

COURSE REPORT

2nd On-demand Training Course on Promoting Climate Change Resilient Forestry in Africa



Building Capacity of KEFRI Partners



March 2026

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

COURSE REPORT

2nd On-demand Training Course on Promoting Climate Change Resilient Forestry in Africa

@KEFRI/JICA 2026

This publication may be reproduced in whole or in part in any form for educational purposes or non-profit uses without permission of the copyright holder provided acknowledgement is made.

Cover photographs captions:

Top: Group photograph during course opening ceremony

Bottom: Group photograph during course closing ceremony

ISBN: 978-9914-723-08-3

Citation: Musingo T.E. Mbuvi, Wanjiku J., Tuwei P., Mwalewa S., Kemboi N., Mwangangi R. and Ide N. (2026). Promoting Climate Change Resilient Forestry in Africa. KEFRI/JICA, KEFRI Headquarters, Muguga, Nairobi.

Published by:

Kenya Forestry Research Institute and Japan International Cooperation Agency

P. O. Box 20412-00200, Nairobi, Kenya

Tel: +254-724 259 781/2, +254-722157414, +254-20-2010651/2

Email: director@kefri.org

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

Acknowledgement

The Kenya Forestry Research Institute (KEFRI) acknowledges the Government of Japan, through the Japan International Cooperation Agency (JICA), for approving and providing financial support for implementation of the Second On-demand Training Course on “Promoting Climate Change Resilient Forestry in Africa”. KEFRI is also grateful to the Ministry of Environment, Climate Change and Forestry (MECCF), for logistical support during the preparation and implementation of the training course. The Institute also appreciated the Ministry for gracing the opening and closing ceremonies of the course.

Appreciation is extended to the Governments of; Botswana, Eritrea, Ethiopia, Eswatini, Kenya, Lesotho, Sierra Leone, Somalia, Zambia, and Zimbabwe for nominating and allowing the participants to fully attend the training, demonstrating a shared commitment to strengthening sustainable forestry and climate resilience across Sub-Saharan Africa. We acknowledge the presence of Ms. Kanako Sasai, First Secretary Embassy of Japan, High Commissioners and members of diplomatic core from embassies of Botswana and Sierra Leone in Kenya Mr. Ontumetse Anthony Ontumetse and Rtd. Lieutenant General Peter Kakowou Lavahun respectively for gracing the opening ceremony, which was a great motivation to the participants.

KEFRI recognizes with gratitude the continued support of the JICA Kenya Office and the experts under the SFS-CORECC Project for their technical guidance and participation throughout the training. Special thanks go to the Mr. Makoto Shinkawa - Chief Representative JICA Kenya Office, Mr. Fumihiko Suzuki - Senior Representative JICA Kenya Office, Ms. Tae Ose - Project Formulation Advisor in the Climate Change Sector and Mr. Abednego B. Osindi - Program Officer, Climate Change and Refugee Affairs, all of JICA Kenya Office, for unwavering support to the training and gracing the opening and closing ceremonies.

The Institute also appreciates the dedication of all resource persons who contributed their expertise and knowledge during the training. KEFRI further acknowledges the technical contributions of partner institutions, including the Agricultural Information Resource Centre (AIRC) and the Kenya Agricultural and Livestock Research Organization (KALRO), for offering valuable knowledge sharing during the training. The model farmers, namely Mr. Jeremiah Ngaya and Mr. Jonathan Kituku are greatly appreciated, for generously hosting participants during field visits and sharing practical experiences on improved pasture production and commercial forestry development in dryland areas respectively. The on-farm demonstrations provided valuable real-world insights that enriched the training.

The authors greatly acknowledge KEFRI management for administrative, technical and logistical support that ensured successful implementation of the course.

Appreciation is also extended to KEFRI Enterprise for providing suitable training facilities, including accommodation and catering services at KEFRI Headquarters and the Dryland Eco-Region Programme (DERP) in Kitui. The Regional Director, DERP, and the technical staff are sincerely thanked for their warm reception and for facilitating the field learning sessions.

Finally, KEFRI thanks all participants for their active engagement, commitment to learning, and willingness to share experiences, which greatly contributed to the success of the training and strengthened regional collaboration in promoting climate-resilient forestry.

