- 1) Availability of land.
- 2) Easy accessibility to the site.
- 3) Trainable.
- 4) Approachable.
- 5) Willingness to share information.

a) Objectives of the group

- Planting own trees on farms to reduce dependency on natural resources from forests and woodlands which leads to over-exploitation.
- To address food insecurity by increasing food crop production.
- To restore degraded agriculture and forestry landscapes.
- To diversify sources of income through tree growing.
- To mitigate climate change.
- Improve micro climate.

Objectives of visiting the group

- Learn about the technologies adopted by farmers through research-farmer linkages.

- Challenges and opportunities experienced by farmers in the drylands.
- Hear testimonials from farmers on how the farmer group has enhanced livelihoods.

Lessons learnt/observations

- Farmers have adopted integrated farming that incorporate fruit trees such as avocado and maize crop.
- Agroforestry practices have contributed to enhanced moisture retention on farms.
- Community involvement through on-farm demonstrations is key for uptake of technologies as farmers learn within their environment.
- Restoring land productivity has given hope to the community.

Challenges

- Extreme weather events, such as floodings that alternate with severe drought.
- Inadequate information/knowledge on climate smart agriculture.
- Poor market linkages.
- Crop pest and diseases outbreak.
- Climate change.

Impacts

a) Ecological impact

- Increased land productivity.
- Improved soil structure and texture.
- Enhanced water infiltration and retention capacity for crops to utilize.
- Improved micro-climate.
- Reduced evapotranspiration through the use of nets to reduce direct sunlight.
- Increased tree diversity on landscape.
- Ecosystem restoration.

b) Social impact

- Increased nutrition and food security through increased crop production.
- Community integration and cohesion
- Increased knowledge sharing within the group and with community members.
- Improved Farming skills.
- Improved awareness on climate smart technologies through interaction with KALRO.

c) Economic impact

- Livelihood improvement through diversified crop and tree growing.
- Diversified income sources.

Do's

- Undertake technical backstopping and frequent follow ups.
- Select farm for group activities that is strategically located for farmers to access.
- Have duties and responsibilities for seamless operations in group activities.

Dont's

- Do not select unwilling farmers.
- Do not select a farmer out of the agro-ecological zone appropriate for the technology.

Recommendations

- Continually engage community to ensure they understand application of the technologies being disseminated.
- Increase the number of groups to upscale technology uptake.
- Use farmer field schools to enable farmers learn by doing.
- Expand tree growing for improved climate change adaptation.
- Empower the farmers by providing access to credit facilities, quality seeds, markets and frequent trainings.
- Establish cooperatives for easier market linkage.
- Continue development and on-farm testing of technologies suitable for drylands.



Figure 4.49: Green Shade Self-help Group farmers sharing experiences with participants



Figure 4.50: A group photo at the group's demonstration site

CHAPTER 5

5.0 Implementation Action Plans

Introduction

Action plans serve as a guiding map for development of special targeted plan or tailored interventions. The process involves: problem identification; documents causes and effects, providing solutions and interventions; stakeholders, resource analysis; and timeframe for implementation of identified activities. This chapter presents the outline of the action plans by the individual participants expected to be integrated into existing institutional workplans.

5.1 Action Plan on Controlling of Flooding of Ruvyironza River Marshes in Burundi

Name:	Gabriel Nimenya
Email address:	nimenyagabriel@gmail.com
Country:	Republic of Burundi
Organization/Institution:	Burundi Office for Environmental Protection
Position:	Head of Department of Inventory, Statistics, Planning and Development of Forest Resources

Problem statement

Ruvyironza river is located in Burundi. The marshes of this river are threatened by flooding leading to a reduction in agricultural production for farmers who exploit the marshes for farming activities.

Causes, effects and solutions

Cause:

- Heavy precipitation which destroys the banks of Ruvyironza River.

Effects:

- Flooding of marshes.
- Reduction of agricultural production.

Solution:

- Stabilize the banks of Ruvyironza River by planting bamboo.

Long-term Goal: Improving agricultural production of Ruvyironza River marsh farmers.

Short-term Goal: Protect the marshes of Ruvyironza River against flooding in 3 years.

Objective: Stabilize the banks of Ruvyironza River over a length of 1,500 kilometers by planting bamboo.

Table 5.1 Implementation Action Plan on Controlling Flooding of Ruvyironza River Marshes in Burundi

Activity	Resources	Responsible Person	Time frame	Expected results	Performance indicator
Train the representatives of farmer cooperatives on the role of bamboo in stabilizing Ruvyironza River	- Facilitators - Flip charts - Travel and refreshment costs for participants	Mr. Gabriel Nimenya	October - Dec 2024	300 people trained	Number of people trained
Produce and plant bamboo plants	- Bamboo stumps/ clumps - Equipment for the production and planting of bamboo plants - Workforce - Charges for payment of labour	Mr. John Hatungimana	Jun 2024-Feb 2025	10,000 seedlings produced and planted	Number of seedlings planted
Maintenance of planted bamboo plants	- Equipment used for maintaining plants - Workforce - Charges for payment of labour	Mr. John Hatungimana	April –May 2025	10,000 plants maintained	Number of plants maintained

5.2 Action Plan on Restoration of Dryland Forest Areas in Ethiopia

Name: Yeshifana Alemneh
Email address: alemnehyeshifana@gmail.com
Country: Ethiopia
Organization/Institution: Ethiopian Forestry Development
Position: Associate Researcher

Problem Statement: Dryland areas forest degradation in Ethiopia

About 80% of forests in Ethiopia are dry forest. Dry forest biomers are experiencing the highest rate of forest loss.

Causes

- Unsustainable utilization.
- Expansion of subsistence and commercial farming.
- Free grazing.
- Population pressure.
- Settlement expansion.
- Drought/moisture stress: the most dominant factor limiting success of plantation development.

Effects

- Land degradation.
- Decline in biodiversity.
- Degradation of water resources.
- Increased temperature.
- Food insecurity.

Solution

- Reforestation and afforestation activities.
- Introduce improved technologies for seedling survival.

Long term goal: Dryland areas Forest restoration in Ethiopia.

Short term goal: To improve seedling survival rate in dryland areas of Ebinat District.

Objective: To introduce long rooted tree seedlings using M-StAR container technology in 2024/2026.

Table 5.2: Implementation Action Plan for Rehabilitation of Degraded Forest Dryland Areas in Ethiopia

Activity	Resource	Responsible persons	Time frame	Expected results	Performance indicator
Training on long rooted seedling using M-stAR container	• Facilitators • Training materials • Logistics	• Ethiopian forestry development • Plantation forestry research program researchers	Sep 2024	Increase knowl- edge on M-stAR container	-Number of trained peoples -Training reports

Selection of suitable seeds	Seed professional	- Ethiopian Forestry Development - Plantation forestry research program researchers	Oct 2024	Quality and adequate seed	-Quality and suitable seed
Production of 1500 seedlings	- Nursery materials - Seed - Labor 20,000 ETB	Plantation forestry research program researchers and nursery professionals	Jan 2025	1500 Quality seedlings	-Number of seedlings, -Reports -Number of seedling species
Planting of long rooted seedlings	1200 seedlings - Plantation area - Labor	Plantation forestry research program researchers	July 2025	Planted seedlings	-Number of planted seedlings -Number of surviving seedlings -Reports

5.3 Action Plan for Development of Dryland Agroforestry in Kenya

Name: Mercy Ruto
Email address: mruto@kefri.org
Country: Kenya
Organization/Institution: Kenya Forestry Research Institute
Position: Research Scientist (Agroforestry)

Agroforestry is the intentional integration of trees and shrubs into crop and animal farming systems to create environmental, economic, and social benefits.

Agroforestry Practices

- Woodlots.
- Hedgerows/Alley cropping.
- Trees scattered on farm.
- Improved fallows.
- Boundary tree planting.
- Fodder lots.

Benefits of Agroforestry

- Livelihood diversification.

- Enhance food security and income.
- Enhance soil and water conservation.
- Climate change mitigation.

Interventions

- Promotion of soil and water conservation technologies.
- Introduction and domestication of valuable tree species.
- Development of tree nursery technologies for production of quality seedlings.
- Diversification of on-farm products (fodder, fruits).
- Establishment of demonstration plots for technology dissemination.

Table 5.3: Implementing Action Plan on Promotion of Agroforestry in Degraded Forests in Dryland Areas in Kenya

Long Term GOAL: Promotion of Agroforestry, Landscape restoration, and Soil-Water Conservation Technologies in 2 Arid and Semi-Arid (ASAL) Counties						
Short Term Goal: Accelerate land restoration and increase farm productivity through agroforestry practices by 2027						
Objective 1: To increase adoption of soil and water moisture conservation technologies for increased farm productivity in two counties						
Activity	Resources	Responsible person	Time Frame	Target	Expected results	Performance Indicator
Conduct survey on land degradation hazard and rate of adoption of agroforestry practices	Funds Stationeries Enumerators Fuel	Mary Gathara	3 months	2 counties	Knowledge on degradation hazards and levels of adoption	-No of surveys -Degradation hazard map -Reports
Training on soil and moisture conservation technologies applicable in the ASALS	Funds Fuel Fare refunds Hall hire fee Stationeries	Mercy Rutto	6 months	30 groups	Increased farm productivity by 1.5 tons per hectare	-Number of groups Training Reports and registers

Long Term GOAL: Promotion of Agroforestry, Landscape restoration, and Soil-Water Conservation Technologies in 2 Arid and Semi-Arid (ASAL) Counties

Establishment of woodlots and fruit orchards demonstration plots using soil and water conservation (SWC) technologies	Land Farm equipment	Riziki Mwadalu	6 months	4 demo plots	Smallholder farmers capable of utilizing SWC technologies and establishment of agroforestry	-No of demonstration plots -Reports
Rehabilitation of degraded landscapes to increase in biodiversity using SMC technologies	-Funds -Fuel -Casual labour -Tree seedlings	Abbey Ahmed	1 year	5,000 acres	-Increased landscape restoration at county level	-Number of acres -Reports
Monitoring and assessment of adoption of agroforestry technologies	-Funds	Mercy Rutto	1 year	3000 households	-Increased household adoption levels of agroforestry practices and SWC technologies	-No of households, -Assessment Reports
Objective 2: To increase adoption of soil and water moisture conservation technologies for increased farm productivity						
Carry out tree -pasture integration of <i>Acacia tortilis</i> and indigenous grasses	Land Funds	Mercy Rutto	2 years	3 trial plots	Knowledge on tree-pasture integration potential in the ASAL areas	-No of trials -Reports
Train community on propagation of <i>Acacia tortilis</i> and its utilization as a fodder species	• Funds • Fuel • Fare refunds • Hall hire fee • Stationeries	Riziki Mwadalu	6 months	30 groups	Increased tree cover and soil erosion control in the ASAL areas	-No of groups Training Reports and registers

Monitoring and Evaluation of adoption levels	Funds	Yasuko Ose	2.5 years	3000 households	Increased uptake of <i>Acacia tortilis</i> in ASAL areas as a multipurpose tree species	-No of households, -Assessment Reports
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5.4 Action Plan to Control Fast Expansion of Arid and Semi-Arid Lands in Kenya

Name: Vashit Kivondo
Email address: Kivondo36@gmail.com
Country: Kenya
Organization/Institution: Kenya Forest Service.
Position: Assistant Conservator of Forests.

Problem statement

Kenya faces a growing challenge as Arid and Semi-Arid Lands (ASALs) expand, now covering 89% of the country's land. This expansion, driven by climate change, land degradation, and unsustainable land use practices, threatens food security, water resources, and livelihoods. Despite existing interventions, the spread of ASALs continues to outpace control efforts, necessitating urgent, coordinated, and sustainable solutions to protect ecosystems and communities dependent on these fragile environments.

Causes

- Deforestation.
- Overstocking.
- Poor cultivation skills.
- Industrialization.

Effects on the people

- Global warming.
- Catastrophes.
- Higher emissions of greenhouse gases.
- Scarcity of food and fodder.

Solutions

- Afforestation, re-afforestation and reforestation.
- Practicing climate smart agriculture.
- Use of green energy.
- Better urban planning strategies and laws.

Long Term Goal: To grow trees in arid and semi-arid lands of Ukia sub-location.

Short-Term Goal: To have 100 households grow trees in one year.

Objective 1: To increase tree cover in Ukia sub-location by 10% through farm forest.

Table 5.4: Implementation Action Plans on Control of Fast Expansion of Arid and Semi-Arid Lands

Activity	Resources	Responsible person	Time frame	Expected results	Performance indicator
Baseline survey	• DSA for 2 officers & driver • Lunches for 10 resource persons • Vehicle	Vashit Kivondo	1 week	• Map land sizes per household • Human & livestock population • Average trees per farm • Income - 7 income sources	Daily reports Records of census Pictures taken
Drafting a budget	Data on; seeds, tree nursery establishment water availability pioneer farmers	Vashit Kivondo	1 week	• Copies of data & reports required	Draft budget
Community training	Venue, training facilities (flip charts, pens, books, pens DSA for 2 officers & driver, vehicle, refreshments for trainees, fare refund for trainees.	Vashit Kivondo John Ouko	4 days	• Trainees' ability to repeat an activity taught with ease • Participation and involvement of trainee on activity during training	Pictures Videos take during training Daily reports
Establishment of tree nursery	• Land • Water • Seeds • Personnel • Tools & Equipment	Vashit Kivondo & John Muthama	2 days	• Construction of germination beds, sowing seeds, potting	Pictures videos, reports

Activity	Resources	Responsible person	Time frame	Expected results	Performance indicator
Monitoring seed germination	- Vehicle - DSA for 1 officer & driver	Vashit Kivondo	2 days	% germination of seedlings & pricking out	Pricked out seedlings (records & pictures)
Set-up and demonstration of tree growing	- Vehicle - DSA for 3 people	Vashit Kivondo John Ouko and John Muthama, Joel Kiamba, Ann Muteti & Lucy Kioko	4 days	No. of seedlings planted	Pictures, videos, farm owner records
Tree growth progress monitoring	- Vehicle - DSA for 2 people	Vashit Kivondo and John Ouko	3 days	Number of seedlings surviving per farm, tree heights	Records of; - trees per farm, heights

5.5 Action Plan for Sustainable Landscape Management in Nkhathe Catchment, Malawi

Name: Ackim July Dickson
Email address: ackimdickson@gmail.com
Country: Malawi
Organization/Institution: Ministry of Agriculture, Department of Land Resources Conservation.
Chikwawa District Agriculture.
Position: Senior Land Resources Conservation Officer.

Goals and objectives

Long-term Goal: To enhance climate adaptation, food and nutrition security for Nkhathe catchment.
Short-term Goal: To increase productivity of the landscape in Nkhathe catchment by 40% by 2029.
Objective 1: To rehabilitate 20,000 hectares of degraded forest area in Nkhathe catchment by 2029.
Objective 2: To restore 70,000 hectares of agriculture landscape in Nkhathe catchment by 2029.

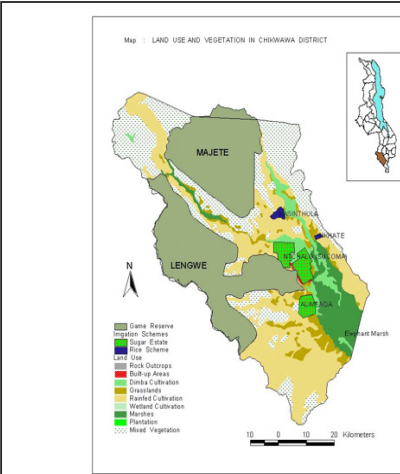


Figure 5. 1: Location of impact area

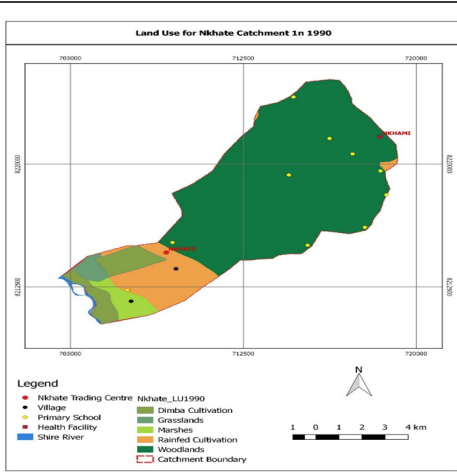


Figure 5.2: Impacted Area

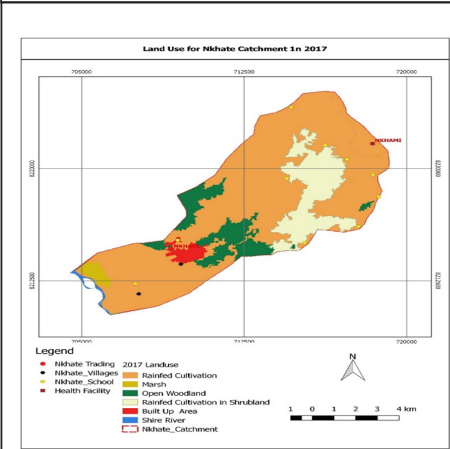


Figure 5.3: Impacted area

Land Use	Area (Km ²)		Change	
	1990	2017	Area (Km ²)	%
Woodland	72.60	23.48	-49.12	67.66
Rain-fed	15.66	66.15	+50.50	322.48
Cultivation				
Built-up Area	0.15	1.73	+1.58	1053.33
Marshes	3.01	0.06	-2.95	98.01
Total	91.42	91.42		

Figure 5.4: Impacted Area

Table 5.5: Implementation Action Plan for Nkhathé Integrated Catchment Management

Activity	Resources	Target	Responsible Person	Time Frame	Expected Results	Performance Indicator
Conduct awareness campaign meetings on sustainable environmental management	To let each stationery item, fuel, mass communication equipment	5	SLRCO	First week of June, 2024	Improved understanding of sustainable natural resources management by frontline staff and farmers	Number of meetings conducted & Number of people sensitized

Activity	Resources	Target	Responsible Person	Time Frame	Expected Results	Performance Indicator
Train extension workers on Climate-Smart Agriculture practices	Stationery, refreshments, allowances, fuel, hall hiring and resource persons.	12	SLRCO	Second week of June, 2024	Improved knowledge and skills of frontline staff on CSA technologies	Number of frontline staff trained
Train Lead Farmers on Climate-Smart Agriculture (CSA) practices	Stationery, refreshments, allowances, fuel, hall hiring and resource persons.	60	SLRCO	Fourth week of June, 2024	Improved knowledge and skills of frontline staff on CSA technologies	Number of Lead Farmers trained
Develop Village Level Action Plan (VLAP)	Stationery, fuel, refreshments, frontline staff, community members	3	AEDC	Fourth week of June, 2024	A detailed analysis of the problems conducted and activities to address them well outlined	Number of VLAPs developed
Develop environmental and social safeguards plan	Stationery, fuel, refreshments, frontline staff, community members	3	EDO	Fourth week of June, 2024	Reduced environmental and social risks	Number of ESMPs developed
Develop integrated catchment management plan	DESC, refreshments, hall hire	1	DCDO	First week of July, 2024	Outline of activities, resources and personnel well documented	Number of plans developed
Promote Climate-Smart Agriculture	Financial & human resources, improved agroforestry seed, improved crop varieties	14,000	SLRCO	From July 2024, On-going	Improved landscape management and productivity	Area conserved (Ha)

Activity	Resources	Target	Responsible Person	Time Frame	Expected Results	Performance Indicator
Promote natural tree regeneration	• Hoes, pangas • Lead Farmers	4,000	AEDC	From 3rd week of July, 2024	Increased forest cover, improved landscape conservation	Forest area (Ha) rehabilitated
Facilitate enrichment planting in the forest area	• Hoes, pangas • Tree seedlings, watering canes • Lead Farmers	2,000,000	AEDC	December to April of every season	Increased forest cover, improved landscape conservation	Number of trees planted and managed per year
Promote bee keeping	• Bee hives • Production gear • Equipment	60	DFO	September, 2024	Increased income, improved nutrition	Number of bee hives and associated equipment
Conduct participatory Monitoring and Evaluation (M&E)	• Fuel • Stationery • Allowances	4	M&E specialist	Quarterly, every year	Increased community participation and ownership, improved landscape conservation	Number of reports submitted

5.6 Action Plan on Introduction of Climate-Smart Agriculture in South Sudan

Name: Isaac Taban Khamis Boaza
Contact: isaactaban00@gmail.com
Country: South Sudan
Organization/Institution: National Ministry of Agriculture and Food Security - Juba.

Problem Statement: Low crop production in Mundri East due to climate change.

Causes

- Drought.
- Pest and diseases.
- Crop failure.
- Soil degradation.

Solution: Introduction of Climate-Smart Agriculture.

Goals and Objectives

Long-term Goal: To involve Mundri East lead farmer groups in climate-smart agriculture.

Short-term Goal: Identify and engage thirty lead farmers from Mundri East in climate-smart agriculture training.

Objective One: Sustainably increase agricultural productivity and incomes by 75% by adapting and building resilience to climate change.

Table 5.6: Implementation Action Plan for Introduction of Climate-smart Agriculture in South Sudan

Activity	Resources	Cost	Responsible Person	Time frame	Expected result	Performance indicator
Training on Climate-smart Agriculture	- Facilitators - Training manuals & materials - Factsheets - Participatory approaches	450,000 South Sudanese Pounds	Director General for Agricultural Research in MAFS-RSS	5 days	Equipped with Climate-smart Agriculture Skills	30 lead farmers trained - Report
Hands-on Implementation	Lead farmers' farms (implement Climate-smart Agriculture practices on their own farms, testing, & adapting them to their context)		Farmers and Extension Agents (3)	Two years 2024-2026	Enhanced resilience, productivity and incomes	- Farms demonstrated - Reports
Regular Refresher Trainings	Extension agents and facilitators		Director General for Agricultural Research in MAFS-RSS	2 days every 3 months	To share experiences and lesson learned	Report

Activity	Resources	Cost	Responsible Person	Time frame	Expected result	Performance indicator
Continuous learning	• Lead farmers will be supported with: • Manuals • Factsheets • Videos		Extension Agents	Two years	Enhanced knowledge and skills	• Report
Evaluation and Adaptation	• Extension agents and facilitators		Director General for Agricultural Research in MAFS-RSS	1.5 year	Lead farmers are equipped with knowledge, skills, and resources	• Enhanced resilience, productivity and incomes • Report

5.7 Action Plan for Addressing Issues on Climate Change and Biodiversity Loss in Tanzania

Name: Fredy Ndandika
Email address: stalonalfred@yahoo.com
Country: Tanzania
Organization/Institution: Tanzania Forest Services Agency (TFS)
Position: Ecologist

Outline of Presentation

Problem Identification

- Problem
- Causes
- Effects
- Solutions

Action Plan Development

- Goal (1)
- Target (1)
- Objectives (2)
- Activities

Table 5.7a: Causes, effects and solutions on Climate Change and Biodiversity Loss in Tanzania

Causes	Effects	Solutions
Deforestation and forest degradation driven by population growth and poverty Illegal logging, settlement, charcoal making, poor agricultural practices, mining activities, overgrazing, and wildfire incidences	• Global warming • Food insecurity • Invasion by species • Spread of pests and diseases • Water and air pollution	Restoration and rehabilitation interventions Village Land Use Planning Promote use of green and safe energy (environmentally friendly energy) Promote Climate Smart Agriculture Strengthening law enforcement (Particularly Forest Act No. 14 of 2002 and its regulation)

Goal 01: Forest Resource Base and Ecosystems improved in Tanzania

Target 01: 14.5 million ha of forest reserves managed by June 2026

Objective A: To restore 1.2 million hectares of coastal forests by 2026

Table 5.7b: Implementation Action Plans for addressing issues on Climate Change and Biodiversity Loss

Activity	Resources	Responsible Person	Time Frame	Costs (TZS)/ Lumpsum	Expected Outcome	Performance Indicator
To conduct 48 surveillance and forest patrol events in 350000 Ha of coastal forest reserves involving 8 staff by June 2025	• Finance • Staff • Forest Guard • Vehicle	In-charge of respective forest reserve	12 Months	46,080,000	• Increased biodiversity • Improved microclimate	• Increased forest cover • Surveillance and Forest Patrol Report

Activity	Resources	Responsible Person	Time Frame	Costs (TZS)/ Lumpsum	Expected Outcome	Performance Indicator
To plant and grow 15 million trees seedlings in 85000 Ha (12500 Ha of degraded forest reserves and 72500 Ha of community woodlots) by June 2026	Finance Staff Community woodlots Trees seedlings (indigenous, fast-growing exotic, and fruits)	Owners of woodlots In charge of a particular forest reserve	10 Months	750,000,000		
To conserve and manage 350 Ha of degraded soil and watershed areas by planting and growing Bamboo trees by June 2025	Finance Staff Vehicle Bamboo seedlings	In charge of a degraded areas	5 Months	140,000,000		

Goal 01: Forest Resource Base and Ecosystems improved in Tanzania.