Executive Summary

The Second On-demand Training Course on “Promoting Climate Change Resilient Forestry in Africa” successfully strengthened the capacity of forestry and natural resource professionals from 10 African countries to address the growing challenges of climate change and forest degradation. The course brought together twelve (12) participants from Botswana, Eritrea, Ethiopia, Eswatini, Kenya, Lesotho, Sierra Leone, Somalia, Zambia, and Zimbabwe, reflecting a strong regional commitment to sustainable forest management and landscape restoration. The course was successfully conducted from 1st to 19th September 2025 at the Kenya Forestry Research Institute (KEFRI) Headquarters in Muguga. The training was jointly implemented by the Kenya Forestry Research Institute (KEFRI) and the Japan International Cooperation Agency (JICA) under the Strengthening Forest Sector Development and Community Resilience to Climate Change through Sustainable Forest Management and Landscape Restoration (SFS-CORECC), with support from the Ministry of Environment, Climate Change and Forestry (MECCF).

The course aimed to enhance participants’ technical, practical, and communication capacities in climate-resilient forestry, focusing on tree germplasm development, tree improvement, landscape restoration, and knowledge dissemination through Training of Trainers (ToT) approaches. Training was delivered through lectures, practical sessions, field visits, group work, and interactive discussions, enabling participants to link theory with practical application.

Key outcomes of the training included enhanced capacity in climate change mitigation and adaptation strategies, improved knowledge of sustainable forest management practices, and strengthened skills in tree seed handling, propagation, and landscape restoration techniques. Participants were also exposed to emerging tools and approaches such as Monitoring, Reporting and Verification (MRV), REDD+ mechanisms, carbon financing, and innovative resource mobilization strategies. A notable output of the training was the development of country-specific action plans aimed at addressing forest degradation, biodiversity loss, and climate change impacts.

Evaluation findings indicated that the training was highly relevant and effective, with participants rating course objectives, content, and delivery as high to very high. The expertise of resource persons, quality of training materials, and field-based learning experiences were identified as key strengths. The training significantly contributed to participants’ professional development and institutional capacity, although feedback suggested the need for slight adjustments in course duration to enhance learning and reflection.

The training further strengthened regional collaboration and knowledge exchange, fostering networks that are essential for addressing shared environmental challenges across Africa. It also reaffirmed KEFRI’s role as a regional hub for forestry research, capacity building, and technology transfer.

The training achieved its intended objectives by equipping participants with the knowledge, skills, and practical tools necessary to promote climate-resilient forestry and sustainable landscape restoration. The implementation of the developed action plans is expected to contribute meaningfully to national and regional efforts in enhancing ecosystem resilience, conserving biodiversity, and improving livelihoods across participating countries.

Table of Contents

Acknowledgement.....	iii
Executive Summary	v
List of Abbreviations and Acronyms.....	ix
CHAPTER 1	1
1.0 Introduction.....	1
1.1 Background.....	1
1.2 Second On-demand Training	1
CHAPTER 2	5
2.0 Official Speeches	5
2.1 Opening Ceremony Speeches and Remarks	5
2.2 Official Closing Ceremony Speeches and Remarks	19
CHAPTER 3	27
3.0 Course Evaluation.....	27
3.1 Introduction.....	27
3.2 Analysis of Evaluation Feedback.....	27
3.3 Potential of On-demand Third Country Training Programmes	36
CHAPTER 4	37
4.0 Field Visits Report	37
4.1 Introduction.....	37
4.2 Sites Visited.....	37
CHAPTER 5	106
5.0 Implementation Action Plans	106
5.1 Action Plan on Enrichment Planting in Low-regenerating and High Seedling Mortality Sites in Nata-Gweta District using <i>Sclerocarya birrea</i> ..	106
5.2 Action Plan on Mitigating Land Degradtion in Moliq, Eritrea.....	113
5.3 Action Plan on Mitigating Carbon Stock Reduction from Natural Forest in Highlands of Ethiopia	118
5.4 Action Plan on Conservation of Biodiversity in the Kingdom of Eswatini..	122
5.5 Action Plan on Restoration and Conservation of the Mau Forest Complex as a Climate-Resilient Water Tower and Livelihood Source in Kenya.....	131
5.6 Action Plan on Advancing Sustainable Forestry, Climate Resilience and Landscape Restoration in Kenya	136