Target 01: 14.5 million ha of forest reserves managed by June 2026.

Objective B: To increase the number of tourists in natural forest reserves by 30% annually

Table 5.7c: Implementation Action Plans for Promoting Tourism Natural Forest Reserves

Activity	Resources	Responsible Person	Time Frame	Costs (TZS)/ Lump sum	Expected Outcome	Performance Indicator
To produce ecotourism information materials and disseminate them to 1500000 students by June 2026	- Finance - Stationaries - Staff	Extension and Tourism Officers	24 Month	50,000,000	- Increased number of tourists - Increased forest cover	- Number of students met - Report

Activity	Resources	Responsible Person	Time Frame	Costs (TZS)/ Lump sum	Expected Outcome	Performance Indicator
To engage six (6) forest-adjacent communities in ecotourism activities (traditional dances and local foods) in coastal areas by June 2026	- Finance - Staff	Extension and Tourism Officers	24 Month	14,400,000	- Increased number of tourists - Increased forest cover	- Number of adjacent communities engaged - Number of tourists visited adjacent community ecotourism activities

5.8 Action Plan on Increased Quality Seed Production of Indigenous Tree Species in Tanzania

Name: Milkajane Job Sangiwa

Email address: milkajane.sangiwa@tafori.org

Country: Tanzania

Organization/Institution: Tanzania Forestry Research Institute (TAFORI)
Kibaha Lowland Afforestation Research Centre

Position: Assistant Conservator of Forests

Goal 01: To establish indigenous seed stands and seed orchards by June 2026.

Target 01: 20 ha of seed stand and orchards of selected indigenous tree species established in Sao Hill, West Kilimanjaro, Rondo and Korogwe by June 2026.

Objective 01: To establish 5 ha seed orchards for *Azizelia quanzensis* in Rondo by 2026.

Table 5.8: Implementation of Action Plans on Increasing Quality Seed Production of Indigenous Tree Species in Tanzania

Activity	Resources	Responsible person	Time frame	Expected results	Performance indicator
Identification of plus tree and seed collection	- Casual labour - Equipment - Transport - Researcher - Tree climber	Researcher (Milka) Technician	Jul-Dec 2024	- Identified plus tree - Mature seeds identified	100 plus trees identified and marked - No. of seeds collected
Seed extraction and processing	- Casual labour - Equipment - Seed lab - Technicians	Technician Nursery attendants	Jan-March 2025	- Extracted seed and dried - Seed germination determined	- No. of seeds extracted 80% of <i>A. quanzensis</i> seeds germinated
Raise 6000 seedlings of <i>Azela quanzensis</i>	- About 7,000,000 Tshs. for equipments - Technical materials - Technician - Casual labour	Nursery attendant	Apr-Jul 2025	6000 seedlings produced	No. of seedlings produced
Identification of plus tree and seed collection	- Casual labour - Equipment - Transport - Researcher - Tree climber	Researcher (Milka) Technician	Jul-Dec 2024	- Identified plus tree - Mature seeds identified	100 plus trees identified and marked - No. of seeds collected
Seed extraction and processing	- Casual labour - Equipment - Seed lab - Technicians	Technician Nursery attendants	Jan-March 2025	- Extracted seed and dried - Seed germination determined	- No. of seeds extracted 80% of <i>A. quanzensis</i> seeds germinated
Raise 6000 seedlings of <i>Azela quanzensis</i>	- About 7,000,000 Tshs. for; - Equipment - Technical materials - Technician - Casual labour	Nursery attendant	Apr-Jul 2025	6000 seedlings produced	No. of seedlings produced

Activity	Resources	Responsible person	Time frame	Expected results	Performance indicator
Site preparation and layout	- Casual labour - Equipment - Researcher - Transport	Researcher (Milka) Technician	Aug-Sept 2025	Site clearing and pitting	Site prepared for planting
Tree planting	- Casual labour - Seedlings - Equipment - Transportation	Researcher (Milka) Technician	Oct - Dec 2025	5 ha planted with <i>A. quanzensis</i> seedlings	No. of seedlings planted
Survival assessment and beating up	- Researcher - Technician - Casual labour - Transport - Stationeries	Researcher (Milka) Technician	Mar 2026	>75% survival - Beating up done	Technical report
Growth assessment	- Researcher - Technician - Stationeries	Researcher (Milka) Technician	Jun 2026	DBH and Ht of trees determined	Technical report

5.9 Action Plan on Mitigating Climate Change in Uganda

Name: Kyomugisha Salimah

Email address: kyomugishasalima@gmail.com

Country: Uganda

Organization/Institution: Nyabyeya Forestry College, Ministry of Water and Environment.

Position: Forest Officer

Problem statement

Climate change is a major issue in Nyabyeya Central Forest Reserve.

Causes

- Climate change has been caused by rampant deforestation in the area, forest fires, over grazing, increased population and urbanization.

Effects

- Climate change has led to catastrophic events like drought, decrease in soil fertility in the area, low crop yields, increased pests and disease infestation and high levels of poverty.

Solutions

- The solutions to these effects include: Tree planting, community sensitization and planting improved tree varieties.

Long term goal: To increase forest cover in Nyabyeya Central Forest Reserve.

Short term goal: To plant 100 ha of land in 2 years in Nyabyeya Central Forest Reserve.

Objective: To have 25 ha of the land area planted every rainy season in Nyabyeya Central Forest Reserve.

Table 5.9: Implementation Action Plan on Mitigating Climate Change in Uganda

Activity	Resource	Responsible Person	Time Frame	Expected Results	Performance Indicators
Training of students and community members on climate change adaptation and mitigation	• Training manual • Posters • Flip charts • Building	K. Salimah	One week (12 th – 16 th August, 2024)	• Increased knowledge on climate change mitigation and adaptation, pests and disease control, improved resilience	• Attendance sheets • Training Reports
Raise 150,000 seedlings of different species in the tree nursery	• Labour • About 1,000,000 Ushs. to purchase • Potting material, seeds • Soil	College Nursery workers	10 th June – 15 th August 2024	• Availability of seedlings to increase forest cover	• Tree Nursery records
Plant 1,600 seedlings of bamboo	• Labour • Marking tape • Ropes • Rods	K.Salimah	17 th August 2024 – 30 th August 2024	• Increased tree cover • Improved climate • Increased knowledge on importance of bamboo	• Planting records • Established bamboo species • Monthly reports

Activity	Resource	Responsible Person	Time Frame	Expected Results	Performance Indicators
Practical demonstration on long rooted seedlings	- Bamboo stems - Seedlings	K. Salimah	16 th August 2024	- Increased knowledge on improved tree growth - Faster growth and survival of seedlings when planted out	- Availability of long rooted seedlings in the nursery - Tree nursery Records
Planting of 10,000 species of indigenous trees	- Seedlings - Labour - Transport	Forest workers	1 st September 2024 – 30 th September 2024	- Increased forest cover - Reduced impacts of climate change - Improved resilience to climate change	Tree planting records
Planting of 27,775 species of exotic trees (Pine and Eucalyptus)	- Seedlings - Labour - Transport	Forest workers	13 th March 2025– 28 th April 2025	- Increased forest cover - Reduced impacts of climate change - Improved resilience to climate change	- Tree planting records - Tree species survivals in the plantation
Training community farmers on Climate Smart Agriculture	- Posters - Logistics	K. Salimah	7 th April, 2025– 9 th April, 2025	- Improved food security - Increased knowledge on new farming technologies	- Training register - Training reports
Raise 20,000 seedlings of exotic tree species	- Labour - About 800,000 Ushs to purchase: - Potting material, seeds - Soil	College Nursery workers	6 th May, 2025 – 15 th July, 2025	Increase in tree cover	Tree nursery records

Activity	Resource	Responsible Person	Time Frame	Expected Results	Performance Indicators
Planting of 15,000 species of Pine	• Seedlings • Labour • Transport	Forest workers	11 th August, 2025 – 28 th August, 2025	• Increased forest cover • Reduced impacts of climate change • Improved resilience to climate change	• Tree planting records • Tree species survivals in the plantation
Enrichment planting with 30,000 indigenous species	• Seedlings • Labour • Transport	Forest workers	8 th March, 2026 – 13 th May, 2026	• Increased forest cover • Reduced impacts of climate change • Improved resilience to climate change	• Tree planting records • Tree species survivals in the plantation

5.10 Action Plan on Strengthening Agro-Ecological Options for Sustainable and Resilient Agro-Food Systems in Selected Landscapes of Eastern Uganda

Name: Phiona Kwaga
Email: kwagaphifi@yahoo.com
Country: Uganda
Institution: National Forestry Resources Research Institute (NAFORRI).
Position: Senior Research Technician

Background

Eastern highlands of Uganda are characterized by steep hills, deep valleys and rivers.

Causes

- The region has experienced severe deforestation and land degradation where soil erosion and soil fertility loss are rampant due to high human population and poor farming practices.

Effects

- Significant negative effects on the overall food security in the region.

Long term goal: To achieve an agro-ecosystem that ensures food and nutrition security, improved access to energy and clean water in Eastern Highlands of Uganda.

Short term goal: Enhance technologies for food and fuel wood production for improved livelihoods by 2027.

Objective: To strengthen capacity of farmers to raise and diversify tree species on farmlands.

Table 5.10: Implementation Action Plans on Strengthening Agro-Ecological Options for Sustainable and Resilient Agro-Food Systems in Selected Landscapes of Eastern Uganda.

Activity	Resources	Responsible persons	Time frame	Expected Results	Performance indicators
Establish community tree nurseries	- Funds - Nursery Inputs	Researcher (Phiona Kwaga)	2 months	3 tree community tree nurseries	No. of tree nurseries
Train nursery operators on tree nursery management	- Funds - Stationery - Training Aids	Researcher	8 months	30 tree nursery operators	- No. of tree seedlings raised - Reports
Sensitize farmers on tree technologies for food and fuelwood	- Funds - Meals and Refreshments	Researcher District Local Government (DFOs, Natural Resource Officers, extension agents) Farmer Groups Local and religious leaders	12 months	Increased tree/vegetation cover	- No. of trees distributed - Training reports

CHAPTER 6

6.0 Information Materials

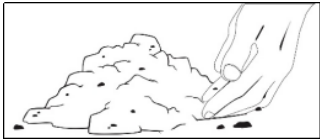
6.1 Introduction

Information materials are essential tools used to communicate knowledge, convey ideas, and provide education in various fields as well as inform about an event. The materials are developed to suit specific audiences and objectives, and they can take different forms depending on the purpose they serve. In today's world, the role of information materials has grown even more prominent due to their ability to bridge gaps in knowledge and to facilitate dissemination of critical information. Information materials can be print-based and include books, manuals, guides, brochures, leaflets, and posters.

During the training the participants learnt and developed posters and brochures outlined as follows:

6.2 Posters

Group 1

	
INVITATION TO A TREE GROWING TRAINING To: All members of Kabi CFA Venue: Kabi Social Hall Time: 9.00 am – 4.00 pm Date: 11 June 2024 All are Welcome Contact: 0711225193	

Group 2



FORESTS: OUR HOPE FOR IMPROVED CLIMATE

Forestry Institute invites Kitui Farmers Cooperative Members to a training on:

The Role of Forests in Managing Climate

BENEFITS

Learn

- What a forest is
- How forests improve our climate
- How to manage our forests

Entrance: FREE!!!!!! Comes with a drink

Venue: Kitui Forest Gardens

When: 22nd May 2024

Time: 2.00 pm – 5.00 pm

Contact: 0704 804260/0777526044

SPONSORS

JICA & KEFRI

Group 3



**TRAINING ON BENEFITS OF FOREST ECOSYSTEMS FOR
BETTER LIVELIHOODS**

DATE	TIME	VENUE
23 rd May 2024	9.00 am – 1.00 pm	Cedar Room KEFRI, MUGUGA

LESSONS TO BE OFFERED

1. Tree Planting
2. Soil and Water Conservation
3. Bee Keeping
4. Commercial Forestry

FOR FURTHER INQUIRIES

Call: 0773064345
Whatsapp: 0793185546
Email: director@kefri.org
Postal: Box 20412-00200, Nairobi, Kenya

FREE ENTRANCE

Group 4



Training on the Importance of Forests

Ecosystem Alliance Programme (EAP) intend to provide training on the importance of forests to farmers of Muguga Ward.

The training will be conducted as follows:

Venue: Kanani Hall
Date: 26th to 30th May 2024
Time: 11.00 am to 2.00 pm
Location: Ajinga Street, Muguga

The training will be on:

- ❖ Selection of Tree Species
- ❖ Soil and Water Conservation and Management
- ❖ Climate Smart Agriculture
- ❖ Sustainable Forest Resources Utilization.

Entrance: FREE

For more Information Contact
Ms. Mercy Fredy
Tel. No.: 0711 011011
Email: m.fredy@gmail.com

Group 5

	TRAINING ON: ROLE OF FORESTS IN AIR FILTRATION	
	Date: 22/05/2024 Time: 8.30 am to 1.00 pm Venue: Village Assembly Hall Invitees: All community members	
Definition: Forest: Is an area covered with trees Air filtration: Refer to removal of particles or CO ₂ from the atmosphere		

AGENDA: 1. Uses of trees 2. How trees regulate air	CONTACT: Call: 0710374038 Email: mj.sangias@kefri.org Location: Muguga, Kenya
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6.3 Brochures

Group 1

	About Us	Agroforestry Practices
TUPANDE MITI  TREES FOR LIVES  ISO: 9001 2018 CERTIFIED	Development of agroforestry for the well-being of households <u>Vision:</u> To be leading agroforestry trainers in the region <u>Mission:</u> Promote agroforestry to improve the living conditions of households <u>Core Values</u> - Change perception of farmers to embrace tree growing - Increase youth and women in commercial tree growing - Promote appropriate agro-forestry practices.	Woodlots • Boundary planting • Hedgerows • Trees scattered on farm • Fodder banks Agro-forestry trees species • Macadamia • Leucaena • Grevillea • Eucalyptus • Pine • Cypress • Calliandra • Cordia • Maesopsis • Fruit trees  

Group 2

REPUBLIC OF KENYA  Group 2 Forestry Institute  Role of Forests in Managing Climate 2024	ACTIVITIES: Income Generating Activities (IGA) • Bee keeping • Mushroom production • Nursery establishment • Nursery management The Institute also offers capacity building in: Establishment of Youth clubs on environmental conservation and protection	 Compiled by: Ackim D. and Salmah K. Email: Forests@gmail.com For More Information: Contact: Director: Group 2 Forestry Institute P. O. Box 222, Kitui, Kenya Website: www.GFI.org/asal-forests@ke Editorial & Publication Department of Forestry
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Group 3

 BENEFITS OF FOREST ECOSYSTEMS FOR BETTER LIVELIHOODS MAY 2024	Introduction Forest ecosystems comprise of seed, tree, insects, animals, birds and human beings. Forests play a big role in conserving the environment and also improving people's livelihoods. Major benefits of forest ecosystems include 1. <u>Soil and Water Conservation</u> Trees stabilize water run off by reducing the speed of water and binding the soil together and in turn maintaining crop yields. For example trees help in river banks stabilization. 	2. <u>Carbon Storage</u> Trees act as stores of carbon emitted from the environment. This reduces the impacts of climate change. 3. <u>Source of Income</u> Forests provide wood and non-wood products. Wood products like timber and non-timber products like mushrooms, medicine, eco-tourism.  	4. <u>Habitat</u> Forests act as home for different birds and animals in the world. 5. <u>Source of Employment</u> Forests are a source of employment especially to the communities that surround forests for example tour guides, tree nursery operators. 6. <u>Other Benefits include:</u> Improved Water Supply and Quality Forests provide benefits by filtering sediments and other pollutants from the water in the soil before it reaches a water source such as streams, lakes and rivers	For more information Contact Kenya Forestry Research Institute Head Office Muguga, off Nairobi - Nakuru Road P. O. Box 20412- 00200 Nairobi
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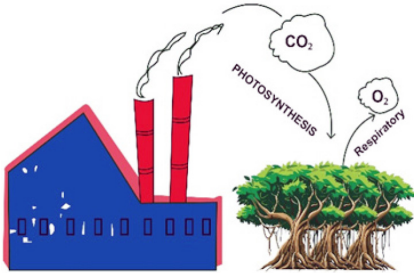
Group 4 (a)

Objectives	Target Categories	
- Enhance farmers knowledge on forest - Increase awareness on how forests help improve climate - Promote farmers skills on forests management and conservation  Farmer training	- Kitui Cooperative Farmers - Youth   Cooperatives for honey processing	Goal To have a favourable climate through participation and improving livelihoods Vision A better environment and improved livelihoods Mission To increase forest cover to meet the needs of the people and conserve the environment through community participation

Group 4 (b)

Head Office and Branch	Tree Products	Photos of tree products
Tupande Miti Project P. O. Box 201-00100 Nairobi, Kenya Mobile: 0711225193 Email: infor@mitiproject.org Website: www.mitiproject.org	1. Timber • Ply wood • Sawn timber • Ply boards • Construction • Furniture	 Fruits
	2. Poles • Power	 Firewood
	3. • Posts • Fencing	
	4. • Leaves and twigs • Manure/mulching • Bio-gas • Briquettes • Fodder & forage	
	5. • Fruits • Juices • Jam • Dry fruits	
	6. Oil & fats	
	 Timber	 Briquettes
	 Bamboo products	 Juices

Group 5

Introduction	Process of Air Filtration	
“Did you know forests are nature’s lungs? They help keep our air clean and fresh!” Forest Is an area covered with trees. Forests play a crucial role in air filtration, benefiting local communities in many ways. Air Filtration This refers to the removal of particles and air (CO₂) from the atmosphere	 Benefits of Forest in Air Filtration • Forests acts as natural filtration, tapping pollutants and releasing clean oxygen (O₂). • Trees absorb harmful gases like carbon dioxide, sulphur dioxide • Forests reduce particulate matter in the air improving air quality and human health	What you can do to support forests • Plant trees in your community to help filter air and provide other benefits. • Support sustainable forestry practices and conservation efforts. Conclusion “Clean Air for a better Future Generation”

CHAPTER 7

7.0 Country Reports

7.1 Promoting Climate Change Resilient Forestry in Burundi

Gabriel Nimenya

Burundian Office for Environmental Protection (OBPE)

Introduction

Burundi covers an area of 27,834 km², and is situated between longitudes 29°00' and 30°54' East and the latitudes 2°20' and 4°28' South. Burundi borders Rwanda to the North, Tanzania to the east and South, and Democratic Republic of Congo to the West. In Burundi, land use is dominated by agriculture, and forest formations which include plantation forests and natural forests. The first forest plantations were established in the 1930s, and since 1976, major afforestation efforts have been carried out with the support of bilateral and multilateral initiatives.

Physical Characteristics of Burundi

Topography

Burundi's topography is shaped by the East African Rift, which has contributed to the formation of Lake Tanganyika in Rift Valley to the west and a series of steeply dissected plateaus to the East. The country's relief is divided into five distinct geomorphological zones: the Western Plain, situated at altitudes ranging from 775 to 1,000m; the Western Highlands, forming the Congo-Nile Ridge with elevations between 1,000m and over 2,600m; the Central Plateaus, covering the majority of the country at elevations between 1,400m and 2,000m above sea level; the Eastern Kumoso Depression, located at altitudes between 1,200m and 1,400m; and the Bugesera Depression in the northeastern part of Burundi, with elevations ranging from 1,200m to 1,500m.

Hydrography

Burundi is divided into two major hydrographic basins: the Nile Basin and the Congo Basin. The Nile Basin includes the Ruvubu River and its tributaries, as well as the Kanyaru River, a tributary of the Kagera River. The Congo Basin is composed of two sub-basins: one located west of the Congo-Nile Crest, formed by the Rusizi River and its tributaries, along with Lake Tanganyika; and the Kumoso sub-basin, located in the eastern part of the country, which includes the Malagarazi River and its tributaries.

Soils

Burundi's soils are generally characterized by poor fertility, with over 36% being acidic and prone to aluminum toxicity. This condition can be corrected through application of organic and calcareous amendments. When cultivated, these soils can respond favourably to such treatments, improving their fertility,

if left untreated, may undergo rapid physico-chemical degradation. Specifically, the soils at higher altitudes, such as in the Mumirwa and Mugamba regions, are typically ferralsols or ferrisols. On slopes and ridges, lithosols, which are poorly evolved tropical brown soils, are commonly found. In marshy valley bottoms, particularly in areas like Kumoso and the Nile Basin, peaty organic soils are prevalent. The Rusizi Plain is notable for its tropical black soils, including regogleys, saline regogleys, and vertisols.

Climate

Burundi's climate is humid tropical, significantly influenced by its varying altitude, which ranges from 773m to 2,670m. The climate is generally bimodal, characterized by two distinct seasons: the rainy season, which typically lasts from October to May, and the dry season, which extends from June to September. Rainfall varies across the country, with minimum annual precipitation of around 500mm occurring in the Rusizi Plain, while maximum precipitation reaches up to 2,200mm in the high-altitude regions. The highest annual average temperature is recorded in the Imbo Plain at 24.1°C, while the lowest average temperature is found in Rwegura at 15.6°C.

Demographic and socio-economic context

Population

Burundi is one of the most densely populated countries in Sub-Saharan Africa. The country's population has grown rapidly over the past fifty years, increasing from 2.94 million in 1960 to 3.51 million in 1970. The first general population census in 1979 recorded 4,028,420 inhabitants, and the second census in 1990 reported 5,292,793 inhabitants. A third census was conducted in 2008, with results published under Decree No. 100/55 on April 5, 2010, estimating the population at 8,053,574. According to projections from Burundi's Institute of Statistics and Economic Studies (ISTEBU), the population is currently estimated at 12,309,600, with an annual growth rate of 3%.

The population distribution is uneven across the country. The seven most populated provinces are Muramvya, Kayanza, Ngozi, Gitega, Bujumbura Rural, Kirundo, and Mwaro which account for approximately 54% of the total population. In contrast, the five least densely populated provinces are Rutana, Cankuzo, Ruyigi, Bururi, and Makamba represent only 18% of the population. This distribution highlights a stark contrast between the heavily populated central and northern regions and the less populated southern and eastern regions.

Social development

Burundi remains one of the least developed nations globally. According to the 2016 UNDP report, the country has a relatively low Human Development Index. In 2015, Burundi's Gross Domestic Product (GDP) per capita was \$276, down from \$285 in 2014. The 2016 Global Food Security Index ranked Burundi last in the world for food accessibility, availability, and quality. Additionally, nearly

70% of the population live below poverty line, surviving on less than \$1 per day per capita.

Economic development

The Burundian economy is characterized by lack of diversification and heavy reliance on the primary sector. Agriculture plays a crucial role, providing over 90% of the country's food supply and accounting for 90% of its export earnings. Much of agriculture is subsistence-based, with 90% of cultivated land dedicated to crops for rural household consumption, while export-oriented agriculture occupies the remaining 10%. Historically, agriculture contributed more than half of the GDP from independence until the early 2000s, but this contribution declined to 35% by 2005.

The service sector has become the largest contributor to the economy, with its share of GDP increasing from 25% in 1980 to 45% in 2005. In contrast, the industrial sector has seen little development since independence. It is primarily composed of industries that process agricultural products, which account for 70% of total industrial output, along with a few textile, mechanical, and chemical industries. The forestry sector also plays a role in the economy, contributing 13.8% to GDP and providing 6% of employment as of 2012 (ODEB).

Occupation, land use and land degradation in Burundi

Land occupation and use

Burundi's land includes both terrestrial and aquatic ecosystems. The terrestrial ecosystems cover an area of 25,200km² (source: SNPADB, 2013-2020) and encompass forest ecosystems, agricultural areas, and settlements (Table 7.1). The aquatic ecosystems, spanning 2,534 ha, consist of inland waters, northeast lakes, and Lake Tanganyika. The forest ecosystems within the country include both natural forests and areas of afforestation or plantation forests.

Table 7.1: Land occupation by various types of ecosystems in Burundi

Types of ecosystems and others	Ecosystems and others	Area in hectares (ha)	Percentage (%) relative to the total area of the country
Natural forest ecosystems	Natural vegetation	240 716	8.6
Artificial forests ecosystems	Plantations	128 375	4.6
Aquatic ecosystems	Lakes and rivers	263 400	9.9

Types of ecosystems and others	Ecosystems and others	Area in hectares (ha)	Percentage (%) relative to the total area of the country
Agricultural ecosystems	Food crops	1 210 000	43.4
	Cash crops	104 000	3.7
	Cultivated marches	81 403	2.9
Others	Pastures and others	775 506	27.8
	Cities	25 000	0.9
Total		2 783 400	100

Main factors promoting land degradation in Burundi

Land degradation in Burundi is caused by both anthropogenic and biophysical factors (Table 7.2)

Table 7.2: Main factors of land degradation in Burundi.

Factors	Causes	Effects
Anthropogenic factors or factors directly linked to human activities	Deforestation	Direct causes: strong pressure on forest resources, the search for arable land, bush fires and poor resource management forestry
	Poor management of afforested and protected areas	Failure to consider the population's needs in the creation of state forests, national parks and reserves
	Mis-allocation/use of land	Poor land use; inappropriate agricultural practices as well as overexploitation of soil
Biophysical and climatic factors	Water deficit	Inappropriate water management is the main cause of water deficit and the destruction of socio-economic infrastructure in Burundi
	Climatic variability	In certain areas of the country, aggressive climate affects agricultural production through the destruction of crops and in certain cases leads to cyclical shortages or famines

Present Status of Forestry and Forestry Resources

Burundi, forests are categorized into plantation forests and natural forests. Since 1978, various projects have been launched to boost economic growth and protect the environment, focusing on forest production and soil erosion control. These initiatives have increased the national forest coverage from 3% to 6.7%

(Department of Forests, 1993). According to the FAO’s FRA 2015 report on global forest status, Burundi’s forest cover is estimated at 17.4%, or 477,200 ha. Of this, 9.9% (or 275,200 ha) consists of forests and open afforestation, while the remainder includes micro-forestations and agroforestry.

The MDG assessment report, preceding Agenda 2015, indicates a deforestation rate of 2% per year, equivalent to an average annual loss of 6,454 ha. Given this rate of deforestation, which exceeds the annual growth rate of forest resources (currently less than 1%), there is a significant risk that Burundi’s forest formations could face severe depletion within 24 years from 2015.

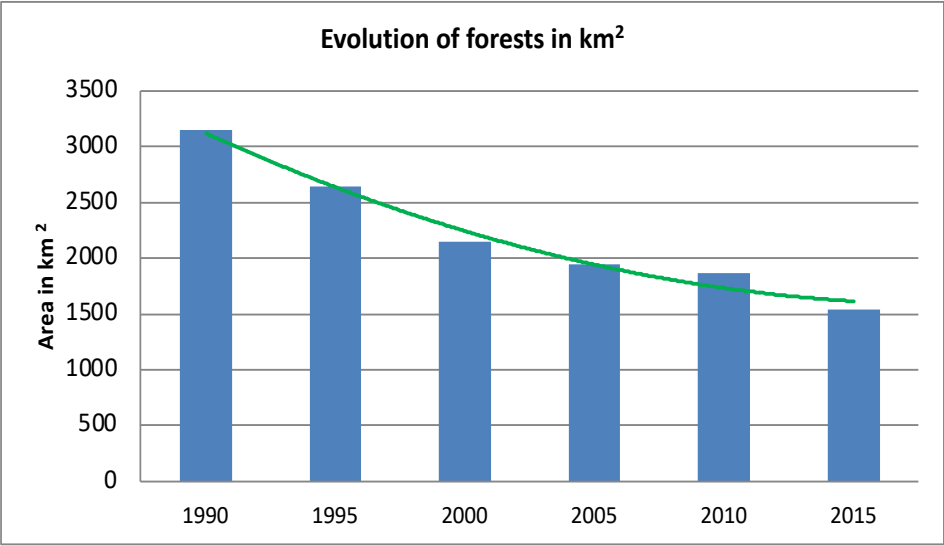


Figure 7.1: Forests acreage in Burundi from 1990 to 2015

In response to the observed deforestation and the need for sustained forest growth, the Burundian Office for Environmental Protection has launched a five-year plan aimed at reforestation. This plan focuses on planting one million trees across all communes in the country. The initiative emphasizes the use of multi-purpose tree species that are well-suited to the various agro-ecological zones of Burundi. This effort is designed to enhance forest cover, support environmental protection, and promote sustainable land management.

Recent and ongoing programs/projects implemented by Burundi to combat climate change

Over the last five years, Burundi has implemented several key projects and programs to enhance climate resilience and support forest conservation. The Government’s Forest policy focuses on preserving and expanding forest resources to address wood shortages, combat land degradation, mitigate climate change, and restore degraded landscapes. Notably, Burundi has committed to restoring 2 million ha of land under the Bonn Challenge and aims to create 4,000 ha of afforestation annually with its own investments. If supported by bilateral and

multilateral partners, this target is expected to increase to 12,000 ha annually. Additionally, the country is engaged in forest management and conservation projects, climate change mitigation efforts, and collaboration with international partners to achieve these ambitious goals and strengthen its climate resilience.

Main projects and programs related to climate resilience over the last five years.

Many of the projects for climate resilience are mostly adaptation in nature (Table 7.3)

Table 7.3: Main climate change adaptation projects

S/No.	Projects	Lessors	Impact
1	Integrated Approach Pilot – Food Security (IAP-FS): Support for sustainable food production and improvement of food security and climate resilience in the highlands of Burundi, 2018 to 2022	IMF - FAO	Adaptation/mitigation
2	Community Disaster Risk Management linked to Climate Change in Burundi (GCRCCCBu) August 2015-September 2019 - 2020 (Project extension)	IMF - UNDP	Adaptation
3	Rehabilitation of natural landscapes and adaptation to climate change in the provinces of Bujumbura and Bujumbura Mairie through the Producer Field Schools approach	IMF - FAO	Adaptation/Mitigation
4	Strengthening resilience to risks linked to natural disasters in Burundi, Dec 2019-Dec 2022	EU - OIM	Adaptation
5	UMUCO W'ITERAMBERE - Rural Energy Services for Population Resilience in Burundi	EU – UNDP - FAO	Mitigation/Adaptation
6	Rural development and resilience - Natural disaster risk reduction	EU- OXFAM	Adaptation
7	Cooking energy / Improved stoves	GIZ ENDEV	Adaptation
8	Sector Development Program (PRODEFI), Period: 1/1/2016 to 1/1/2022	IFAD	Adaptation
9	Food security – Environment – Health Period: 2017 – 2022	Germany - Caritas	Adaptation

S/No.	Projects	Lessors	Impact
10	Project for Intensification of Agricultural Production and Reduction of Vulnerability, Period: 4/14/2/1/2019 to 4/12/2024	IFAD	Adaptation
11	Project adaptation to climate change for the protection of water and soil resources, (ACCES) Period: 10/2018 – 09/2021	GIZ	Adaptation
12	Productivity and Agricultural Market Development Project in Burundi (PRODEMA)	World Bank	Adaptation
13	National Program for Food Security and Rural Development of Imbo and Moso (PNSADR-IM) Period: 1/1/2015 to 19/3/2021	IFAD	Adaptation
14	Support Project for Intensification of Agricultural Development, PAIVA	IFAD	Adaptation
15	Soleil Nyakiriza Project (solar energy electrification of isolated centers, rural households, schools, health centers, improved homes)	World Bank	Mitigation/ Adaptation
16	Landscape Restoration and Resilience Project in Burundi, Period: 9/21/2018 to 3/14/2023	World Bank	Mitigation/ Adaptation
17	Micro-projets du Programme National des Micro-subventions du FEL Micro-projets of the FEL National Micro-Grants Program	IMF - UNDP	Adaptation
18	Shade coffee development project, PADZOC, Period: 4/9/2013 to 31/8/2018	World Bank	Adaptation

Source: MINEAGRIE, Forest Department 2023

In addition to the projects listed in the Table 7.3, it is worth mentioning other ongoing projects for the sustainable management of forests in Burundi as indicated in the Table 7.4.

Table 7.4: Sustainable forest management projects in progress

Program/project title	Brief description of the intervention	Start year	Expected year of closure	Source of funding
Improving the effectiveness of the protected area management system for the conservation of biodiversity in Burundi	Restore the landscape and protect the Kibira and Rusizi parks. Initiate ecotourism activities in these parks	2022	2026	Belgium
Program/project title	Brief description of the intervention	Start year	Expected year of closure	Source of funding
Support for natural disaster risk reduction and community resilience in Burundi	Strengthen the resilience of communities, particularly women, young people, children, the elderly, people living with disabilities and indigenous people, by strengthening disaster monitoring, preparation and response mechanisms	2019	2023	UNDP
Project to support Environmental Protection through reforestation and watershed development	Support or sustained and multi-sectoral for sustainable environmental management and protection of biodiversity. Promoting clean energy innovations relating to mitigation and adaptation to climate change	2022	2026	UNDP
Support Project for the Conservation of Ecosystems of the Rusizi River Basin (PACECOR) in Burundi- “TUBUNGABUNGE ISI”	Protection of biodiversity in the Rusizi and Kibira national parks.	2023	2027	EU:1.000.000 UNDP:1.000.000

Program/project title	Brief description of the intervention	Start year	Expected year of closure	Source of funding
Project to support the restoration of landscapes to increase resilience in the urban and peri-urban areas of Bujumbura	Reduce vulnerability to increased frequency of flooding, runoff and landslides and strengthen the resilience of urban and peri-urban communities in Bujumbura and the Ntakangwa watershed in and around Bujumbura	2023	2028	GEF:8,932,420 UNDP:500,000

These commitments are being advanced through various projects and programs. For instance, the “**EWE BURUNDI URAMBAYE**” program and the Project to Produce Agroforestry, Forestry, Indigenous Species, and Medicinal Plants focus on implementing Nationally Determined Contributions (NDCs) without conditionality’s. Additionally, the Government of Burundi has secured funding from the World Bank for the Burundi Landscape Restoration and Resilience Project (PRRPB). This project, currently underway, aims to develop progressive terraces, conduct afforestation and reforestation, and apply bioengineering techniques using the HIMO (Haute Intensité de Main d’Oeuvre) approach in three municipalities: Isare, Buhinyuza, and Matongo.



Figure 7.2: Progressive furnished terraces

Main achievements, challenges and opportunities in Burundi

Main achievements

Burundi's forest resources encompass both natural formations, such as parks and reserves, and plantation, including state, municipal, public establishment, and private afforestation. Exotic tree planting began in 1919 to address firewood demands, initially featuring Eucalyptus species along roads and on community lands. In 1931, the colonial administration mandated the establishment of community wooded areas to protect natural forests and prevent soil erosion. Significant progress occurred from 1978, when large-scale tree plantations were initiated to address a timber crisis. By 2001, Burundi aimed for a forest cover rate of 20% to balance socio-economic and ecological needs. International support has facilitated substantial funding for reforestation efforts. Before the socio-political crisis that began in 1993, forest cover had increased from 3% in 1978 to 8%. However, the rate fell to 5% by 1997 due to conflicts, resulting in the destruction of 30,000 ha of planted forests and 3,400 ha of natural forests. Despite these efforts, Burundi still faces significant challenges, including an 80% deficit in utility and firewood needs compared to 20% for timber. Challenges such as unregulated afforestation, recurrent bushfires, agricultural expansion, overgrazing, resource overexploitation, and climate change continue to contribute to deforestation and forest degradation.

Main challenges facing the forestry sector

The challenges affecting the forestry sector can be summarized into three drivers of deforestation and forest degradation. The drivers include agricultural expansion, mining and extension of infrastructure and housing

a) Agricultural expansion

In Burundi, the size of the family farm is continuously decreasing, and its average does not exceed 0.5 ha per household of 6 children, which pushes the population to expand agricultural land by encroaching on wooded areas and engaging in cultural clearing practices.

b) Extension of infrastructure and housing

In Burundi, housing is categorized into four main types: urban agglomerations, villages, urban centers, and scattered settlements on the hills. Despite these distinct categories, the level of urbanization remains relatively low. Infrastructure development often extends into various types of land, including vulnerable areas. Public and private infrastructures are frequently established on the immediate borders of, and even within, forests and river line areas, leading to encroachment and potential negative environmental impacts.

c) Mining

Mining activities in Burundi, particularly artisanal mining result in significant physical destruction of forest ecosystems. These operations, spread across various regions of the country, involve numerous individual sites that collectively cause

considerable environmental impact. These activities extensive nature leads to degradation of forests, disrupting the ecological balance and local environment.

Policy, legislation, strategies and guidelines for promotion of climate change mitigation and adaptation measures, and landscape restoration in Burundi

Burundi has adopted a certain number of political instruments, plans and programs in recent years, mainly:

- (i) the national forest code,
- (ii) the environment code,
- (iii) the water code
- (iv) the National Development Plan of Burundi PND-BDI 2018-2027,
- (v) the National Forestry Policy of Burundi of 2012, and
- (vi) development plans for two state-owned forests of Gakara and Vyanda
- (vii) of the National Strategy and Action Plan on Climate Change.

However, these instruments have not been translated into concrete actions following the lack of or insufficient funding from national and international partners in the forestry sector. Recently, Burundi has just acquired another important political orientation tool which is the Vision of Burundi Emerging country in 2040 and developed country in 2060.

Opportunities and challenges for capacity building on climate change mitigation and adaptation measures

Opportunities

The Government of Burundi has utilized significant international funding for reforestation initiatives. A significant opportunity lies in the country's seed center, which handles the collection, processing, and distribution of seeds for agroforestry, forestry, indigenous species, and medicinal plants. The recently launched reforestation program, “**EWE BURUNDI URAMBAYE**,” along with the project for producing agroforestry and other plant species, aligns with the Nationally Determined Contributions (NDCs). Additionally, the Burundian Office for Environmental Protection (OBPE) is executing a five-year plan to plant one million trees nationwide, focusing on multi-use species suited to various agro-ecological zones.

With World Bank support, the Burundi Landscape Restoration and Resilience Project (PRRPB) is underway, aiming to develop progressive terraces, conduct afforestation and reforestation, and apply bioengineering techniques using the High Labor Intensity (HIMO) approach. The country's climate, characterized by an eight-month rainy season from October to May, is conducive to forestry development. Furthermore, Burundi possesses the institutional framework

necessary to implement effective government policies for advancing the forestry sector.

Challenges

Despite significant efforts by the Government of Burundi to develop the forestry sector, several challenges persist. The socio-political conflict that began in 1993 led to the destruction of 30,000 ha of planted forests and 3,400 ha of natural forests, resulting from numerous incursions and devastating events in protected and artificial forest areas. Although the sector benefits from a robust legal and institutional framework, it continues to face several challenges: illegal logging of forest formations and premature cutting of trees, particularly eucalyptus, which exacerbates deforestation; and the disappearance of certain exotic and indigenous species, such as cypress, blackwood, and bamboo, due to diseases and overexploitation.

7.2 Promoting Climate Change Resilient Forestry in Ethiopia

Yeshifana Alemneh

Ethiopian Forestry Development

Introduction

Ethiopia is a landlocked country located in Eastern Africa and is bordered by Djibouti, Eritrea, Kenya, Somalia, South Sudan, and Sudan. Ethiopia is the second most densely populated country in Africa with a population of about 120 million people (Solomon *et al.*, 2016). Notably, 70% of the population consists of youth. The total land mass of Ethiopia is about 1.2 million km². The altitude ranges from 110 m below sea level at the Danakil Depressions in the northeast to 4600 m above sea level at Ras Dashen Mountain in the northwest (Solomon *et al.*, 2016). The landscape includes a large highland area of mountains and dissected plateaus, divided by the Rift Valley, which runs southwest to northeast and is surrounded by lowlands, steppes, or semi-desert. This large diversity of terrain has led to wide variations in climate, soils and natural vegetation.

Agro-climatic conditions

Ethiopia is an extremely ecologically heterogeneous country. There are six major agro-ecological zones in the country namely: alpine (>3700 meter above sea level (masl)), wurch (>3200-3700 masl), dega (>2300-3200 masl), woyna dega (>1500-2300 masl), kola (500-1500 masl) and bereha (<500 masl). Ethiopia has three main seasons: June–September (kiremt), October–January (bega), and February–May (belg). Kiremt rains account for 50–80% of the total annual rainfall. Therefore, the main rainy season of Ethiopia is from June to September (ATLAS, 2016 and Geleta *et al.*, 2024). The lowlands in the southeast and northeast are tropical, with average temperatures of 25°–30°C, while the central highlands are cooler, with average temperatures of 15°–20°C. Lowlands are vulnerable to rising temperatures and prolonged droughts, while highlands are prone to intense and irregular rainfall. Annual rainfall varies from less than 200 mm in lowland areas to over 2,000 mm in highland regions.

Agriculture and other land use types

Agriculture forms the backbone of the Ethiopian economy, accounting for about 36% Gross Domestic Products (GDP) and employs 66% of the population (Bekana, 2018). The national GDP is near 850 billion (Birr, 2022), and is the fastest growing economy in the region. Despite this growth, Ethiopia remains one of the poorest countries though it aims to achieve lower-middle-income status by 2025.

A key source of information on forests and other land uses in Ethiopia is Woody Biomass Inventory and Strategic Planning Project (WBISPP). WPISPP (2005) classified the land cover types as indicated in Table 7.5.

Table 7.5: Land-cover types of Ethiopia and their magnitude (WBISPP, 2005)

Land cover type	Area in hectare	Percentage
Cultivated land	21,298,529	18.6
High forests	4,073,213	3.56
Plantations	501,522	0.4
Woodlands	29,549,016	25.8
Shrublands	26,403,048	23.1
Grasslands	14,620,707	12.8
Land cover type	Area in hectare	Percentage
Afro-alpine	245,326	0.21
Highland bamboo	31,003	0.027
Lowland bamboo	1,070,198	0.97
Swamp	810,213	0.70
Water	828,277	0.72
Bare rock, soil, etc	15,359,409	13.4

Forestry

Forests are crucial for Ethiopia's ecological diversity and economic development. The forest cover in Ethiopia was about 18.5% in 2000. However, the forest cover has suffered great decline over the decades. According to the National Forest inventory report (2018), the forest cover of Ethiopia is estimated to be 15.7%, a percentage attributed to continuous efforts to rehabilitate degraded areas, afforestation /reforestation efforts, and partly due to the change in the definition of forests. The country has diverse vegetation resources that range from lowland scrubs to tropical rainforest that comprise both natural and planted forest. The natural forests are also different types which include: moist and dry tropical Afromontane forests, woodlands and shrub lands while the planted forests comprise industrial plantation and small-scale woodlots. In addition, there are four forest biomes in the country such as acacia, comiforea, combretum terminalia, dry afro-mountain forest, and wet afro-mountain forest.

Land degradation status

Ethiopia is one of the Sub-Saharan African countries that is severely impacted by land degradation. Land degradation is a leading factor in the country's low and declining agricultural productivity, persistent food insecurity, and widespread rural poverty. The estimated annual cost of land degradation in Ethiopia ranges from 2 to 3% of agricultural GDP, which represents a significant loss for a nation where agriculture contributes nearly 50% to GDP, 90% of export revenue,

and provides a livelihood for over 85% of its 70 million people. The causes of land degradation in Ethiopia are multifaceted, including the heavy reliance of a rapidly growing population on unsustainable subsistence farming practices, high dependence on wood and biomass for energy, poor livestock management, and land tenure insecurity. Additionally, the agriculture and forest sectors are responsible for 75% of greenhouse gas emissions (Acquay, 2008).

Current Programmes/Projects Addressing Climate Change

The Ministry of Agriculture (MoA) and Ethiopian Forestry Development (EFD) have integrated climate commitments into the Growth and Transformation Plans (GTP) 1 and 2, actively addressing desertification, land degradation, and drought (DLDD). Under EFD, the Forest Sector Development Program (FSDP) operates in over 56 districts (woredas), focusing on afforestation, reforestation, water conservation, and livelihood interventions.

Key national programs managed by the MoA include:

- **Managing Environmental Resources to Enable Transitions (MERET):** This project aims to rehabilitate degraded natural resources, enhance land productivity, and improve livelihoods to reduce dependence on food assistance.
- **Sustainable Land Management (SLM) Program:** Implemented in phases (SLM-1, 2, and 3), this program focuses on restoring degraded land through various interventions.
- **Productive Safety Net Program (PSNP) and Agricultural Growth Program (AGP):** Both programs contribute to restoration efforts and have a significant impact on livelihoods and environmental sustainability.
- **Climate Change Adaptation (CCA) Projects:** These initiatives address afforestation, reforestation, water conservation, and livelihood support, particularly in highland and lowland areas.
- **REDD+ (Reducing Emissions from Deforestation and Forest Degradation):** The REDD+ Investment Program (RIP) focuses on emission reduction through sustainable forest management, afforestation, and reforestation. The project is currently in the implementation phase, working in 57 woredas through Participatory Forest Management.

Ethiopia has a history of coping with extreme weather events and climate change. In response, the country adopted its first National Adaptation Program of Action (NAPA) in 2008, prioritizing several actions that include:

- Promoting drought and crop insurance programs.
- Enhancing drought and flood early warning systems.
- Developing small-scale irrigation and water harvesting schemes in arid, semi-arid, and dry sub-humid areas.
- Improving rangeland resource management in pastoral areas.