5.7	Action Plan on Restoration of Degraded Landscapes in ASALS in Kenya	140
5.8	Action Plan on Reducing High Carbon Emissions in Lesotho	144
5.9	Action Plan on Sustainable Forest Management and Climate-Resilient Landscapes Restoration in Sierra Leone	148
5.10	Action Plan on Forestry Restoration in Somaliland	153
5.11	Action Plan for Enhancing Biodiversity in Natural Forests of Chikankata District, Zambia	156
5.12	Action Plan for Mitigating Land Degradation, Forest Loss and Climate Change Impacts in Shurugwi District, Zimbabwe	162
CHAPTER 6		168
6.0	Information Materials	168
6.1	Introduction	168
6.2	Posters	168
6.3	Brochures	170
6.4	Flyers	172
CHAPTER 7		174
7.0	Country Reports	174
7.1	Promoting Climate Change Resilient Forestry in Botswana	174
7.2	Promoting Climate Change Resilient Forestry in Eritrea	182
7.3	Promoting Climate Change Resilient Forestry in Ethiopia	199
7.4	Promoting Climate Change Resilient Forestry in the Kingdom of Eswatini	203
7.5	Promoting Climate Change Resilient Forestry in Kenya	209
7.6	Promoting Climate Change Resilient Forestry in Lesotho	216
7.7	Promoting Climate Change Resilient Forestry in Sierra Leone	221
7.8	Promoting Climate Change Resilient Forestry in Somaliland	226
7.9	Promoting Climate Change Resilient Forestry in Zambia	234
7.10	Promoting Climate Change Resilient Forestry in Zimbabwe	255
APPENDICES		265
Appendix I:	Course Programme	265
Appendix II:	List of Resource Persons	269
Appendix III:	List of Course Participants	275
Appendix IV:	Confirmation of Attendance by Course Participants	277
Appendix V:	Sample Course Certificate	278

List of Abbreviations and Acronyms

AFR100	African Forest Landscape Restoration Initiative Programme
AIRC	Agricultural Information Resource Centre
ANR	Assisted Natural Regeneration
CBNRM	Community-Based Natural Resource Management
CFA	Community Forest Associations
CIFOR-ICRAF	Center for International Forestry Research and World Agroforestry
DERP	Dryland Eco-Region Research Programme
DPs	Development Partners
DSS	Decision Support System
FAO	Food and Agriculture Organization
FMNR	Farmer-Managed Natural Regeneration
FRL	Forest Reference Level
GHG	Greenhouse Gas
GIS	Geographic Information System
ICT	Information and Communication Technology
IPM	Integrated Pest Management
JICA	Japan International Cooperation Agency
KALRO	Kenya Agricultural and Livestock Research Organization
KEFRI	Kenya Forestry Research Institute
KEPHIS	Kenya Plant Health Inspectorate Service
KFS	Kenya Forest Service
KFSC	Kenya Forestry Seed Centre
LRP	Landscape Restoration Plan
MECCF	Ministry of Environment, Climate Change and Forestry
MoA	Memorandum of Agreement

MoU	Memorandum of Understanding
MRV	Monitoring, Reporting and Verification
NDCs	Nationally Determined Contributions
NGO	Non-Governmental Organization
NRM	Natural Resource Management
NTFP	Non-timber Forest Products
PES	Payment for Ecosystem Services
PPE	Personal Protective Equipment
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SAS	Somaliland Agriculture Society
SFM	Sustainable Forest Management
SFS-CORECC	Strengthening Forestry Sector Development and Community Resilience to Climate Change through Sustainable Forest Management and Landscape Restoration
SOER	State of Environment Report
TCTP	Third Country Training Programme
TICAD	Tokyo International Conference on African Development
TNA	Training Needs Assessment
ToT	Training of Trainers
UNDP	United Nations Development Programme
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WWF	Wild Wide Fund

CHAPTER 1

1.0 Introduction

1.1 Background

The African continent is rich in biodiversity and has diverse ecosystems that support livelihoods and socio-economic needs. However, the continent faces significant challenges mainly due to climate change and extensive landscape degradation. Increased forest and landscape degradation has resulted in low forest and tree cover, loss of biodiversity, desertification, and low land productivity.

Addressing these challenges necessitates holistic approaches that promote accelerated landscape restoration such as: aggressive reforestation and afforestation application of climate change mitigation and adaptation measures; and sustainable land use; which should be supported by capacity building of natural resources managers and users.