- Establishing community-based sustainable management of wetlands.
- Creating a capacity-building program for climate change adaptation.
- Implementing a multi-purpose large-scale water development project in the Genale-Sawa Basin.
- Developing a community-based Carbon Sequestration Project in the Rift Valley System.

Major Achievements, Challenges and Opportunities of Climate Change Mitigation and Adaptation

Achievements

Ethiopia has achieved significant milestones in land restoration and climate change mitigation through various initiatives. Under the Growth and Transformation Plan (GTP), the country has restored 1 million hectares annually through area closure and afforestation projects, driven by government funding and community labor. The government's afforestation efforts have successfully added 1 million hectares each year, contributing to a total restoration of 12 million ha to date. This impressive achievement earned the Tigray region the Champion Award at COP-13 for its efforts against desertification. Additionally, several national programs, including Managing Environmental Resources to Enable Transitions (MERET), Sustainable Land Management (SLM), Productive Safety Net Program (PSNP), Agricultural Growth Program (AGP), REDD+ Investment Program, Forest Sector Development Program (FSDP), and Climate Change Adaptation (CCA) Projects, have been actively implemented under the Ministry of Agriculture and the Ethiopian Forest and Climate Change Commission. These initiatives highlight Ethiopia's robust commitment to environmental sustainability, restoration, and climate resilience through effective policies, community engagement, and international collaboration.

Opportunities

Ethiopia has various national and sub-national technical studies and assessments that have provided valuable insights. These studies have facilitated multi-sectoral coordination and consultations among stakeholders, laying the foundation for modernizing the forestry sector and enhancing its visibility and significance through institutional upgrading.

Additionally, resource mobilization efforts have been strengthened by bilateral agreements, particularly with Norway, which has contributed around 80 million USD for mitigation projects. Key projects like REDD+ and the Forest Sector Development Program (FSDP) under the Environment and Forest Convention on Climate Change (EFCCC) are actively working on both climate change mitigation and adaptation. Furthermore, the mobilization of community resources, including free labor and in-kind contributions, serves as collateral support for Ethiopia's efforts in this sector.

Challenges

Ethiopia faces several challenges when addressing climate change. The challenges include;

- Lack of well- organized institutional alignment among the federal and regional states.
- Inadequate funds.
- Conflicts between forestry and agriculture sectors, primarily due to competition over land resources.
- Lack of governing land use plan for demarcating forest from agriculture land.
- Lack of expert for evaluation of land cover change through GIS.
- Poor coordination, monitoring and evaluation system of DLDD activities by Government and civil society organizations.

Ethiopia faces different challenges to managing climate change risks and opportunities (EPA, 2010):

- Current adaptation initiatives are limited in scope and scale, and their impacts are neither cohesive nor sustainable.
- Individual, institutional, and systemic capacities to assess and manage climate change risks are not developed sufficiently to create an enabling environment, with corresponding political and social champions to support the formulation and implementation of efficient solutions to a problem that has complex multi-sectoral effects.
- Limited knowledge of the most appropriate adaptation policies and measures weakens the development of the right institutional capacities to support climate risk management.
- Limited financing options to sustain scaled-up adaptation is a constraint to testing and demonstrating possible solutions and developing the requisite institutional and technical capacities.
- It is difficult for different communities with different capacities to learn from each other about their experiences with different approaches to adaptation.

Policies, legislation, strategies and guidelines governing climate change mitigation and adaptation

The Ethiopian government has put in place several policies, strategies and programmes aimed at enhancing the adaptive capacity and reducing the vulnerability of the country to climate variability and change. Such programmes include the plan for accelerated and sustainable development to end poverty (PASDEP), the environmental policy and the agricultural and rural development policy and strategy. The government has established a strategic investment framework for sustainable land management (SLM) (EPA, 2010).

Ethiopia is signatory to a host of environmental agreements that require countries to develop specific implementation mechanisms and fulfil obligations involving reporting, training, public education, and other activities. Apart from the UN Framework Convention on Climate Change (UNFCCC) two of the most relevant are the UN Convention to Combat Desertification (UNCCD) and the Nile Basin Initiative (NBI) (EPA, 2020).

As part of the green economy strategy, the government has selected four initiatives for fast-track implementation in the Climate Resilient Green Economy (CRGE), Strategy document (FDRE. 2011):

- Exploiting the vast hydropower potential.
- Large scale promotion of advanced rural cooking technologies.
- Efficiency improvements to the livestock value chain; and
- Reducing Emissions from Deforestation and Forest Degradation (REDD+); increased GHG sequestration in forestry, i.e. protecting and re-establishing forests for their economic and ecosystem services including as carbon stocks.

National Adaptation Plan (NAP), Growth and Transformation Plan (GTP) 1, Growth and Transformation Plan (GTP) 2, Forest Sector Development Program (FSDP), REDD+ strategies, Civic Society Organizations (CSOs) and Community-Based Organizations (CBOs) are the major legislative frameworks enabling promotion of climate change mitigation and adaptation measures, landscape restoration, forestry, and rural development in Ethiopia.

Opportunities and Challenges to Capacity Building

Opportunities

- Establishment of a coordinated national platform involving all stakeholders for DLDD implementation through joint planning, implementation, and reporting.
- Development of a strong monitoring and evaluation system under the UNCCD strategic framework (2018-2030).
- Strengthening partnerships between government and civil society organizations (CSOs) for efficient resource utilization toward achieving SDG 15 and SDG 17.
- Signing of a new MOU between the International Union for Conservation of Nature (IUCN) and EFCCC, enabling third-party verification of restoration efforts.
- Climate change challenges providing opportunities to focus on environmental well-being and livelihood improvement initiatives.

Challenges of capacity building

- Inadequate financial resource for capacity building.
- Insufficient skilled manpower to train.
- Weak institutional arrangement.
- Inadequate training facilities.

Training needs

The training needs include:

- Land restoration.
- Economics of land restoration.
- Community contribution in restoration.
- Policy framework on restoration.

7.3 Promoting Climate Change Resilient Forestry in Kenya

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Introduction

Kenya is located on the East African coast of the Indian Ocean. It lies at an average elevation of 762m above sea level between latitude of 4° North to 4° South and longitude 34° East to 41° East. Kenya borders South Sudan and Ethiopia in the north, Somalia to the east, Indian Ocean to the south-east, Tanzania to the south and Uganda to the west. The country is administratively divided into 47 counties (Constitution of Kenya, 2010). Kenya has a total land area of 580,370 km² and a total coastline of 536 km. Kenya is the 23rd biggest country in Africa and in terms of area ranks 48th worldwide and has a total population of 47,564,296 million people (KNBS, 2019). Kenya's land mass is over 80% arid and semi-arid in nature.

The longest river in the country is Tana River (800km) with Lake Turkana being the largest lake at 6405km². The country has diverse landscapes ranging from coastal plains to mountainous regions, the Great Rift Valley, savannas, and deserts. Mount Kenya, Africa's second-highest peak, is a notable geographical feature. The country's total land area, 16%, is of high to medium potential and the rest is arid and semi-arid lands (84%). Of the 47 Counties, 29 are under arid and semi-arid lands. Arid and semi-arid lands are home to 25% of the country's population, range land users and support much of the livestock.

Climatic and ecological conditions

Kenya's temperatures vary dramatically, with the highlands experiencing considerably cooler temperatures than the coastal and lowland regions. Kenya's average annual precipitation is typically 680 mm, ranging from less than 250 mm in the northern ASALs areas to about 2,000 mm in the western region.

The country has two main rainfall seasons: the long rains, which occur from March to May, bringing substantial showers especially to the central highlands and western regions; and the short rains from October to December, delivering lighter but significant precipitation, particularly in the eastern and southeastern parts. The periods between these rains are relatively dry, with January to March and June to September typically experiencing lower rainfall, especially in the ASALs (Arid and Semi-Arid Lands). Temperature patterns vary widely across the country. The highlands, maintain cooler temperatures year-round, ranging between 10°C and 20°C. In contrast, the coastal and lowland regions are warmer, with temperatures averaging between 20°C and 30°C and higher humidity levels. Western Kenya experiences temperatures ranging from 15°C to 25°C. The northern ASALs, however, face hotter and drier conditions, with temperatures

often exceeding 30°C and minimal rainfall. This climatic diversity supports a wide range of ecosystems, from lush highlands to arid deserts, influencing Kenya's agriculture and natural resource management.

Major landscapes in Kenya

1. **The Great Rift Valley:** This geological feature stretches from the north to the south of Kenya, characterized by escarpments, and several large lakes such as Lake Naivasha, Lake Elementaita, and Lake Nakuru. The valley's floor is known for its fertile soil and rich biodiversity.
2. **Highlands:** The central highlands, including the Aberdare Range and the Kenyan Highlands around Mount Kenya, feature lush forests, coffee and tea plantations, and cooler temperatures. Mount Kenya, Kenya's highest peak, is a significant landmark with its snow-capped peaks and glaciers.
3. **Coastal Plain:** The coastline along the Indian Ocean, stretching from the Somali border to Tanzania, includes sandy beaches, mangroves, and coral reefs.
4. **Savannahs:** Kenya's extensive savannahs, including the Maasai Mara and Amboseli National Parks, are known for their vast open plains, grasslands, and iconic wildlife such as elephants, lions, and wildebeests. These regions are crucial for Kenya's tourism industry and conservation efforts.
5. **Deserts and Semi-Arid Lands:** Northern Kenya includes the Chalbi Desert and the Nyiri Desert, characterized by arid conditions, sparse vegetation, and extreme temperatures. These areas are home to resilient flora and fauna adapted to harsh environments.
6. **Wetlands:** Notable wetlands include the Sibiloi National Park's wetlands along Lake Turkana and the Tana River Delta, which support diverse ecosystems and are vital for both wildlife and local communities.
7. **Lake Victoria Basin:** This region, encompassing parts of western Kenya, is known for Lake Victoria, Africa's largest lake. The basin is rich in biodiversity and supports local fisheries and agriculture.

Economic Activities

Agriculture

Agriculture is a significant sector, with tea, coffee, and horticultural products being major cash crops. The Sector is the mainstay of the economy. Agriculture forms the largest (40%) employment sector as of 2013 that contributes 25% to GDP. The agricultural exports forms 65% of Kenya's total exports. Agricultural sector is not only the driver of Kenya's economy but also the means of livelihood for the majority of Kenyan people. The sector comprises of crop production (industrial and food crops), horticulture, livestock, fisheries and forestry. Production of crops and horticulture contributes 76.5% of Agriculture GDP followed by livestock production at 4.9%. Fishing and forestry contribute 0.5% and 0.7% of the total

agriculture GDP respectively. Overall, the Agriculture output grew by 2.9% in 2013 as a result of depressed rainfall reducing production of maize, beans and sugarcane. Kenya's Agricultural exports are classified into traditional (tea and coffee) and non-traditional exports (horticulture – which increased to 213.8 thousand tonnes in 2013 from 205.7 thousand tonnes in 2012).

Forestry

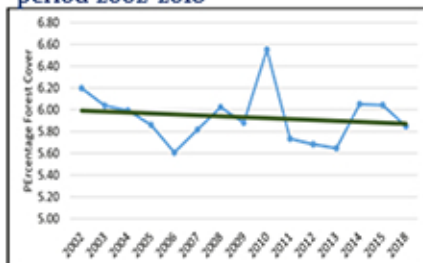
The forest sector in Kenya plays a vital role in the nation's economy, contributing approximately 3.6% of the Gross Domestic Product (GDP). This contribution includes both direct and indirect contributions from various forest-related activities. Employment is one of the significant benefits of this sector, providing jobs for around 10% of Kenya's population, particularly in rural areas. People are engaged in activities such as logging, charcoal production, and harvesting non-timber forest products.

Forests also offer crucial ecosystem services, including water catchment protection, soil conservation, and climate regulation. These services are essential for supporting agriculture, energy production (particularly hydropower), and other sectors, thereby indirectly boosting the economy. Additionally, the forestry sector significantly supports tourism, which is a major economic driver in Kenya. The sector supplies both timber and non-timber products for domestic use and export. These products range from construction materials and furniture to fuelwood and medicinal plants. Furthermore, Kenyan forests play a role in carbon sequestration, offering environmental benefits and economic advantages. Through participation in global carbon markets, particularly initiatives like the REDD+ (Reducing Emissions from Deforestation and Forest Degradation) program, Kenya earns revenue by reducing emissions.

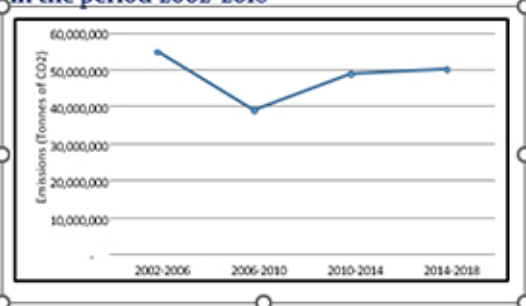
The forest sector in Kenya significantly supports community livelihoods, offering diverse benefits beyond economic contributions. Activities such as beekeeping, fishing, and agroforestry, all supported by forest resources, play a crucial role in enhancing food security and generating income for many local communities.

Forest Trends

Forest cover trends in Kenya in the period 2002-2018



The Trend of Emissions due to Deforestation in the period 2002-2018



(MECCF, 2020, Sleaf maps)

Human and Natural Influences on Global Temperature

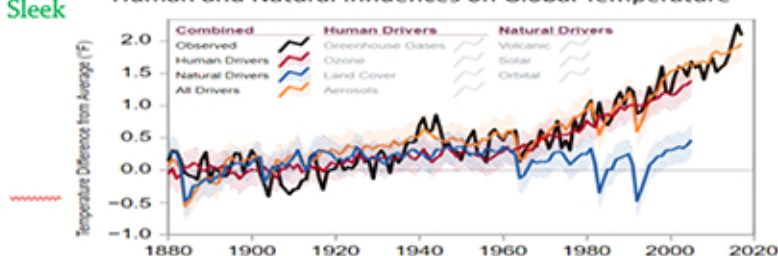


Figure 7.3: Forestry trends in Kenya

Tourism

Kenya is renowned for its wildlife and natural parks, including the Maasai Mara, Amboseli, and Tsavo National Parks, which are pivotal to the country's vibrant safari tourism industry. Tourism stands as one of Kenya's leading foreign exchange earners and the third largest contributor to the GDP, following agriculture and manufacturing. This sector has experienced rapid growth due to a combination of factors such as market diversification, liberalization, sustained government support, and successful tourism promotion. Additionally, Kenya's political stability has further enhanced the attractiveness of its tourism industry, ensuring a favourable environment for both domestic and international visitors.

Current Programmes/Projects Being Undertaken to Address Climate Change

Kenya continues to advance its efforts to combat climate change through a variety of programmes and projects. Some of the current initiatives to address climate change include;

1. **Climate Action Plan 2024-2028:** This plan focuses on enhancing climate resilience and reducing greenhouse gas emissions. It outlines specific actions in sectors such as agriculture, water, energy, and urban development to address both current and future climate impacts.

2. **Kenya Green Economy Strategy and Implementation Plan:** This strategy promotes sustainable economic growth by integrating green practices into various sectors. It focuses on reducing carbon emissions, improving energy efficiency, and supporting sustainable land use.
3. **National Adaptation Plan (NAP) 2024:** NAP includes new measures to address climate vulnerabilities and enhance adaptation efforts. It emphasizes strengthening infrastructure, managing water resources, and supporting climate-resilient livelihoods.
4. **REDD+ Phase II:** The second phase of the REDD+ program aims to scale up forest conservation efforts and enhance forest management. It includes initiatives for increasing forest cover, improving monitoring and reporting, and engaging local communities in conservation activities.
5. **Nationally Determined Contributions (NDCs) Enhancement:** Kenya is updating its NDCs to align with more ambitious climate goals. This includes setting new targets for reducing greenhouse gas emissions and enhancing climate resilience in line with global climate agreements.
6. **Green Bond Issuance:** Kenya has introduced green bonds to raise funds for environmentally sustainable projects. These bonds support investments in renewable energy, energy efficiency, and climate-resilient infrastructure.
7. **Climate Resilient Agriculture Program:** This program supports farmers in adopting climate-smart agricultural practices. It includes initiatives for improving soil health, water management, and crop varieties to enhance productivity and resilience.
8. **National Water Master Plan 2024:** This plan focuses on sustainable water management and climate resilience. It includes projects for improving water storage, irrigation systems, and watershed management to address water scarcity and variability.
9. **Community-Based Climate Adaptation Projects:** These projects are designed to involve local communities in climate adaptation efforts. They focus on activities such as reforestation, sustainable land management, and disaster risk reduction to enhance local resilience.
10. **Urban Climate Resilience Projects:** Kenya is investing in projects aimed at improving the climate resilience of urban areas. This includes upgrading infrastructure, enhancing green spaces, and implementing flood management systems.
11. **Strengthening Forestry Sector Development and Community Resilience to Climate Change through Sustainable Forest Management and Landscape Restoration (SFS-CORECC) project 2022-2027:** This project aims at strengthening the capacity of relevant key institutions in Kenya, namely Ministry of Environment, Climate Change and Forestry (MECCF), Kenya Forest Service (KFS), Kenya Forestry Research Institute (KEFRI) and county governments, in order to promote sustainable forest management,

landscape restoration and climate change mitigation and adaptation in the country and in the sub-Saharan Africa region. The project also aims at building Kenya's capacity further to contribute to Sub-Saharan Africa through technology and knowledge sharing.

12. **The Green Zones Development Support Project-** Promote sustainable livelihood options for communities living adjacent to forests and improve the management of forest resources.
13. **Breeding *Melia Volkensii*** for improved productivity and drought tolerance- This aimed at production of genetically improved germplasm in order to meet demand of forest products such as a high quality timber.

These initiatives reflect Kenya's commitment to addressing climate change through a combination of policy frameworks, financial instruments, and community-based approaches, all aimed at building a more resilient and sustainable future.

Major Achievements, Challenges and Opportunities of Climate Change Mitigation and Adaptation

Achievements

- Increase tree and forest cover through afforestation, reforestation and restoration initiatives. Kenya's tree cover is estimated to be 12.13%, while forest cover is 8.83% as reported in the National Forest Resources Assessment (NFRA) Report of 2021.
- Bilateral country support through improved resource mobilization.
- Carbon sequestration and emission reductions from reduced deforestation.
- Improving forestry operation efficiency and promotion of sustainable alternative fuel.
- Forest conservation and sustainability initiatives put in place.
- Capacity building initiatives that enhance forestry knowledge, skills and expertise of stakeholders to make a positive impact.
- Sustainable livelihoods improvement .
- Forest governance, policy and strategy support.

Opportunities

- Incorporation of ecosystem services in the national accounting frameworks, climate regulation, water, and natural hazard prevention.
- Emergence of green and blue economies and associated incentives.
- Favourable government plans and strategies.
- Enhanced prioritization of forestry in the national development agenda eg

funding for the 15 BN national tree growing programme.

- Research and technology transfer.
- Favourable global campaign for environmental/biodiversity conservation and restoration such as SDGs.
- Increased funding and partnerships in forestry for research and development.
- Uptake of technologies for restoration of forests and landscapes.
- Community engagement and awareness creation.
- Forestry technology uptake.
- Carbon markets.
- Increasing agro-processing industries – value addition.
- Sustainable landscapes management.
- Capacity building in climate-smart forestry practices -reducing vulnerability to extreme weather events.

Challenges

- Drought and floods are the main climate hazards in Kenya, negatively impacting lives and livelihoods, with human health increasingly being at risk. Extreme climate events cause significant loss of life, and adversely affect the national economy.
- Inadequate artisanal skills i.e. for bamboo cottage industry.
- Slow and low technology uptake.
- New and emerging challenges due to climate change that include invasive plant species, tree pests and diseases.
- Inadequate resources to undertake sufficient backstopping of projects.
- Limited access to resources.
- Unsecure land tenure.

Climate Change Mitigation and Adaptation Measures

Current activities undertaken to mitigate and adapt to Climate Change include:

- **Agriculture:** Promoting irrigated agriculture, conservation agriculture, climate smart agriculture and value addition to agricultural products; developing weather indexed crop insurance schemes, support for community-based adaptation including provision of climate information to farmers, enhanced financial and technical support to drought resistant crops. Diversifying crops so that they are better able to adapt to changing climates and promoting climate smart agriculture.

- **Forestry and Forestry Research:**
 - Intensified afforestation, promoting agroforestry-based alternative livelihood systems, promoting alternative energy sources, community forest management, REDD+ initiatives, promoting nature-based solutions.
 - Replanting forests (15 billion strategy) and restoring damaged ecosystems.
 - Research is focused to produce and promote trees of superior quality including those that are drought tolerant, research to generate information to support forest management and conservation.
- **Livestock and Pastoralism:** Breeding animals tolerant to local climatic conditions, weather indexed livestock insurance, establishment of fodder banks, documenting indigenous knowledge, provision of water for livestock and humans, early warning systems for droughts and floods, and vaccination campaigns.
- **Water Resources:** Enforcement and/or enactment of laws for efficient water resource management, increasing capture and retention of rainwater, water quality monitoring, de-silting rivers and dams, protecting and conserving water catchment areas, campaigns on water harvesting.
- **Energy:** Promoting the use of alternative energy including geothermal, wind, solar and mini hydro power generation; and the promotion of improved cook stoves and clean energy to reduce use of biomass energy.
- **Capacity development:** Building capacity of farmers to improve their adaptation and resilience to climate change.
- Erecting buildings and infrastructure that is safer and more sustainable e.g. green building.
- Investigating and developing innovative solutions to prevent and manage natural catastrophes.

Table 7.6: Legal frameworks, policies and strategies underpinnings for FLR implementation

International agreements	Objective
United Nations Framework Convention of Climate Change (UNFCCC) 1992	The main objective is to stabilize greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system in a time frame that allows ecosystems to adapt naturally and enable sustainable development.
Kyoto protocol 1997	The main aim was to reduce carbon dioxide emissions and greenhouse gases to minimize climate change impacts.

International agreements	Objective
Rio declaration on Environment and development (1992)	The main objective was to produce a broad agenda and a new blueprint for international action on environmental and development issues that would help guide international cooperation and development policy.
Convention on Biological Diversity (CBD) 1992	The UN Convention on Biological Diversity (CBD) of 1992 recognizes the intrinsic value of biological diversity and of the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biological diversity and its components.
Paris agreement	It aims at strengthening the global response to the threat of climate change by keeping a global temperature rise this century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C.
National legislations, plans and strategies	
The Constitution of Kenya, 2010	- Places the responsibility of environmental conservation at individual level and targets attainment of 10% tree cover. - In Chapter 4 on the Bill of Rights, the Constitution of Kenya, 2010 gives every person a fundamental right to clean and healthy environment. In section 1, of the article, it directs that such cleanliness and health must consider protection, management, and conservation of environment and associated resources for the benefits of future generations. - In its preamble, the constitution demands maximum value to environment as a national heritage and unifier of all citizens that needs proper management for the benefits of the future generations.
Forest Conservation and Management Act 2016	- The Act gives effect to Article 69 of the Constitution of Kenya 2010 with regard to forest resources; to provide for the development and sustainable management including conservation and rational utilization of all forest resources for the socio-economic development of the country and for connected purposes. - Describes procedures for forestry management in gazette and non-gazetted forests. It addresses issues to do with management protection and conservation of forest resources.
Environment Management and Coordination Act, 2015	Promotes environmental conservation for the benefit of all and mandates rehabilitation of polluted and degraded environments.

International agreements	Objective
Physical and Land Use Planning Act, 2019	Promotes planning and land use that optimizes the value of the land.
Land Act 2016	- Describes the variety of land tenure systems with specific mandates of the made owner which allows tree planting for specific objectives. - It seeks to provide legal, administrative, institutional and technological framework for optimal utilization and productivity of land and land related resources in a sustainable and desirable manner at National, County and local level.
The water Act 2002	- This prohibits the pollution of water. Part ii, section 3 states” every water resource is hereby vested in the state subject to any rights of user granted by or under the Act of any law. In addition, the right to any use of water from any water resources is vested in the minister for water Resources.
Wildlife Conservation and Management Act, 2013	Restoration of landscapes is justified in supporting conservation of wildlife.
Draft National Forest Policy 2020	Describes the role of devolved governments in managing and conserving forests
National Energy Policy and Energy Act 2006	Promotes use of energy saving cooking stoves and use of alternative sources of energy to reduce destruction of forests.
Draft National Forest Landscape and Restoration Action Plan 2021-2025	This indicates government commitment to restore degraded landscapes across the country.
National Forest Program 2016-2030	Provides in-depth guidance on solutions for the forest sector including support to tree planting.
Environment and development policy (sessional paper No. 6 of 1999)	This policy aims to harmonize environmental and development goals to ensure sustainability. The paper provides comprehensive guidelines and strategies for government action regarding environment and development.
National REDD+ strategy 2021	Identifies the potential of tree planting and conservation activities for Results based payments that result in reduced emissions from the forestry sector.

International agreements	Objective
National Agroforestry Strategy 2020-2030	Indicates government commitment to integrate trees in agricultural landscapes to enhance their sustainability.
Kenya Climate Smart Agriculture 2018-2022	Promotes planting of climate resilient crops and plants that enhance landscape sustainability such as trees.
15 Billion Tree Growing Strategy 2023-2032: Special Presidential Forestry Programmer for Landscape and Ecosystem Restoration	Shows government commitment to increase forest cover at national level through an aggressive tree planting programme.
Agricultural Transformation and Growth strategy 2019-2029	Identifies priorities for transforming the agricultural sector and includes agroforestry and fruit trees.
Presidential directive on revising chief's tree nurseries	The directive mandates local leaders to maintain tree nurseries at local levels.
Kenya's Vision 2030	Identifies flagship projects to rehabilitate and protect indigenous forests in water towers towards 10% forest cover by 2030.
National Climate Change Response Strategy 2010	Propose planting of 7.6 billion trees by 2030.
Agriculture (Farm Forestry) Rules, 2009	Aimed at increasing tree cover in agricultural landscapes by maintaining a compulsory farm tree cover of at least 10% of any agricultural land holding
County Integrated Development Plan (CIDPs).	To be integration in the national policies for better implementation and sustainability.

Training needs

Training needs include;

- Mitigation measures aimed at reducing greenhouse gas emissions.
- Adaptation strategies for forests to cope with the impacts of climate change and understanding response to climate change stressors such as floods.
- Tree valuation.
- Endangered tree species management.
- Climate change financing/ Carbon trade .
- Monitoring and Evaluation (M&E).
- Educational material production e.g. video making.
- Proposal writing.

7.4 Promoting Climate Change Resilient Forestry in Malawi

Ackim July Dickson

Ministry of Agriculture

Introduction

Malawi is a South-East African landlocked country bordered by Zambia in the west, the United Republic of Tanzania in the north and Mozambique in the south and eastern part. Its administrative capital city is Lilongwe. The country's estimated population is 21.2 million (2024) with an annual growth rate of 2.6%. The country has a total area of 118,484 km² defined by its topography of highlands split by the Great Rift Valley and enormous fresh water of Lake Malawi, the third largest lake in Africa. Malawi has sub-tropical climatic conditions with two major seasons: the rainy season (December to April) and the dry season (May to November). The country receives about 850 mm of rainfall per year, which is adequate for rain-fed crop production and recharging underground aquifers. However, the distribution and intensity of rainfall is erratic and water storage capacity is limited. Temperatures are mild during the rainy season ranging from 17°C to 27°C while the dry season is hot with temperatures range of 25°C to 37°C. Malawi is currently classified as one of the world's least-developed countries.

The country's economy is agro-based, characterized by rain-fed agriculture. The agriculture sector drives the country's economy and is vital for the livelihoods of most people of Malawi including national food self-sufficiency and household food and nutrition security. The agriculture sector employs approximately 80% of the country's workforce and contributes over 80% of the country's foreign exchange earnings. However, the country has major land use and development challenges which include deforestation and land degradation. Currently, the country's forest resources are steadily declining due to agriculture expansion, heavy dependence on wood fuel for energy, population growth and high poverty levels. FAO (2020) indicated that annual forest loss is estimated at 1.8%, which corresponds to approximately 42,000 hectares. FAO (2013) reported an average soil loss of 29 metric tonnes per hectare per year, whose main case was attributed to poor agricultural practices, deforestation and natural disasters thereby negatively affecting agricultural productivity.

Recent Programmes/Projects Being Undertaken to Address Climate Change

The following are some of the major programmes being undertaken by government of Malawi to address effects of climate change:

- Climate-Smart Enhanced Public Works Programme (CS-EPWP) which is funded by the World Bank and Multi-donor Trust. Its focus is on integrated watershed management (IWM), covering sub-projects such as land resources conservation, afforestation, natural regeneration and sustainable livelihoods.

The primary objective of the programme is to create visible, durable, and quality assets within micro-catchments that will assist to improve household resilience to shocks, increase impact on household-level incomes and food security, and reduce households' exposure to risks associated with climate change and other disasters.

- Malawi Watershed Services Improvement Project (MWASIP) whose main objectives include scaling up landscape restoration and improving watershed services. Specifically, the project will enhance the livelihoods of small-holder farming communities, address climate change vulnerabilities by making the farmers and the watershed more resilient to droughts and floods.
- The Forest and Landscape Restoration Mechanism which is part of a larger programme funded by Germany to support the Government of the Republic of Malawi's ambitious target of restoring 4.5 million ha by 2030 under the Bonn Challenge and the AFR100 initiative. The project also supports implementation of the Malawi's National Forest Landscape Restoration Strategy and National Charcoal Strategy (2017).
- The Shire Valley Transformation Programme which started in 2018 and will run up to 2032. The main objectives of the programme are to increase agricultural productivity and commercialization for targeted households in the Shire Valley through gravity-fed irrigation farming; and to improve the sustainable management and utilization of natural resources.
- Better Preservation, Restoration and Regeneration of Natural Resource Base and its Diverse Ecosystems is a European Union funded project which is promoting increased preservation and restoration of forests and eco-systems, strengthening land use planning and registration of land parcels around protected areas and on customary land; and enhancing integrated sustainable land and watershed management.

Major Achievements, Challenges and Opportunities for Conserving and Restoring Forest Landscapes

Achievements

The departments of Forestry, Environment and Land Resources Conservation has implemented various programmes aimed at conserving and restoring forest landscapes. Below is a list of selected major achievements on climate change mitigation and adaptation.

- Increased awareness and advocacy on climate change and sustainable natural resources management.
- Creation of visible, durable and quality assets within micro-catchments that will assist to improve household resilience to effects of climate change.
- Implementation of large-scale gravity-fed irrigation system and landscape restoration under the Shire Valley Transformation Programme.
- Country-wide demonstration of Climate Smart Agriculture (CSA) technologies.

Examples of the promoted technologies include; Conservation Agriculture, Agroforestry, Solar-powered Irrigation System, Rainwater Harvesting, Soil and Water Conservation, Bee keeping, and Energy Saving Stoves.

- Establishment of the National Conservation Agriculture Task Force to coordinate implementation of Conservation Agriculture.
- Establishment of the Malawi National Climate-Smart Agriculture Framework which guides mobilization of resources and implementation of all Climate-Smart Agriculture interventions.
- Decentralization of government functions which entails devolving responsibilities and resources to local councils so that they operate as independent entities to strengthen their capacity to deliver social and economic services more efficiently including implementation of programmes aimed at addressing effects of climate change.
- Establishment of functional Community Based Natural Resources Management Committees (CBNRMs) also known as Catchment Management Committees (CMCs).
- Development of Village Level Action Plans for integrated catchment management for selected hotspots in every district under the Climate-Smart Enhanced Public Works Programme.
- Increased shared ownership and active engagement of various stakeholders in natural resources management.
- Promotion of Participatory Integrated Climate Services for Agriculture (PICSA) approach which facilitates farmers to make informed decisions based on accurate, location specific, climate and weather information; locally relevant crop, livestock and livelihood options.

Challenges

Despite the achievements highlighted above, Malawi is facing many challenges when implementing various programmes to mitigate and adapt the effects of climate change. Some of the major challenges include:

- Inadequate coordination among stakeholders
- Poor governance at all levels
- Inadequate financing towards natural resources management
- Low literacy, and limited access to knowledge and extension support services
- Project-based planning which may leave out long term benefits of sustainable natural resources management.
- Natural disasters such as floods and prolonged dry spells negatively affect planning and implementation of climate change management programmes.

Opportunities

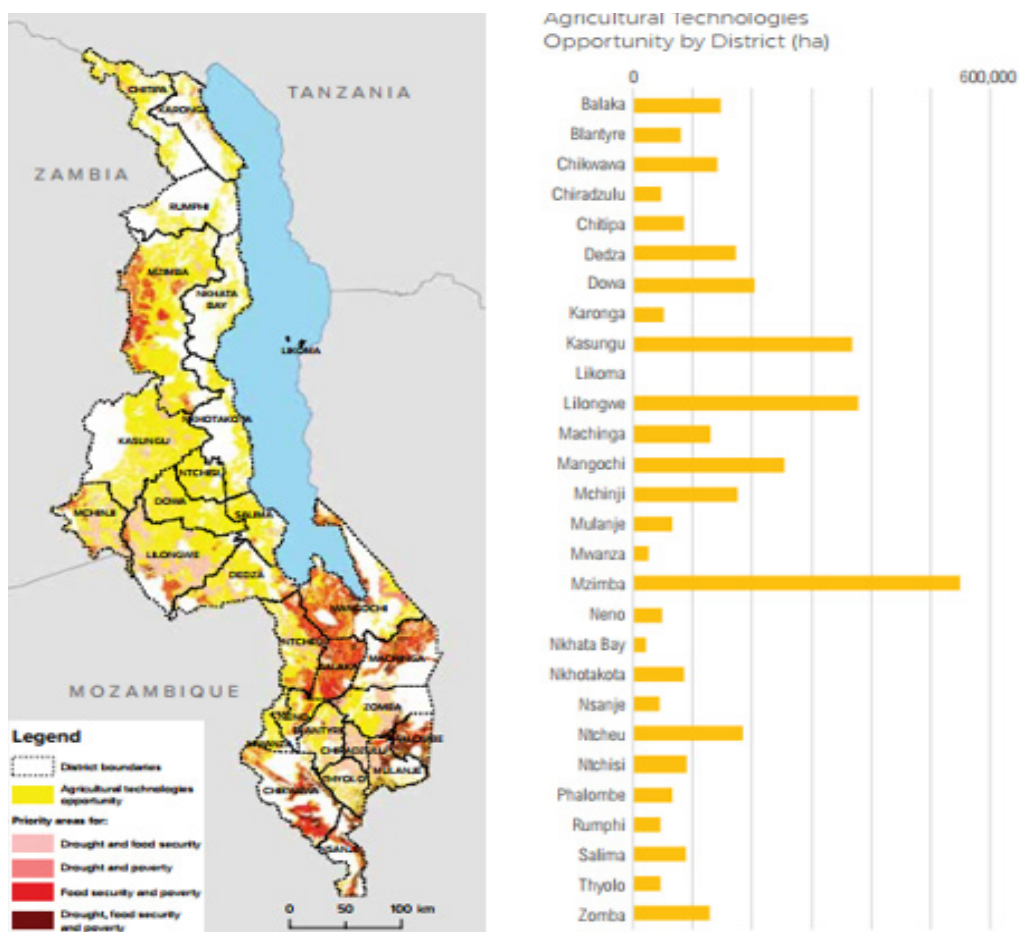
There are many opportunities which can enhance conservation and restoration of degraded forest landscapes. Some of the opportunities which could greatly accelerate implementation of various conservation and restoration interventions in Malawi include the following:

- Presence of educational and research institutions.
- Availability of policies guiding landscape restoration programmes.
- Presence of many stakeholders implementing NRM technologies.
- Availability of land for implementation of various forest landscape interventions.

Table 7.7: Summary of land restoration opportunities for different interventions in Malawi

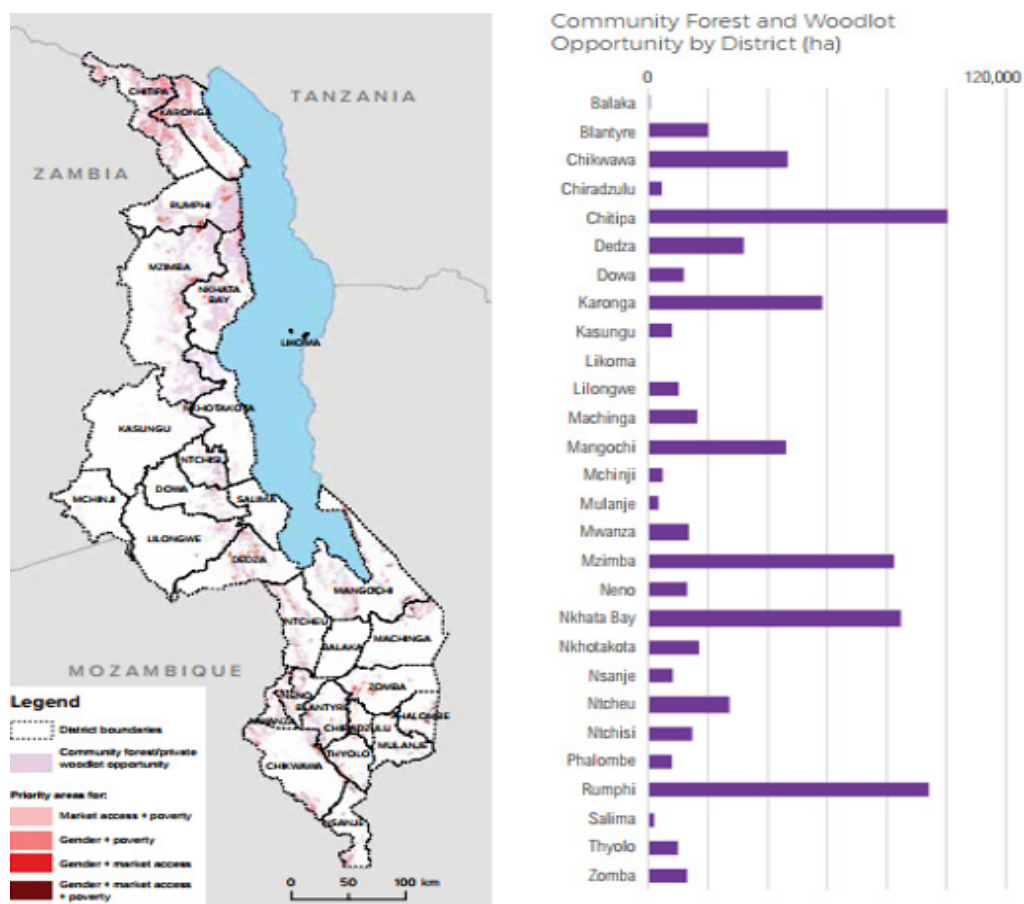
Specific restoration objective	Benefits	Primary contribution to National Goals	Estimated area of opportunity	Percent of country
Agricultural technologies (conservation agriculture, farmer-managed natural regeneration and agroforestry)				
Increase tree cover on degraded, low-yielding cropland and pastures in agricultural landscapes through natural regeneration, direct seedling and planting of agroforestry trees and shrubs; Implement climate-smart agriculture techniques, including FMNR, continuous cover crops, crop rotation, other agroforestry technologies.	Increased crop yields with reduced dependence on inorganic inputs, reduced soil/nutrient Increased resilience to drought and other climate shocks	• Food security • Climate resilience • Poverty alleviation • Gender equity and equality	3,730,790	39%
Community forests and woodlots				
Restore forest cover on degraded customary land and nonarable land in agricultural landscapes by expanding area and improving management of village forest areas and woodlots through demarcation, strengthened community bylaws, and agreements for protection against uncontrolled cutting, grazing and fire	Locally managed, more sustainable sources of fuelwood, increased access to forest products for subsistence and sale, Reduced burden on women in collecting fuelwood	• Food security • Climate resilience • Sustainable energy • Poverty alleviation • Gender equity and equality • Biodiversity conservation	753,471	8%

Forest management				
Restore forest cover and improve management in deforested and degraded forests, including forest reserves, natural forests outside reserves and plantations	Decreased sedimentation in catchment of hydropower infrastructure, protection of source water, Increased access to forest products for subsistence and sale, conservation of biodiversity	• Climate resilience • Water quality and supply • Sustainable energy • Poverty alleviation • Biodiversity conservation • Gender equity and equality	3,401,279	36%
Soil and water conservation				
Stabilize soils and increase infiltration in areas with high rates of rainfall runoff, erosion and source areas for downstream sedimentation by constructing check dams, gully, infiltration ditches, and other rainwater harvesting and soil and water conservation techniques.	Protection of croplands and water sources from rainfall runoff and erosions, reduced landslide risk during high rainfall events	• Food security • Climate resilience • Water quality and supply • Equity and equality	1,043,768	11%
River and stream –bank restoration				
Increase tree cover in denuded buffer zones of rivers and streaming through natural regenerations and tree planting	Protection of source water and decreased sedimentation in catchments of hydropower infrastructure, reduced impacts of flood events	• Climate resilience • Sustainable energy • Water quality and supply • Gender equity and equality	36,478	0.4%



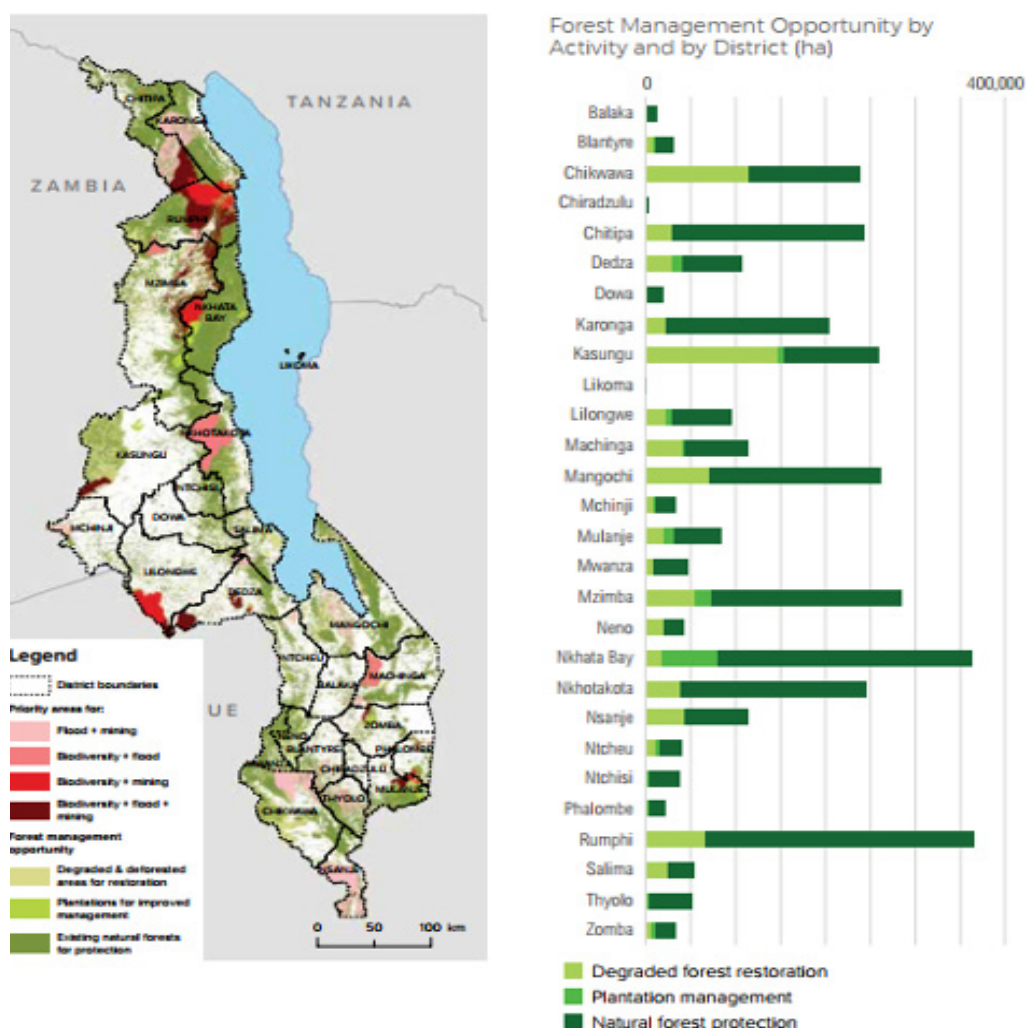
The map of opportunity area for agricultural technologies (including CA, FMNR, and AF) targets areas of annual cropland with very low or no existing tree cover. The map (left) shows where opportunity exists to implement agricultural technology interventions and highlights areas to prioritize for poverty alleviation, food security, and drought alleviation. The bar chart (right) shows the proportion of the district that is potential opportunity for implementing agricultural technology interventions.

Figure 7.5: Restoration opportunity for agricultural technologies



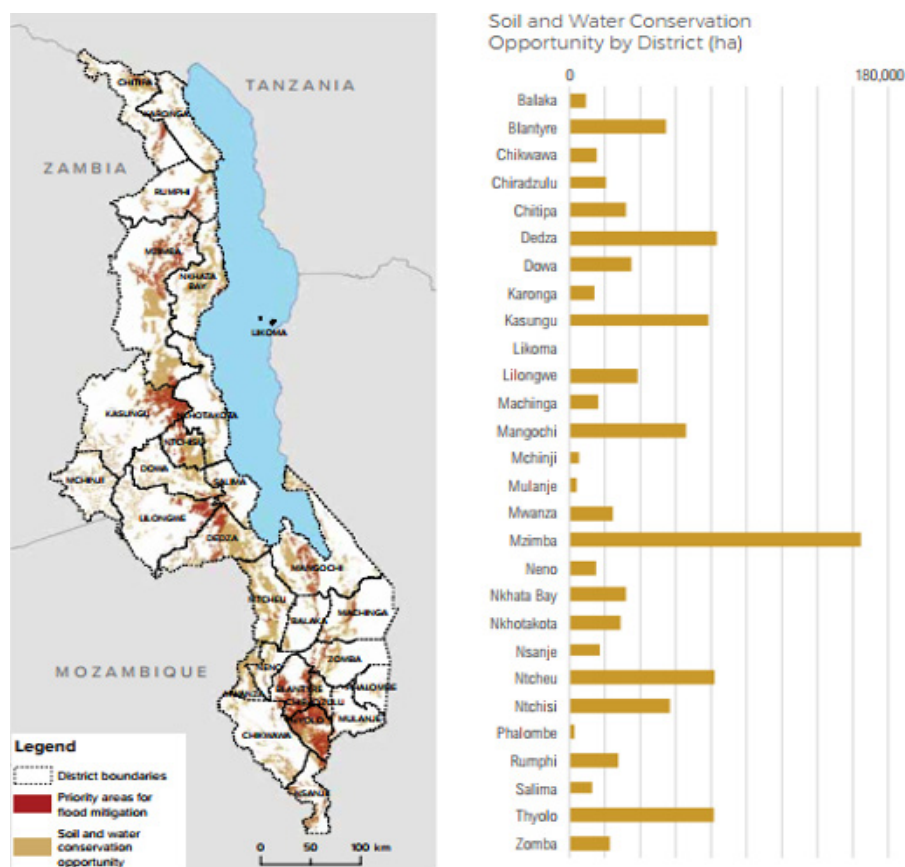
The map of opportunity for community forests and woodlots targets areas that are unsuitable or less desirable for cultivation (e.g. shallow soils and steep slopes) near village centers. The map (left) shows where opportunity exists to establish community forests or woodlots, and highlights areas to prioritize for market access, poverty alleviation, and female-headed households, where at least two of these priorities could be achieved. The bar chart (right) shows the proportion of the district that is potential opportunity for implementing community forest and woodlot interventions.

Figure 7.6: Restoration opportunity for community forests and woodlots



The map of opportunity for forest management targets existing plantations, existing natural forest areas either inside or outside forest reserves, and areas of recent deforestation from cutting or fire. The map (left) shows where opportunity exists to establish the three types of forest management interventions, and highlights areas to prioritize or flood mitigation, mining site rehabilitation, and biodiversity improvement, where at least two of these priorities could be achieved. The bar chart (right) shows the proportion of the district that is potential opportunity for implementing the three types of forest management interventions.

Figure 7.7: Restoration opportunity for forest management



The map of opportunity for soil and water conservation interventions targets areas of high erosion risk either on or near cultivated areas. The map (left) shows where opportunity exists to establish soil and water conservation interventions, and highlights areas to prioritize areas for flood mitigation. The bar chart (right) shows the proportion of the district that is potential opportunity for soil and water conservation interventions.

Figure 7.8: Restoration opportunity for soil and water conservation

Policy, Legislation, Strategies and Guidelines for Promotion of Climate Change Mitigation and Adaptation Measures

An important goal of forest landscape restoration is to create landscape conditions that incentivize the sustainable use of natural resources. Policies, administrative frameworks, and institutional strategies create the conditions within which social and economic activities either exploit or sustainably use natural resources. Currently, Malawi has several legislative frameworks for enabling promotion of climate change mitigation and adaptation measures, landscape restoration, forestry and rural development. The major legislative frameworks include:

- The Forestry Act (2020) which provides for participatory forestry, forest management, forestry research, forestry education, forest industries, protection and rehabilitation of environmentally fragile areas and international cooperation in forestry and for matters incidental thereto or connected therewith.

- b) Malawi National Environmental Policy (2004) which aims at preventing the degradation of the environment; providing a healthy living and working environment for the people of Malawi; according to full recognition to the rights of future generations by means of environmental protection; conserving and enhancing the biological diversity of Malawi.
- c) Environmental Management Act (2017) which provides for the protection and management of the environment; the conservation and sustainable utilization of natural resources and for matters connected therewith and incidental thereto.
- d) The Water Resources Act (2013) which gives the responsible minister powers to reasonably protect aquatic and wetland ecosystems, including their biological diversity, and to maintain essential ecosystem functions.
- e) National Forest Policy (2016) which aims at addressing linked problems of increased deforestation at 2.8% annually as of 2016 due to agricultural expansion, human settlements, uncontrolled bush fires, growing demand for cooking, heating, wood carvings and brick burning.
- f) National Agriculture Policy (2016) which guides the country to achieve transformation of the agriculture sector by increasing production, productivity, and real farm incomes.
- g) National Forest Landscape Restoration Strategy and National Charcoal Strategy (2017) which will assist the country to achieve several national environment and development goals
- h) National Climate Change Management Policy (2016).
- i) The National Land Resources Management Policy and Strategy (2000) which seeks to actively involve land users in adopting sustainable land management practices to improve agricultural productivity.
- j) Apart from the national legislations and policies, Malawi is signatory and party to a number of international legal frameworks and instruments which include the following:
 - United Nations Convention on Combating Desertification (UNCCD).
 - Convention on Biological Diversity (CBD).
 - United Nations Framework Convention on Climate Change (UNFCCC).
 - Paris Agreement.
 - Ramsar Convention.

Training Needs

Training need required includes;

- Monitoring and assessment of the changes brought about by implementing various restoration interventions in the region/respective countries over time. This could include use of drones and/or Geographic Information Systems (GIS).

7.5 Promoting Climate Change Resilient Forestry in South Sudan

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Introduction

South Sudan is a landlocked country located in Northeast Africa, lying within the tropical zone between latitudes 3.5° and 12° north and longitudes 25° to 36° East. South Sudan is bordered by Sudan to the north, Ethiopia to the east, Kenya, Uganda, and the Democratic Republic of the Congo to the south, and the Central African Republic to the west (Mohy el Din Sabr *et al.*, 2023). The country covers a total area of 624,929.2 km² making South Sudan the 19th largest country in Africa and ranks 43rd in the world in terms of area. A significant portion of its population (79%) lives in rural areas.

South Sudan, the world's youngest nation, as prior to 2011, it was part of Sudan. South Sudan is home to a population that is predominantly made up of African ethnic groups who primarily adhere to Christian and animist beliefs. This cultural and religious identity has long set the people of South Sudan apart from the largely Muslim and Arab population of the northern Sudanese government, leading to decades of conflict and ultimately the pursuit of independence. The capital city, Juba, serves as the political and economic hub of South Sudan, reflecting the country's aspirations for stability and development as it navigates the challenges of nation-building in a complex regional context. In 2023, South Sudan's population was estimated at 11,088,796 people, representing about 0.14% of the total world population. This places South Sudan at number 86 in regard to position of countries by population. The country has an average population density of 18 people per km² making the country relatively sparsely populated.

Climate and Ecological Conditions of South Sudan

South Sudan has a tropical climate with wet and dry seasons. The seasons are characterized by oscillation in the north and south. This phenomenon involves the seasonal migration and pulsation of the northern tropical continental air mass and the southern maritime continental air mass, which are divided by the inter-tropical convergence zone. In winter the north winds of the tropical air mass blow across the country toward the front, which may be as far south as the Tropic of Capricorn. These winds are relatively cool and dry and usually bring no rain. In April, the front begins to move northward, and the moist southerly air of the maritime air mass is drawn in from the South Atlantic Ocean. Due to its geographical location, South Sudan experiences a rainy season whose length varies depending on latitude. Typically, the rainy season lasts between eight to nine months, starting as early as April and extending as late as December. This extended period of rainfall is crucial for the country's agriculture and water resources, shaping the livelihoods of many South Sudanese, particularly those in rural areas. The climate in South Sudan is generally hot throughout the year. July is the coolest month, with average temperatures ranging from 20 to 30 °C (68 to 86 °F). In contrast,

March is the warmest month, with temperatures averaging between 23 and 37 °C (73 to 99 °F). These temperature variations reflect the country's tropical climate, which influences the lifestyle and agricultural practices of its population.

Ecologically, South Sudan is divided into six agro-ecological zones (MAF 2007): the Greenbelt, Ironstone Plateau, Hills and Mountains, Flood Plains, the Nile/Sobat Rivers and the arid and pastoral zone. The rainfall pattern varies according to agro-ecological zones. In the Green belt it ranges from 800 mm to 2,000 mm, while in the Arid Zone, may be as low as 300 mm per year. Temperatures range from 25°C to 40°C. The growing season is generally between 100 to 200 days (about 6 and a half months) depending on the agro-ecological zone. Most parts of the country have two cropping seasons, April-June and July-December, (SSLHP/2006).

Major Landscape and Economic Activities

South Sudan is mostly covered by tropical forest, swamps, and grassland. The White Nile passes through the country, passing by the capital city of Juba. Half of the water of the White Nile is lost in the swamps as vegetation absorbs and for livestock use.

Agriculture

Agriculture is the main economic activity in South Sudan. Traditional rain-fed farming of small plots predominates in South Sudan, although mechanized farming techniques are increasingly utilized in some areas, such as in the northern part of the country. South Sudan's main crop is sorghum. Other crops include corn (maize), millet, rice, cassava (manioc), peanuts (groundnuts), sweet potatoes, okra, and coffee. The main subsistence crops are sorghum, corn, and cassava, with smaller amounts of millet and rice being grown in some areas. Peanuts are the primary cash crop. There are many livestock raised in the country, including goats, sheep, and cattle. Some livestock are raised for export, but this sector of the country's economy is underdeveloped.

Status of forestry and forest resources, woodlands, and allied national resources in South Sudan

South Sudan is well endowed with diverse natural forests and woodlands, with an estimated total area of 191,667 km², taking up about 30% of total land area. However, forest assets of South Sudan have been seriously degraded by the prolonged conflict affecting the country. Several case studies concluded that annual forest loss was on average of 2% each year, a rate which if sustained, would lead to complete forest loss within 50 years. The main causes of this deforestation are fuel wood collection, charcoal production, agricultural expansion, livestock grazing, and the construction industry. There is an urgent need to introduce and implement effective forest-related programmes, policies and legislation in the country.

Trends of forestry/agricultural development in South Sudan

Agriculture is the backbone of South Sudan's economy, playing a crucial role in the livelihoods of its population. In 2010, agriculture, forestry, and fisheries contributed approximately 36% to the non-oil GDP, underscoring the sector's significance. With around 80% of the population residing in rural areas, agriculture, along with forestry and fisheries, provides the primary source of income for most households across the country. However, much of the rural sector is currently engaged in low-input, low-output subsistence farming rather than market-oriented production.

Several factors contribute to this focus on subsistence agriculture:

- 1. Need for improved agricultural inputs and techniques:** There is a significant need for better seeds, fertilizers, storage facilities, advisory services, and irrigation development to boost productivity.
- 2. Market access challenges:** Farmers face difficulties accessing markets due to a poor road network, lack of alternative transportation modes, and the burden of nuisance taxes, charges, and even bribes.
- 3. Lack of farmer and rural producer associations:** The absence of strong farmer and rural producer associations limits farmers' ability to enter the marketplace, reduce input costs, access affordable loan finance, and influence farm-gate prices.
- 4. Uncertainties regarding property rights and land access:** Issues related to property rights and land access create further challenges for agricultural development.

Two and a half decades ago, South Sudan was a net exporter of agricultural products to regional markets. However, due to war-related destruction, poor infrastructure, and lack of investment in the agriculture sector, the country is now a net importer of food. Currently, South Sudan imports up to 50% of its food needs, including 40% of its cereals, mainly from neighbouring countries like Uganda and Kenya. The total food imports are estimated to be around \$200-300 million annually.

Despite producing and consuming a wide range of agricultural commodities, certain crops have become staples in the national diet. Cereals, particularly sorghum, maize, millet, and rice, are the dominant staple crops in South Sudan, forming the backbone of the country's food consumption.

Current situation of land degradation in South Sudan

An analysis of land degradation in South Sudan reveals that 27,019 km² (4.32%) of the country's total area of 624,919.2 km² was degraded, while 342,763.7 km² (54.85%) showed signs of improvement. Overall, most of the country's land cover, amounting to 606,113.7 km² (96.99%), remained unchanged, with only a small portion, 3,900.6 km² (0.62%), experiencing degradation. When

broken down by land cover type, it was found that grasslands, other lands, and wetlands experienced some losses, while the rest of the land types showed slight improvements.

Recent and/or Current Programmes/Projects Being Undertaken to Address Climate Change

Trust Fund: GEFTF

Trust Fund: GEFT is the long-term solution for transformative shift from unsustainable to integrated sustainable land and forest management in the Imatong mountains landscape in order to secure habitat for biodiversity conservation. The goal of this project is to improve natural resource management and contribute to rural livelihoods and promote national, regional and global environmental benefits. The project objective is to promote sustainable approaches to ecosystem conservation in the Imatong landscape of South Sudan for effective natural resources management and improved livelihoods. This will be achieved through the following four components:

1. Developing enabling policy and regulatory frameworks for effective planning, management and governance of forest PAs (Protected Areas).
2. Forest Management plan development and capacity building for effective forestry protected area management.
3. Promoting sustainable agricultural practices and improved community livelihoods in the Imatong landscape.
4. Knowledge management and learning.

Achievements, Challenges and Opportunities of Climate Mitigation and Adaptation

Achievements

- Declaration of 20% of the country's natural forest as reserve forests to protect it from deforestation.
- Promotion of agroforestry practices.
- Implementing environmental regulations.
- Increasing awareness of local communities on climate change, deforestation and environmental protection.

Challenges

South Sudan faces numerous challenges due to decades of political instability, poverty, and persistent food insecurity, all of which are exacerbated by climate change. These include:

1. Internal conflicts and security concerns.
2. Lack of a clear and transparent institutional framework for climate change adaptation.

3. Limited coordination between ministries and line departments to maximize climate change adaptation.
4. Insufficient institutional and technical capacity to implement planned activities.
5. Economic challenges and limited budget.
6. Low level of afforestation, forest development, landscape restoration and environmental awareness.

Policy, Legislation, Strategies and Guidelines for Environment and Biodiversity Conservation and Management

South Sudan currently lacks specific policy and legislative frameworks for forest protected areas. Although the country has an Environment Policy, there is no dedicated policy governing forest protected areas or the sustainable use of natural resources, which has contributed to issues such as heavy charcoal burning, logging and deforestation.

The relevant national legislation promoting the biodiversity conservation and management, and ecologically sustainable development in South Sudan is the Transitional Constitution of South Sudan adopted in 2011 and amended in 2015, in its Article 173, paragraph 2 which emphasizes the protection of the environment and biodiversity. This Constitution provision has laid the groundwork basis for the preparation of the draft bills including Environmental Protection Bill (2015), the Wildlife Conservation and Protected Areas Bill (2015) and the Forestry Conservation and Protection bill (2013). If enacted, these bills, will empower the Ministry of Environment and Forestry to supervise and co-ordinate all matters relating to the environment, forestry and wildlife protected areas. It is hoped that the draft bills, after further review, will be approved by the newly created inclusive national assembly under the coalition government. The South Sudan new parliament was sworn in, on 2nd August 2021 under peace deal.

The absence of a comprehensive legal framework has severely hampered effective forest management in South Sudan. At various administrative levels-national, state, county, Payam, and Boma – forestry management relies on informal and de facto arrangements due to the lack of formal regulations. Mandates between the national and State governments, Non-Governmental Organization (NGOs) and Private Sector Organizations (PSO) overlap creating uncoordinated actions. Poor inter-sectorial coordination and collaboration among stakeholders negatively impact on forest management and investment. In addition, forest management is impacted negatively due to weak governance structures and untrained law enforcement entities and staff. These conflicts have led to a lack of trained personnel in natural resource management and biodiversity conservation. Ex-soldiers and combatants, many of whom have very limited skills and understanding of biodiversity conservation were incorporated into the environment and natural resources sectors, and this is undermining effective management and biodiversity conservation.

Opportunities and Challenges to Capacity Building

Opportunities

The Government of South Sudan has launched a major USD 9 million-initiative to help communities adapt to climate change by strengthening climate early warning systems and restoring the country's precious ecosystems in two of the ten states.

Challenges

- Lack of equipped research institutions and research scientists.
- Lack of road infrastructures.
- Insecurity.
- Limited resources.

Training needs

- Climate change issues.
- Agroforestry.
- Afforestation.
- Forest restoration.
- Climate smart agriculture.

7.6 Promoting Climate Change Resilient Forestry in Tanzania

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Introduction

Background

Tanzania is located in East Africa within the African Great Lakes Region. The country's diverse terrain includes the eastern coastline bordering Indian Ocean, central plateau, and the Great Rift Valley which runs through the country from north to south. Tanzania's climate is tropical, with two main seasons: a wet season from November to May and a dry season from June to October (Crawford *et al.*, 2016). The country experiences diverse ecological conditions, from coastal and marine ecosystems to savannas, forests, and mountains. Tanzania has a population of nearly 62 million people, making it the second most densely populated country in East Africa (URT, 2022). The country's economy is primarily based on agriculture, which employs about 65% of the population (Cowling, 2024). Tanzania is a major producer of coffee, tea, cotton, cashewnuts and tobacco. Other important economic sectors include; mining, manufacturing, and tourism. The population comprises 120 ethnic, linguistic, and religious groups, with over 100 languages spoken, whereas Swahili is widely spoken. Land use in Tanzania is shaped by historical and cultural factors, ecological and climatic conditions, and population growth. The country's population is projected to double by 2050, increasing demand for land for agriculture, housing, and infrastructure (URT, 202).

Forestry status in Tanzania

Tanzania is characterized by a significant forest cover representing 55% of total land area, which amounts to 48.1 million hectares. These forests are classified into various types based on the height of vegetation, including forest (both natural and plantation), woodlands, bushlands and grassland. According to the National Forest Resource Monitoring and Assessment (NAFORMA) (URT, 2015), 44.6 million ha (93%) of the forestland is woodlands and contain 73.9% of the growing stock, while 3.4 million ha (7%) is occupied by forests which account for 11.3% of the growing stock. The remaining 40.1 million ha are trees on farms (TOF), which constitute 14.8% of the growing stock. About 20 million hectares (22.7%) of forestland are production forests and 28 million hectares are protected forests in reserves and other areas. Total wood volume is 3.3 billion m³. Natural forest regeneration is healthy with up to 3000 tree seedlings/wildings per hectare.

Deforestation rate as reported by URT (2017) was 469,420 ha per year. Main causes of deforestation being increasing population, forest clearing for agriculture, wildfires, reliance on wood fuel for energy, over-exploitation of wood resources, and unsustainable land use. Inadequate community engagement in agroforestry

also contributes to deforestation. Forest loss contributes to greenhouse gas emissions, impacting global warming and climate change. The effects of climate change on forests include reduced growth rates, species loss, migration to higher altitudes, and changes in reproductive biology. Drought leads to intense fires and forest losses, while floods cause erosion and tree loss. The subtropical thorn woodland in Tanzania has a likelihood of vanishing, and subtropical dry and moist forests will decline by 61%. About 4% of the country will see an increase in tropical very dry forest, tropical dry forest, and tropical moist forest, replacing current life zones. This will affect Tanzania's forests and their management processes and products.

Recent/Current Programme/Projects Undertaken by Tanzania to Address Climate Change

Tanzania has undertaken various initiatives as described in URT (2012) to address climate change. The following are some of the initiatives described at national level;

- Development of Climate Change National Action Plan.
- Adoption of National Environment Policy - provides framework for environmental issues relating sectors to climate change.
- National Adaptation Program of Action (NAPA) - identified Urgent and Immediate Adaptation options to combat climate change impacts.
- Enactment of the Environmental Management Act – CAP 193 (Section 75 of EMA describes how climate change issues can be addressed in Tanzania).
- Preparation of National REDD Framework for Reducing Emissions from Deforestation and Forest degradation.
- Tanzania economics of climate change (The objective was to evaluate the costs and implications of climate change to Tanzania and explore carbon opportunities in mitigation activities).
- Climate Change, Impacts, Adaptation and Mitigation in Tanzania (CCIAM) - Research programme initiated to support the REDD+ implementation capacity in the country.

Recent/Current Programme/Projects Undertaken by Tanzania to Landscape Restoration Programmes for Forest and/or Agricultural Landscapes Rehabilitation

- Conservation of *Pterocarpus tinctorius* (Mkurungu) and other selected commercial reserved indigenous timber trees species in Tanzania.
- Forest landscape restoration initiatives through AFR100 (Tanzania restore 5.2 million hectares).
- Operationalization of the tool on systematic mechanism of reporting illegal activities in the eastern arc mountains of Tanzania.

- Investigating pests and diseases affecting tree seed orchards in the southern highlands and eastern zones of Tanzania.
- Piloting innovative community business models for accelerating uptake of efficient electric cooking appliances.
- Rehabilitation and conservation of forest reserves in the country.
- Establishment of exotic species trial plot around the country.
- E-services developed for Forest Fire information and Site-species Matching Tool.
- Assessing growth performance, productivity and utilization properties of selected commercial bamboo species in Tanzania.

Major Achievements, Challenges and Opportunities in Climate Change

Achievements

In ensuring effective participation of Tanzania in climate change issues, various initiatives and programmes have been undertaken in Tanzania in the context of UNFCCC and its Kyoto Protocol. Tanzania ratified UNFCCC and its Kyoto Protocol in 1996 and 2002 respectively, to ensure that climate change issues are addressed at the national level supported by national policies and legislation. Therefore, implementation of the UNFCCC and the Kyoto Protocol is further supported by the enabling environment including the National Environment Policy (1997) and the Environmental Management Act (EMA).

In 2009, the National REDD framework was developed, followed by the National Climate Change Strategy in 2012 (updated in 2021) and the National REDD+ Strategy in 2013. The Government is engaged in developing the capacity, knowledge and mechanisms to implement the REDD+ commitments expressed in the Strategy. Tanzania has also signed several protocols and internationally committed itself to comply with the international obligations associated with the forest sector. These include; Southern African Development Community (SADC) Protocol on Forestry (2002), East Africa Forest Policy (2020) and National Forest Policy Implementation Strategy (2021-2031), African Forest Landscape Restoration Initiative (AFR100) and United Nations Framework Conventions on Climate Change (UNFCCC, 1992). The Conventions include; the Paris Agreement of 2015, United Nations Convention on Combating Desertification (UNCCD), Convention on Biological Diversity (CBD), UN Forest Instrument adopted in December 2015 and Sustainable Development Goals (SDGs).

Other achievements include;

- Successful domestication of *Albizia gummifera*, *Cordia africana*, *Entandrophragma excelsum*, *Newtonia buchananii* and *Prunus africana*
- PFM Database for 16 SADC member states.

- Climate change adaptation options and their implications on Mangrove resources.
- Impacts of woody invasive plants on rural livelihood, ecosystem services and biodiversity in Eastern Africa for mitigation in Tanga and Kilimanjaro regions assessed.
- Tree planting in national forest plantation and woodlots.
- Positive impacts of agroforestry technologies in forest management.
- Improved seed and clonal orchards for *Tectona grandis*.
- Seed orchards for indigenous tree species (*Milicia excelsa*, *Khaya anthotheca*, *Azizelia quanzensis*) established.
- Establishment of ranger posts in/near national forest reserves.
- Screening trials for Eucalyptus clonal hybrids against local landraces.
- Gene conservation stand for lesser-known fast growing timber tree species (*Gmelina arborea* and *Melia azedarach*).

Challenges

Challenges that are facing the natural forest land management include: conversion of land for other economic use due to population pressure, wildfires, persistent reliance on traditional wood fuel for energy, and over-exploitation of wood resources. Other challenges include disappearance of unique forest species, unreserved and inefficient management of village forests.

Forest plantations and woodlots are faced with the following challenges: low productivity due to inadequate adherence to silvicultural treatments, poor seeds quality/low improved seed, occurrence of pests and diseases, and inadequate extension services. Similarly, inadequate forest restoration and research financing, low engagement in Public-Private Partnership arrangements such as lease, concessions and joint management agreement are challenges facing the establishment and management of forest plantations and woodlots. Other challenges include; limited forest land tenure, inadequate certified forests mechanisms, over-reliance on traditional species and inadequate supply of good quality seeds and fertilizers. Apart from the challenges, large plantation forests faced with business environment-related challenges required to be preserved and non-productive land, creating additional costs (MNRT, 2021).

Opportunities

Major opportunities on Climate Change mitigation and adaptation, landscape restoration and forestry development initiatives in Tanzania include;

- The presence of vast forested areas of diverse nature provides an important opportunity for their conservation and sustainable management.

- Presence of education and research institutions.
- Government support and political will.
- Potential sites for ecotourism activities.
- Conducive environment to carry out carbon trading.
- Potential areas for investment, including reforestation, agroforestry, and sustainable forest management, as well as opportunities for public-private partnerships and community-based forest management.
- Capacity building, policy and institutional reforms, and incentives for private sector investment in the forest sector.

Overall, the successful implementation of these initiatives has the potential to generate significant economic, social, and environmental benefits for Tanzania.

Policies, Legislations, Strategies and Guidelines for Promotion of Climate Change Mitigation and Adaptation in Tanzania

The following are the major legislative frameworks in Tanzania;

- National Forest Policy (1998).
- Forest Act No. 14 (2002).
- Environmental Management Act (2004).
- National Forest Policy Implementation Strategy (2021-2031).
- Forest Regulation (2004).
- The Environmental Management (control and management of carbon trading) Regulations (2022).
- The National Carbon Trading Guideline (2022).
- National Climate Change Strategy (2012).
- National Forestry Research Master Plan III (2020-2030).
- National Bamboo Development Master Plan (2023-2031).

Opportunities and Challenges to Capacity Building in Tanzania

Tanzania is among the countries that are vulnerable to the impacts of climate change, particularly in the agriculture and forestry sectors. The country has made efforts to build capacity in climate change mitigation and adaptation measures, landscape restoration, promotion of forestry, and rural development (Mwakisunga and Majule, 2019). However, there are still challenges that need to be addressed. The National Forest Policy Implementation Strategy (2021-2031) outlines the main opportunities and challenges to capacity building on climate change mitigation and adaptation measures, landscape restoration, promotion of forestry and rural development in Tanzania.

Opportunities

- Increased funding from international and domestic sources to support capacity building programs. As a country, institutions and funding mechanisms to manage the sector and promote sectoral self-financing are in place. The Tanzania Tree Seed Agency (TTSA), and Tanzania Forest Services (TFS) Agency were established in 2003 and 2010 respectively to strengthen the capacity to manage forest and tree seed resources. Moreover, the Eastern Arc Mountains Conservation Endowment Fund (EAMCEF) and the Tanzania Forest Fund (TaFF) were established in 2001 and 2010 respectively to promote sectoral self- financing.
- Collaboration between the government, private sector, and civil society organizations to promote knowledge sharing and skills development. In promoting skills development for private sector, the Private Forestry Programme (2014-2018) was implemented and resulted in the establishment of Forestry and Wood Industries Training Centre in Mafinga. Forestry and Value Chain Development Programme (2018 - 2021) is advancing responsible private sector involvement in managing forest reserves. Additionally, a library and laboratory facilities have been constructed at Forest Industries Training Institute to enhance skills development.
- The main source of forestry professionals is the College of Forestry, Wildlife and Tourism (CFWT) at Sokoine University of Agriculture (SUA) and the Institute of Resource Assessment at the University of Dar es Salaam. Recently, the Paramilitary Service was established to ensure effective management of forest resources.
- Efforts have been made to ensure adequate employment of skilled workforce in the sector. The main employers of foresters are the Central Government, Local Government Authorities (LGAs), NGOs and the private sector. The providers include government, NGOs and private sector.
- Integration of climate change considerations into national and local development plans. Such as in the National Forestry Research Master Plan 2011 - 2020 and recently the third National Forestry Research Master Plan 2021 - 2031 developed by Tanzania Forestry Research Institute (TAFORI).
- Awareness raising campaigns to ensure that communities are informed about the importance of climate change mitigation and adaptation measures.
- Use of innovative technologies to enhance capacity building efforts.

Challenges

- Limited financial and technical resources.
- Limited access to information and knowledge, particularly in rural areas.
- Limited institutional capacity to support effective implementation of capacity building programs.

- Limited participation of marginalized groups, such as women and youth, in capacity building programs.
- Inadequate coordination and collaboration among stakeholders involved in capacity building programs.

Training Needs

The training needs include;

- Global/International Forest management and research funding facilities/ organization in order to establish more sustainable funding mechanisms for forest management and landscape restoration in Sub-Sahara African landscapes.
- Technical skills for wood and non-wood product development and value addition, agroforestry and commercial and urban forestry.
- Resource mobilisation skills.

7.7. Promoting Climate Change Resilient Forestry in Uganda

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Introduction

Background

Uganda, a landlocked country in East Africa, spans approximately 241,500km², with 194,000 km² being land and the rest comprised of open water and wetlands (UBOS, 2014). The Country is situated between 1° N and 4° N latitude and 30° E and 35° E longitude. Uganda is home to a rapidly growing population, which as of October 18, 2023, stood at 48,977,651 persons. With one of the highest population growth rates in the world, exceeding 3% annually, over 80% of Ugandans rely on agriculture for their livelihoods, making the sector crucial to the nation's economy (UBOS, 2014). However, this dependence on agriculture places significant pressure on the country's land and natural resources, necessitating sustainable farming practices and effective resource management to ensure food security and environmental conservation amidst the challenges posed by rapid population growth.

Climatic conditions of Uganda

Uganda experiences a predominantly equatorial climate, with mean annual temperatures ranging from 16°C to 30°C (UBOS, 2014). The country's climate varies across regions, with the Central, Western, and Eastern regions experiencing two distinct rainy seasons from March to May and September to November. In contrast, the Northern region has a single, extended rainy season from April to October. Annual rainfall in Uganda varies widely, with most areas receiving between 750 mm and 2,100 mm. The hottest months are January and February, during which average daytime temperatures range from 22°C to 28°C, with temperatures in the far north often exceeding 30°C.

Major landscapes in Uganda

Relief features

Relief features in Uganda include;

- **Muhavura plateau:** Muhavura plateau is part of the expansive plateau that characterizes most of Uganda's landscape. This plateau gently slopes from about 1,500m in the south to approximately 900m in the north. The plateau is bounded by a series of mountains and valleys, which define its limits and contribute to the country's varied topography. Notable among these geographical features is Mount Muhavura, a volcanic peak in the southwestern part of Uganda, which is part of the Virunga Mountains. The plateau's elevation and its surrounding mountains and valleys create a diverse landscape that influences the region's climate, agriculture, and settlement patterns.

- **Margherita Peak:** This peak is located within the Ruwenzori Range and is one of the most prominent features of Uganda's western natural boundary, which also includes the Virunga (Mufumbiro) Mountains and the surrounding valleys. The Virunga Mountains, a volcanic range, rise to impressive heights, with Mount Muhavura reaching 4,125m. This range also includes **Mount Sabinio** 3,645m, a significant peak where the borders of Uganda, the Democratic Republic of Congo and Rwanda converge.
- **Rwenzori Range:** Popularly believed to be Ptolemy's Mountains of the Moon rises to 5,109m at Margherita Peak. Uganda's highest point; its heights are often hidden by clouds, and its peaks are capped by snow and glaciers. Lakes Edward and George are between the Virunga and Rwenzori mountains. The rest of the boundary is composed of the Western Rift Valley, which contains Lake Albert and the Albert Nile River.
- **The Northeastern border of the plateau** is defined by a string of volcanic mountains that include Mounts Morungole, Moroto, and Kadam, all of which exceed 2,750 m in elevation.
- **Mount Elgon:** It is the southernmost mountain and highest of the chain, reaching 4,321m. South and west of these mountains is an eastern extension of the Rift Valley and Lake Victoria.

Drainage

Lakes

- Lake Victoria 69,484 km², in the south eastern part of the country, is the world's second largest inland freshwater lake by size after Lake Superior in North America. Lake Victoria is also one of the sources of the Nile River.
- Five other major lakes exist in the country: namely Edward and George to the southwest; Albert to the west; Kyoga in central Uganda; and Bisina in the east.

Rivers

- **There are eight major rivers.** These are the Victoria Nile in central Uganda; the Achwa, Okok, and Pager in the north; the Albert Nile in the northwest; and the Kafu, Katonga, and Mpongo in the west.
- **Victoria Nile:** The southern rivers empty into Lake Victoria, the waters of which escape through Owen Falls near Jinja and form the Victoria Nile. This river flows northward through the eastern extension of Lake Kyoga. It then turns west and north to drop over Karuma Falls and Murchison Falls before emptying into Lake Albert.
- Lake Albert is drained to the north by the Albert Nile, which is known as

the Al-Jabal River, or Mountain Nile, after it enters South Sudan at Nimule. Rivers that rise to the north of Lake Victoria flow into Lake Kyoga, while those in the southwest flow into Lakes George and Edward.

- **Nile River:** Except for the Victoria and Albert Niles, the rivers are sluggish and often swampy. Clear streams are found only in the mountains and on the slopes of the Rift Valley. Most of the rivers are seasonal and flow only during the wet season, and even the few permanent rivers are subject to seasonal changes in their rates of flow.

Ecological conditions of Uganda

Soils

Uganda's soils are generally fertile, with the predominant type being lateritic, which is rich in iron and aluminum. These soils are particularly productive, especially in the region surrounding Lake Victoria, where they are considered some of the most fertile in the world. This fertility supports extensive agricultural activities, making the area a crucial agricultural hub for the country. However, interspersed within this fertile landscape are patches of waterlogged clay soils, particularly in the northwest and along the western shores of Lake Victoria. These clay soils tend to retain water, which can limit agricultural productivity in those specific areas, but they also support different types of vegetation and land use.

Plant and animal life

Flora (Plant): Vegetation varies significantly across the country, with the densest vegetation found in the south, gradually transitioning into wooded savanna, or grassy parkland, in the central and northern regions. In areas where conditions are less favourable, particularly in the south, the landscape shifts to dry acacia woodland. This woodland is characterized by scattered acacia trees, occasional candelabra trees, tropical African shrubs or trees with large, spreading heads of foliage and euphorbia plants, which often resemble cacti and contain a milky sap. These woodlands are interspersed with patches of grassland and can also be found in the Rift Valley floors, where similar vegetation patterns emerge. The northeast of Uganda, representing the driest regions, is dominated by steppes, which are treeless plains, and dense thickets, reflecting the harsher climatic conditions of that area.

In the Lake Victoria region and the western highlands, forest covering has been replaced by elephant grass and forest remnants because of human incursions. The medium-elevation forests contain a rich variety of species. The high-elevation forests of Mount Elgon and the Ruwenzori Range occur above 1,800 m; on their upper margins they give way, through transitional zones of mixed bamboo and tree heath, to high mountain moorland. Uganda's 514,500 km² of swamplands include both papyrus and seasonal grassy swamp.

Fauna (animal): Lions and leopards are now present mainly in animal reserves and national parks, but they are occasionally seen outside these places. Hippopotami and crocodiles inhabit most lakes and rivers, although they are not found in Lakes Edward and George. Mountain gorillas, chimpanzees, and small forest elephants appear only in the extreme west. Elephants, buffalo, and the Uganda kob (an antelope) are limited to the west and north, while the black rhinoceros and giraffes are confined to the north. Zebras, topis, elands, and roan antelopes live in both the northeastern and southern grasslands, while other kinds of antelopes (oryx, greater and lesser kudu, and Grant's gazelle) are found only in the north eastern area.

Uganda is home to a diverse variety of bird life, including threatened species. Most of the country's national parks provide excellent bird-watching opportunities. The country's varied fish life includes ngege (a freshwater nest-building species of *Tilapia*), tiger fish, barbels, and Nile perch.

Insects are a significant element in the biological environment. Elevations below 1,500 m are the domain of the female *Anopheles* mosquito, which carries malaria, while the presence of tsetse flies has closed extensive areas of good grazing land to cattle. Butterflies are also very prevalent in Uganda. Many different species, including those which are endemic, can be found in the country.

Land Use and Land Use Changes in Uganda

Agriculture is the most dominant form of land use. Other forms of land use include wildlife management (through) tourism and employment, Forestry (provision of forest resources and services), wetlands management, and human settlement (through industrial production, commercial enterprises and employment).

Land use has changed due to increase in population: impacts include, reduction of tree cover and species composition, water quality and quantity and soil quality.

Economic Status of Uganda

Crop production is the key economic activity in the Agricultural sector. Ugandan farmers grow both food and cash crops. The traditional cash crops are coffee (Arabica and Robusta), cotton, tea and tobacco. These crops have formed the bulk of Uganda's agricultural export earning much desired foreign exchange. The agricultural sector is responsible for almost half of the Gross Domestic Product and employs almost 80% of the population.

Uganda has achieved an impressive economic growth rate estimated at an annual average of 6.6% over the last decade (World Bank, 2016). This growth has produced positive changes in the economic, social and environment development indicators. The eastern and northern regions of the country continue to lag behind and remain stagnant in terms of income poverty and age dependency levels. Also,

the growth was mainly generated by the service sectors, such as banking, finance and telecommunications, which have a low job creation multiplier effect. From the environment perspective, natural resources such as forests and wetlands have shrunk, raising concerns about whether economic growth was achieved at the expense of the environment and natural resources.

Uganda's economy is made up of the Agriculture, Industry and Services sectors. Agriculture is a core sector of Uganda's economy and the largest employer. Over 80% of the rural population are employed in the sector. It contributes about 75% of agricultural production (MWE, 2022). The Agricultural sector includes fisheries, animal husbandry, dairy, and crop sub-sectors. While the Industrial sector includes manufacturing, construction, and electricity supply sub-sectors; the services sector is made up of wholesale and retail trade, telecommunications, hotels and restaurants, transport and communications and tourism sub sectors.

Status of Forestry and Forest Resources, Woodlands, and Allied Natural Resources in Uganda

The forest cover of Uganda is currently estimated at less than 10% of the total land area. This current situation is worsened by land degradation associated with soil erosion. In order to mitigate this, Uganda has prioritized forest restoration in targets that are provided in Government of Uganda's Vision 2040, National Development Plans (I & II), and the National Forestry Plan (2011/12 - 2021/22). The main target is to restore forest cover from the current less than 10% to the 1990 level of 24% of the land area. This national aspiration was translated in the pledge that Uganda made in the Bonn Challenge to restore 2.5 million hectares of land to forests using the Forest Landscape Restoration (FLR) approach.

Trends of Forestry/Agricultural Development in Uganda

The annual forest cover loss was 2.2% of the total forest cover over the years. Forests on private land reduced from 16% to 4% and protected forests reduced from 8% to 6% of the national land area. Annual forest cover loss was recorded highest in private forests. Forests outside protected areas (PAs) reduced from 67% of the total forest cover area in 1990 to 38% in 2017 (MWE, 2022). The forest estate shrunk from 24% of the total land area in 1990 to 9% in 2015. In terms of acreage, a total of 3.05 million hectares were lost in a span of 25 years. Out of this loss, about 2.2 million hectares were from the woodlands. Between 2005 and 2015 the area of forest plantations both conifers and broadleaved increased to 37,000 hectares on private land and 64,000 in Central Forest Reserves (MWE, 2016). The biggest loss of forest cover is from the privately owned category where well stacked Tropical High Forests (THFs) and woodlands were lost between 1990 and 2015.

The main causes of deforestation have been mostly the conversion of forest land to other land use types such as agriculture and urbanization, and rampant felling of trees for firewood and charcoal burning. The other important ones are issues

relating to governance in the forestry sector, issues associated with illegal and unregulated trade of forest products and the unsecured forest tenure rights. There is a remarkable difference in the degree of deforestation inside protected areas (PAs) as compared to forests on private land.

Current Situation on Land Degradation in Uganda

Even though Uganda has a large percentage of arable land, land degradation is a substantial problem in the country. Generally, it is estimated that 4% - 12% of Gross National Product (GNP) is lost from environmental degradation, 85% of this from soil erosion, nutrient loss and changes in crops. The worst affected areas include highland areas in the southwest and some dry land districts. The percentages of land affected by land degradation range from 90% in Kabale to 20% in Masindi.

The socio-economic reasons for land degradation and low productivity have been summarized as: poverty and land fragmentation leading to over-exploitation of the land with inadequate soil and water conservation practices; increasing rural population densities with few non-farm income opportunities; low levels of commodity trade and the production of lower value commodities; reducing incentives to invest in the soil; little farmer knowledge of improved agricultural technologies; insufficient agricultural research that takes into account the needs and resource constraints of farmers; and a lack of effective agricultural extension.

Recent and/or Current Programmes/Projects Being Undertaken to Address Climate Change

Agroforestry: Growing trees with crops have been practiced in many farming systems in Uganda. Agroforestry practices integrate diverse trees or shrubs with crops and livestock. In particular, pastures with trees can sequester 5 to 10 times more carbon than treeless areas of the same size. Farmers can also be more productive by growing crops and raising livestock simultaneously using significantly less land. For example, in the central region where much of the Robusta coffee and bananas are grown, tree species such as *Ficus*, *Albizia coriaria*, *Spathodea nilotica*, *Markhamia lutea* and *Maesopsis eminii* have for ages been grown as shade trees for those crops. Other forms of agroforestry that have potential for restoring tree cover include trees planted along boundaries, in homesteads, as windbreaks, hedgerows, and in woodlots.

Diversifying crops and livestock: Keeping livestock and crops give farmers additional sources of income and reduces the risks to livelihoods caused by climate change and unpredictable weather. Diversification enables adaptation to changing climates. Investigating and developing innovative solutions to prevent and manage natural catastrophes.

Afforestation: The most grown fruit trees in the country are mangoes, oranges, paw paws, and tangerine. Other commonly grown tree species are; *Melicia excelsa*, *Artocarpus heterophyllus*, *Pinus caribaeae*, *Ficus natalensis*, *Grevillea*

robusta, *Combretum indicum*, *Eucalyptus grandis*, *Psidium guajava*, *Maesopsis eminii*, *Senna spectabilis* and *Tectona grandis*. These help to adapt to the changing weather conditions in the area.

Climate Smart Agriculture (CSA) Program (2019-2030): The program was developed jointly by Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) and Ministry of Water and Environment (MWE) to contribute to reduction of emissions intensity by reducing conversion of forest into cropland (MAAIF, 2019a). Priority areas in the CSA program include improved productivity of crops, livestock and fisheries; irrigation and water management; improved food storage, distribution and human nutrition; and increased incomes.

Solar-powered irrigation projects: This covers Bugomola village, Lwabenge sub-county in Kalungu District as well Gomba, Kiboga, Luwero, Mubende, Nakaseke, Nakasongola, Rakai and Sembabule districts. The project funded by FAO, is part of the multi-million-dollar Global Climate Change Alliance (GCCA) Project that aims to strengthen the resilience of rural populations and agricultural production systems through provision of water for irrigation in 33 districts of Uganda's Cattle Corridor.

Solar powered irrigation systems in Moyo District: This is a solar powered irrigation scheme developed by FAO with support from the government of Japan and serves a purpose of addressing water scarcity in the community where villagers are known to travel for long distances in search of water.

Electric powered buses (Kayoola EVS bus): Uganda has already piloted the establishment of assembling center of Kayoola EVS Bus in Uganda. The Kayoola EVS Bus is innovatively designed to facilitate a total sustainable mass mobility solution for urban centers in Sub-Saharan Africa.

Landscape restoration programs for forest and/or agricultural

Community tree planting programme

The National Forestry Authority (NFA) works with the District Forest Officers (DFOs) who identify communities to whom seedlings are to be distributed during the rainy season. The NFA has on its part decentralized production of the seedlings to its regional tree nurseries to ease the distribution process. DFOs are responsible to assist those allocated seedlings to plant them according to required specifications.

Corporate tree planting in forest reserves

As a means of involving the corporate bodies in tree planting under their Corporate Social Responsibility (CSR), NFA engaged several corporate bodies in rehabilitating some of the degraded Central Forest Reserves (CFRs). The corporate bodies provided funds for seedlings, and their staff participated in planting of trees in areas allocated to them.

Talk Foundation

Tree Talk Foundation has since 2004 been engaged in the northern region of the Country and in Karamoja working mainly with schools and community groups. Its main focus has been to work with the adolescents and the youth through production and dissemination of information, communication and education materials including those on tree planting, forestry and environmental protection. It has worked with school children to establish tree nurseries and planting school woodlots to alleviate the problem of firewood (Tree talk, 2015). It is reported that some of the first schools to engage in this initiative have started using trees they planted to construct teacher's houses and for making school furniture.

Afforestation programs to increase forest cover, several efforts to restore the landscape have been employed and planting and re-planting of degraded areas has been on going.

Forestry and rural development

Several trainings have been conducted and many people in Uganda have been encouraged to use alternative sources of energy such as briquettes for cooking. Solar panels instead of electricity have been encouraged and used mainly in the rural areas of Uganda as a means of using clean energy. Farmers are practicing enrichment planting, crop rotation, planting early maturing plants, fertilizer application, growing resilient crops, growing drought resistant crops, mulching, use of improved seed varieties, intercropping, shifting in planting seasons, planting many crops and new varieties.

Forestry development

Forestry sector has implemented adaptation actions mainly through research, and resilient projects that conserve forests. Through the National Forestry Resources Research Institute (NAFORRI), there was promotion of intensified and sustained forest restoration efforts through biological control agents. NaFORRI updated the pests and diseases guideline developed under SPGS II and trained 80 key stakeholders in the forest sector in tree pests and diseases identification, recognition, and management.

More research in forestry has been carried out. In Nyabyeya Forestry College, there is an arboretum where research in Forestry is ongoing.

Projects from different organizations such as World Bank, Wildlife Conservation Society that encourage or promote tree planting and education of people on forestry through the existing institutions to broaden their knowledge on forestry development. Other efforts to develop forestry include community sensitization and training of students from the forestry institutions.

Major Achievements and Opportunities on Climate Change Mitigation and Adaptation in Uganda

Presence of educational institutions: Education offers people knowledge and ability to forecast future scenarios and they have greater access to information and opportunities than their counterparts who have less education. Knowledge and education enables them to adapt more to climate change. Forestry institutions have been established and more people from the community are sensitized on measures to undertake to adapt better in the changing climate. The only institution offering technical forest training in Uganda is Nyabyeya Forestry College, located in Masindi District and neighbouring Budongo Central Forest Reserve (CFR). The Forestry and Nature Conservation Department at Makerere also has since the mid- 1970s been training students.

Community groups: Farmer involvement in community groups is one of the adaptation measures at the community level. This means that engagement in groups helps farmers get benefits which otherwise they would not have got. Farmers involved in groups share knowledge and innovative ideas, discuss problems and challenges with farmers and engage in collaborative decision-making. It is through these groups that information is passed on to the farmers regarding climate. Seeds for planting are provided to farmers through these farmer groups.

Water bodies: The presence of the water bodies also facilitates the adaptation to climate change. These water sources which include Lake Kyoga in Uganda are sources of water in case of extreme weather events in the area.

Other opportunities for adaptation to climate change are; availability of improved seed variety, presence of NGOs in the area, availability of water sources, availability of fertile soils and favourable government policies.

Gender: Several studies report that gender is a critical variable affecting decisions at farm level. Females are more likely to adopt new natural resource management techniques than their male counterparts as more women are found at home. This implies that gender of the household head plays a critical role in farm decision-making process.

Age: In areas where more people over thirty years are found, adaptation measures are believed to be better. This agrees with most studies that indicate a significant positive relationship between age of farmer and level of adoption of conservation measures. However, farmers in older age sets show a negative relationship as farmers are reluctant to undertake new innovations in agricultural practices such as implementing soil and water conservation techniques probable since activities are labour intensive.

Diverse climate smart agriculture technologies that also consider the smallholder farmers who are the biggest population in Uganda.

The presence of projects undertaken by Government Organizations (GOs) and Non-Government Organizations (NGOs)

The projects are designed to create off-farm livelihoods activities so that farmers can diversify and supplement their income and continue their agricultural operations in the face of climatic uncertainty for example the Tree Talk Foundation whose main focus has been dissemination of information, communication and education materials including those on tree planting, forestry and environmental protection, The NFA and DFOs who identify communities to whom seedlings are to be distributed during the rainy season.

Challenges

The major challenges for adaptation and mitigation to climate change include:

- Inadequate capacity to write proposals for accessing funding under the different winding of the Green Climate Fund (GCF), and awareness of the latest requirements for GCF funding proposal.
- Limited accessibility to climate data and climate change scenarios to underpin effective adaptation actions.
- Limited access to and use of technology related to various sectors.
- The lack of sufficient storage capacity both at farm level and agricultural produce trading system levels, plus inability to construct durable and weather tight stores.
- The legal environment for the agricultural sector is conducive but implementation of many initiatives has been low.
- Gender-related constraints: External resources and technical assistance is in most cases directed towards men, and women are accorded minimal rights compared to men.
- Inadequate funding of the forestry sector to conduct research because of its long-term nature.
- Inadequate quality germplasm sources.

Policy, Legislation, Strategies and Guidelines for Promotion of Climate Change Mitigation and Adaptation in Uganda

The Uganda Forestry Policy (2001)

The Uganda Forestry Policy (2001) outlines the guiding principles for forestry sector development which are reflected in the National Forest Plan. The core themes are conservation and sustainable development, livelihood enhancement, and institutional reform with new roles for central and local government, the private sector, local communities and NGOs. Uganda Forest Policy (2001)

Guiding Principles include;

- Consistency with the Constitution and Vision 2025 in guiding sustainable development.
- Commitment to conservation and sustainable development, meeting the needs of this generation without compromising the rights of future generations.
- Improvement of livelihoods as a major goal in all strategies and actions for the development of the forestry sector so as to contribute to poverty eradication.
- Safeguarding the nation's biodiversity and environmental services.
- Development of partnerships in governance, to enhance efficiency, transparency, accountability and professionalism, and build confidence in all forest stakeholders.
- Reforming the role of central government to withdraw from activities that can be carried out more effectively by the private sector or other stakeholders, but to maintain core functions of policy development and regulation.
- Enhancing the role of local government with more devolved responsibility for resource management wherever practical and advisable.
- Developing the role of the private sector as investors and managers.
- Encouraging more active participation of local communities and farmers in the management of the country's forests.
- Enhancing the role of NGOs/CBOs to strengthen civil society, build capacity and grassroots participation, and help develop the rights and responsibilities of forest users.
- Enabling active participation and affirmative action of all women and men, young people and the elderly, and vulnerable or disadvantaged groups in forestry sector development.
- Respecting the attributes of cultural and traditional institutions in forestry sector development given the respect they are accorded by their subjects in respect to the administration of customary tenure as in Northern Uganda.
- Supporting the implementation of current and future international commitments that affect the forestry sector.
- Ensuring that environmental and social values are used in assessing strategies to implement the Forestry Policy.

National Forestry and Tree Planting Act (NFTPA, 2003)

The NFTPA (2003) repealed the Forests Act (1964) Cap 246, and the Timber (Export) Act 1965 Cap 247. The Act consolidated and operationalized the Uganda Forestry Policy (2001), the National Forest Plan (2002) and also established the National Forestry Authority (NFA) as a legal entity to manage CFRs, while the District Forestry Services (DFSS) under local governments manage LFRs and

provide advisory services to local communities and private forest owners on management of their forests which constitute a larger percentage of forests in the country. The Act is an enabling law that provides new and positive opportunities for better management of the forestry sector to balance the traditional “regulatory” functions of government. It provides for new opportunities for collaboration of all sectorial partners, private sector and an empowered civil society.

National Forest Plan (NFP) (2002) revised in 2012

The objectives of the NFP are to conform with national planning framework, the Poverty Eradication Action Plan (PEAP), later replaced by the National Development Plan 1 (NDP1)-2010/11-2015/16 and the NDP 2 (2015/16-2019/20). The main focus of the first NFP (2002) was on the management of tree and forest resources for the economic, social and environmental benefits for all the people of Uganda, in line with the pillars of PEAP. The NFP was designed to improve the livelihoods of Ugandans, especially those living in rural areas through raising the incomes of the poor, increasing the number of jobs and enhancing the contribution of forests to Uganda’s economic development, while ensuring that the future of the country was not jeopardized in the process.

Constitution of the Republic of Uganda (1995)

Uganda constitution stipulates the following:

Every person has a right to a healthy environment, every person has a duty to maintain and enhance the environment including the duty to inform the authority or the local environment committee of all activities and phenomena that may affect the environment significantly.

National Environment Management Policy for Uganda (1994)

This policy established the government’s first strategies for integrating environmental concerns into the national development planning process and established the National Environment Management Authority (NEMA) to regulate this process.

National Environment Act (CAP 53)

An Act to repeal, replace and reform the law relating to environmental management in Uganda; to provide for the management of the environment for sustainable development; to continue the National Environment Management Authority as a coordinating, monitoring, regulatory and supervisory body for all activities relating to environment; to provide for emerging environmental issues including climate change, the management of hazardous chemicals and biodiversity offsets; to provide for strategic environmental assessment; to address environmental concerns arising out of petroleum activities and midstream operations, to provide for the management of plastics and plastic products; to establish the Environmental Protection Force; to provide for enhanced penalties for offences under the Act; and to provide for procedural and administrative matters (The National Environment Act, 2019).

The United Nations Framework Convention on Climate Change (UNFCCC), (1992)

The United Nations Framework Convention on Climate Change (UNFCCC) was established as an international environmental treaty to combat “dangerous human interference with the climate system”, in part by stabilizing greenhouse gas concentrations in the atmosphere.

The Convention to Combat Desertification (UNCCD), (1994)

The convention was established in 1994 to protect and restore our land and ensure a safer, just, and more sustainable future. The UNCCD is the only legally binding framework set up to address desertification and the effects of drought.

Opportunities and Challenges to Capacity Building on Climate Change mitigation and Adaptation in Uganda

Opportunities

The presence of Institutions: The only institution offering technical forest training in Uganda is Nyabeyya Forestry College, located in Masindi District and neighbouring Budongo CFR. This equips people with information on climate change and forestry knowledge serves as an opportunity for capacity building. The Forestry and Nature Conservation Department at Makerere has since the mid- 1970s been training mainly Ugandan students, after Tanzania and later Kenya started their own departments of forestry.

Favourable government policies: The presence of favourable government policies has encouraged capacity building on climate change, landscape restoration promotion of nature-based solutions and forestry development.

Research institutions: Forestry research is undertaken by the National Forestry Resources Research Institute (NaFORRI). Research carried out by NaFORRI focuses on developing technologies and practices for conservation of natural forest ecosystems; sustainable management of plantation forests; growing and managing trees on farms; developing and promoting tree/forest products and services; integrated pests, diseases control and fire management; tree improvement and production of quality germplasm as well as nature-based recreation.

The availability of water sources, availability of fertile soils and favourable to promote afforestation programs.

Challenges to capacity building on climate change mitigation and adaptation in Uganda

- Weak institutional coordination within government and among donors makes it difficult to estimate expenditure on climate change activities in many ways lead to duplication of climate change interventions. A particular gap exists in the structures for implementing climate change activities in local governments.

- Lack of streamlined system and sufficient information sharing: Several entities especially NGOs, CSOs, academic institutions receive technical assistance support directly from donors as part of the global action which is important in filling the existing gap. This information may not be captured and often leads to duplication of efforts.
- Logistical and infrastructural risks at farm and produce trading system levels that leads to high post-harvest storage losses.
- Weak enabling environment especially the inadequate institutional arrangements and financial resources to enforce policies.
- Gender related productivity gaps resulting from differentiated impacts of climate change and access to factors of production by men and women.
- Collecting data is still limited to data collectors.
- Development of mitigation scenarios for non-energy sector, require training on marginal abatements curves.
- Absence of arrangements for data sharing with the private sector especially for the mitigation actions and disclosure of their emission reductions.
- Limited mechanisms for the collection of reliable data, archiving and updating in a manner that meets the minimum IPCC requirements Climate Change.

Training Needs

- Measures which ensure that communities access and utilize timely and accurate weather information.
- How to develop a comprehensive plan that addresses transfer of knowledge.
- Environmentally sound technologies.

Additional information

Efforts have been made to educate and raise awareness of the entire population on climate change and its impacts on national development with enhanced attention being given to decision makers. In addition, substantial progress has been made in the institutional and legal regimes. However, limited progress is evident in transfer of mitigation and adaptation technologies in the country.

APPENDICES

Appendix I: Course Programme



PROMOTING CLIMATE CHANGE RESILIENT FORESTRY IN SUB-SAHARAN AFRICA



6th –24th May 2024
at
KEFRI, Nairobi - KENYA

Course Programme

WEEK 1: Module 1				
DAY	MORNING 8:30am-10:30am	MID- MORNING 11:00am-1:00pm	AFTERNOON 2:00pm-5:00pm	
SAT 4/05/2024 International Arrivals SFS-CORECC team				
SUN 5/05/2024 International Arrivals and Local Arrivals SFS-CORECC team				
MON: 6/05/2024	• Welcome • Introductions • Overview of KEFRI • Course Brief • Programme overview • Orientation • Participants Expectations • TNA Feedback • (SFS-CORECC)	Development of forestry in Kenya: Successes, challenges opportunities and synergies <i>(D. Mbithi-KFS)</i>	JICA strategies and activities in SSA on environment - <i>(JICA- Kenya Office)</i> Brief on SFS-CORECC <i>(Saito Katsuro- Chief Advisor)</i>	Presentation and discussions of country reports by participants (SFS-CORECC) Official Opening Ceremony (MECCF/EoJ/ KEFRI/ JICA/ Embassy and high commissions of participating countries)
TUE: 7/05/2024	Climate change: trends, impacts, challenges, opportunities and mitigation and adaptation <i>(R. Akombo-MECCF)</i>	Introduction to Tree seed science in a changing climate <i>(B. Kamondo- KE-FRI)</i>	Tree seed source identification and development <i>(S. Omondi -KEFRI)</i>	
WED: 8/05/2024	Tree seed collection, handling and storage <i>(B. Kamondo-KEFRI)</i>	Tree Seed quality control; Principles of seed testing <i>(B. Kamondo -KEFRI)</i>	Practical Session I: Tree seed testing - Visit KEFRI Tree Seed Centre <i>(B. Kamondo - KEFRI)</i>	
THUR: 9/05/2024	Technologies for Rehabilitation, restoration and conservation of woodlands and forests landscapes <i>(J. Amwatta- KE-FRI)</i>	<u>Learning Experience</u> I: Landscape restoration through re-afforestation: Case study of Nguriunditu Valley <i>(S. Wairungu-KEFRI)</i>	Presentation and discussions of country reports by participants (Participants/SFS-CORECC)	

DAY	MORNING 8:30am-10:30am	MID-MORNING 11:00am-1:00pm	AFTERNOON 2:00pm-5:00pm
FRI: 10/05/2024	Forest Health I: Dynamics of tree diseases in a changing climate. Case studies from Africa (<i>J. Njuguna- KE-FRI</i>)	Forest Health II: Managing Forest pests: Case studies from Africa (<i>E. Mutitu-KEFRI</i>)	Practical Session II: Visit KEFRI Pathology laboratories (<i>A. Muthama -KEFRI</i>) Practical Session III: Visit KEFRI Entomology laboratories and plant quarantine facility (<i>M. Gathogo-KEFRI</i>)
SAT: 11/05/2024	<u>Learning Experience II:</u> Participatory Forest Approaches: The case of Participatory Forest Management: Visit to Kereita Forest (<i>M.T.E Mbuvi-KEFRI</i>)	Travel to Nairobi and its environs (<i>S. Mwalewa, R. Okello, N. Kemboi, R. Mwangangi, A. Ng'etich</i>)	
SUN: 12/05/2024	FREE	Travel to Kitui	

WEEK 2: Model 1

DAY	MORNING 8:30am-10:30am	MID-MORNING 11:00am-1:00pm	AFTERNOON 2:00pm-5:00pm
MON: 13/05/2024	Dryland forestry R&D: Overview of KEFRI activities, achievements and challenges (<i>A. Luvanda-KEFRI DERP</i>)	Development of a centre excellence for dryland forestry research: KEFRI Pilot Forest on drought tolerant species activities at Tiva (<i>A. Luvanda - KEFRI DERP</i>)	Indigenous tree improvement and breeding- The case of <i>Melia volkensii</i> and <i>Acacia tortilis</i> (<i>S. Omondi-KEFRI</i>) Visit to Melia and Acacia breeding sites (<i>S. Omondi KEFRI</i>)
TUE: 14/05/2024	Practical Session IV: Demonstration on long root tree species to enhance survival (<i>R. Karanja- KE-FRI DERP</i>)	<u>Learning Experience III:</u> Technology Transfer through Model Farmers approach: case of Mr Ngonde and Kivelenge's farms (<i>E. Kitheka- KEFRI DERP</i>)	Travel to Kibwezi (<i>SFC-CORECC Team</i>)

DAY	MORNING 8:30am-10:30am	MID-MORNING 11:00am-1:00pm	AFTERNOON 2:00pm-5:00pm
WED: 15/05/2024	<u>Learning Experience IV:</u> Commercial forestry development in the drylands: Farm visit on Melia growing for climate change adaptation and livelihood improvement in Kibwezi, Makueni County <i>(J. Kituku-Kibwezi)</i>	<u>Learning Experience V:</u> Irrigated agricultural scheme - Department of Agriculture Makuni County- Kibwezi	Night in Kibwezi <i>(SFC-CORECC Team)</i>
THUR: 16/05/2024	Rehabilitation of pasture land for sustainable livelihood in drylands <i>(KALRO-Kiboko)</i>	<u>Learning Experience VI:</u> Demonstration Improved natural pasture growing for sustainable livelihood in drylands <i>(KALRO -Kiboko)</i>	Travel to Machakos <i>(SFC-CORECC Team)</i>
FRI: 17/05/2024	Dryland agriculture for community and climate resilience: <i>(KALRO Katumani - Machakos)</i>	<u>Learning experience VII:</u> Demonstration of Dryland agriculture for community and climate resilience	Travel to Muguga <i>(SFC-CORECC Team)</i>
SAT: 18/05/2024	Compiling field reports by participants	<u>Learning Experience VIII:</u> Visit to historical sites in Nairobi	
SUN: 19/05/2024	Free / Compiling field reports and action plans		
WEEK 3:			
DAY	MORNING 8:30am-10:30am	MID-MORNING 11:00am-1:00pm	AFTERNOON 2:00pm-5:00pm
MON: 20/05/2024	Policies and legal frameworks for Sustainable Forest Management <i>(J. Njigoya- KFS)</i>	Emerging forestry opportunities: Case of NBS Forest and Ecosystem services <i>(D. Lang’at- KEFRI)</i>	Compiling Field reports/ Participants

Module 2				
DAY	MORNING 8:30am-10:30am	MID-MORNING 11:00am-1:00pm	AFTERNOON 2:00pm-5:00pm	
TUE: 21/05/2024	Extension in forestry in the era of climate change (<i>R. Nyambati-KEFRI</i>)	Training of Trainers: (<i>AIRC</i>)	ToT tools; communication, facilitation and presentation skills (<i>AIRC</i>)	
WED: 22/05/2024	Writing and editing skills (<i>AIRC</i>)	Development of extension materials (<i>AIRC</i>)	<u>Practical Session V</u> : Development of extension materials (<i>AIRC</i>)	
THUR: 23/05/2024	Presentation of extension materials (<i>AIRC</i>)	Action plans development (<i>AIRC</i>)	Development of individual action plans (<i>participants, AIRC</i>)	
FRI: 24/5/2024	Presentation of individual action (<i>Participants AIRC/SFS-CORECC</i>)	Course evaluation Plenary/Way forward SFS-CORECC	Consultations	Official Closing Ceremony (<i>JICA/PS – MECCF</i>)
SAT: 25/05/2024	International Departure			

NB:

Module 1: Knowledge and Technology Transfer

Module 2: Training of Trainers (ToTs)

ACRONYMS

AIRC	Agricultural Information Resource Centre
CS	Cabinet Secretary
EoJ	Embassy of Japan
JICA	Japan International Cooperation Agency
KALRO	Kenya Agricultural and Livestock Research Organization
KEFRI	Kenya Forestry Research Institute
KFS	Kenya Forest Service
MECCF	Ministry of Environment, Climate Change and Forestry
PS	Principal Secretary
SFS - CORECC	Project for Strengthening Forestry Sector Development and Community Resilience to Climate Change through Sustainable Forest Management and Landscape Restoration

Appendix II: List of Participants

No.	Participant Name	Country	Present Position	Highest Education	Organization/Department and Contacts
1.	Gabriel Nimenya (M)	Burundi	Head of Service Department in charge of inventory, statistics, planning and development of forest resources	Degree in Forestry	Burundian Office for Environmental Protection (OBPE), Department of Forests Town: Gitega, Neighborhood; Masinzira; Street: The Triumph B.P. 56 Gitega, Bujumbura, Burundi Email: nimenyagabriel@gmail.com nibitangasam@gmail.com\
2.	Yeshifana Alemneh Mengesha (F)	Ethiopia	Associate Researcher	BSc. in General Forestry	Ethiopian Forestry Development Bahir Dar center G+2 office No. 102, Addis Ababa, Ethiopia E-mail: alemnehyeshefana@gmail.com
3.	Mercy Rutto (F)	Kenya	Research Scientist in Agroforestry	BSc. in Environmental Studies	Kenya Forestry Research Institute (KEFRI) P. O. Box 20412-00200, Nairobi Email: mrutto.jebet@gmail.com mrutto@kefri.org
4.	Vashit Mwikali Kivondo (F)	Kenya	Assistant Conservator of Forests	BSc. in Environmental Science	Kenya Forest Service (KFS) P. O. Box 30513-00100, Nairobi Email: kivondo36@gmail.com
5.	Ackim July Dickson (M)	Malawi	Land Resources Conservation Officer	BSc. Forestry	Ministry of Agriculture, Department of Land Resources Conservation Zomba District Agriculture Office, Box 287, Zomba, Malawi E-mail: ackimdickson@gmail.com
6.	Isaac Taban Khamis Boaza (M)	South Sudan	Assistant Farm Manager	BSc. in Agricultural Sciences	Ministry of Agriculture and Food Security, Directorate of Agricultural Research National Ministry of Agriculture and Food Security/RSS – Juba, South Sudan E-mail: isaactaban00@gmail.com

No.	Participant Name	Country	Present Position	Highest Education	Organization/Department and Contacts
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8.	Fredy Ndandika Akwilin (M)	Tanzania	District Forest Conservator	BSc. in Forestry	Tanzania Forest Service Agency (TFS) P. O. Box 30072, Kibaha, Pwani Tanzania E-mail: fredy.akwilin@tfs.go.tz
9.	Phiona Kwaga (F)	Uganda	Senior Technician	MSc. in Agroforestry	National Forestry Resources Research Institute (NaFORRI) 12Km along Mukono-Kayunga Road P. O. Box 1752, Kampala, Uganda E-mail: naforridir@infocom.co.ug / kwagaphifi@yahoo.com
10.	Salimah Kyomugisha (F)	Uganda	Forest Officer	BSc. in Conservation Forestry	Ministry of Water and Environment Department of Forestry Sector Support Services, Nyabyeya Forestry College P. O. Box Private Bag, Masindi, Uganda E-mail: kyomugishasalima@gmail.com

Appendix III: List of Resource Persons

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13.	Mr Paul Tuwei	Kenya Forestry Research Institute	P. O. Box 20412-00200, Nairobi Email: ptuwei@kefri.org
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No.	Name	Institution	Contacts Address/Email
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20.	Ms. Damaris Munyao	Kenya Forestry Research Institute Dryland Eco-region Research Programme	P. O. Box 892-90200 Kitui Email: dmunyao@kefri.org
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25.	Mr. Saito Katsuro	Japan International Cooperation Agency Climate Change Sector, JICA Kenya Office	NHIF Building

No.	Name	Institution	Contacts Address/Email
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No.	Name	Institution	Contacts Address/Email
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44.	Ms. Jane Njeru	Agricultural Information Resource Centre (AIRC)	Waiyaki Way, P. O. Box 66730-00800, Westlands. Nairobi
45.	Ms. Josephine Mogere	Agricultural Information Resource Centre (AIRC)	Waiyaki Way, P. O. Box 66730-00800, Westlands. Nairobi
46.	Mr. Jonathan Kituku	Melia Farmer	Kibwezi
47.	Daniel Kituku	Melia Farmer	Kibwezi
48.	Mr. Stephen Kithuku	Chair, Green Shade Self Help Group	Machakos
49.	Mr Michael	Pasture Farmer	Kiboko
50.	Mr Rogers Kaleve	Model farmer	Kitui

Appendix IV: Confirmation of Attendance

KEFR I/F/MK/02



Project for Strengthening Forestry Sector Development and Community Resilience to Climate Change through Sustainable Forest Management and Landscape Restoration (SFS-CORECC)

ATTENDANCE REGISTER

On-demand Regional Training Course on
Promoting Climate Change Resilient Forestry in Sub-Saharan Africa

No.	Name	Country	Organization	Contact	6/5/2024 DAY 1	7/5/2024 DAY 2	8/5/2024 DAY 3	9/5/2024 DAY 4	10/5/2024 DAY 5
1.	Ackim Bwaka	Tanzania	Min of Agric	0999 664734	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
2.	Phiona Kwaga	Uganda	NatFORRI	1256773 064345	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
3.	ISAAC BOAZA	S. Sudan	MAFS	+21192 722100	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
4.	Mervy Ruto	Kenya	KEFRI	31902957	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
5.	Yesseana Kiemeni	Ethiopia	ESD	+251931 855446	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
6.	NIMENYA Gabriel	Burundi	ORPE	+25779 21576	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
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8.	Fredy Nbandika	Tanzania	FFS	+255046 240382	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
9.	Vashit Kivondo	Kenya	KIFS	+2547 12834256	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
10.	Kyomugisha Salim	Uganda	Nyabeya Forestry College	+256789015	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>



Project for Strengthening Forestry Sector Development and Community Resilience to Climate Change through Sustainable Forest Management and Landscape Restoration (SFS-CORECC)

ATTENDANCE REGISTER

On-demand Regional Training Course on

Promoting Climate Change Resilient Forestry in Sub-Saharan Africa

No.	Name	Country	Organization	Contact	11/5/2024 DAY 6	12/5/2024 DAY 7	13/5/2024 DAY 8	14/5/2024 DAY 9	15/5/2024 DAY 10
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5.	MIMENYA Gabriel	Burundi	OBPE	+2577930170					
6.	Yesniana Alemeneh	Ethiopia	EED	+251931855446					
7.	Mesay Reda	Kenya	KEPRI	+254706300465					
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Appendix V: Sample Course Certificate





Kenya Forestry Research Institute and Japan International Cooperation Agency

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