Kenya Forestry Research Institute (KEFRI) in collaboration with Japan International Cooperation Agency (JICA) has since 1985 undertaken research, provided information and technologies in forestry and allied resources as well as undertaken capacity development. Though tremendous progress has been made in forestry research and development, and capacity build for countries in Africa, emerging challenges brought about mainly by climate change, necessitate a need for further capacity building programmes that address current environmental challenges while taking into account socio-economic status of recipient countries and communities.

1.2 Second On-demand Training

Title

The course was entitled “Promoting Climate Change Resilient Forestry in Africa”.

Purpose

The training aimed to strengthen participants’ technical capacities by addressing critical knowledge and skills gaps in high-quality tree germplasm development, tree improvement, and climate-smart agricultural technologies. Through the dissemination of knowledge, practical skills, experiences, and innovative technologies, the training sought to enhance participants’ ability to support effective landscape restoration, promote resilient forestry, and facilitate improved knowledge sharing and technology transfer within their respective institutions and countries.

Themes and Modules

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

Theme 1: Tree germplasm and Tree Improvement (tree breeding)

Theme 2: Landscape restoration

Theme 3: Dissemination and Communication of information

The training themes were delivered through two structured modules. Themes 1 and 2 were covered under Module 1, while Theme 3 was delivered through Module 2. In this case, Module 1 focused on enhancing participants' knowledge and technical skills in relevant subject areas, whereas Module 2 emphasized strengthening participants' capacity to effectively transfer knowledge and skills through Training of Trainers (ToT) approaches and related dissemination methodologies.

Output

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

- Acquired knowledge and technical skills on high-quality tree germplasm development and tree improvement for effective promotion of landscape restoration.
- Gained knowledge and practical skills in forestry and agriculture climate smart technologies and product development for climate resilient landscapes.
- 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, 1st to Friday, 19th September 2025**.

Participating Countries

Participants were nominated and drawn from the following nine (9) countries: Ethiopia, Eritrea, Eswatini, Kenya, Lesotho, Sierra Leone, Somalia, Zambia and Zimbabwe.

Number of Participants

The number of participants from participating countries were twelve (12).

Sponsor

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

Implementing Agency

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

Diplomatic Representation

Diplomatic representation from High Commission and Embassies of Botswana and Sierra Leone participated in the opening ceremony of the course on 1st September 2025, 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.

Course Delivery

The second On-demand training Course employed diverse learning approaches and modules, including paper presentations through lectures, group work, discussions, learning excursions to themed field sites in Kenya, hands-on practical, 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 agriculture landscape degradation. Training-of-Trainer (ToT) module enhanced participants ability to successfully transfer appropriate technologies NRM to stakeholders and end users.

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).
- Kenya Agricultural and Livestock Research Organization (KALRO).
- Kenya Forest Service (KFS).
- Selected Model farmers from Kitui and Makueni Counties.
- Japan International Cooperation Agency (JICA).
- Participants.

Expectation by Participants

At the end of the training, participants had acquired knowledge and skills in:

- Development of effective extension and training materials for forestry and climate change programmes.
- Communication, facilitation, and presentation skills, including ethical communication practices.

- Application of training tools and participatory learning approaches, including Training of Trainers (ToT) methods.
- Climate change mitigation, adaptation, and resilience strategies relevant to forestry and landscape restoration.
- Climate-resilient forestry and agroforestry practices, including sustainable forest management.
- Tree improvement and high-quality germplasm development, including identification, collection, conservation, and propagation of superior genetic materials.
- Landscape restoration techniques, including fire management, bush encroachment control, and restoration design suited to different ecological zones.
- Use of Monitoring, Reporting, and Verification (MRV), Forest Reference Levels (FRL), and REDD + tools.
- Integration of technology and innovation for landscape monitoring and reduction of carbon footprints.
- Preparation of clear, realistic, and achievable action plans aligned with institutional and national strategies.
- Community engagement and participatory approaches for environmental governance, empowerment, and project implementation.
- Knowledge sharing and experience exchange on best practices in climate change mitigation and restoration from participating countries.
- Strengthening institutional and inter-institutional linkages at national, regional, and international levels.
- Identification of funding pathways and project financing mechanisms, including climate funds and result-based finance.

CHAPTER 2

2.0 Official Speeches

2.1 Opening Ceremony Speeches and Remarks

Speech by Mr. Gitonga Mugambi, CBS, Principal Secretary State Department for Forestry Represented by Mr. George Tarus, the Forest Development Secretary

Your Excellence, the Ambassador of Japan to Kenya, H.E. Mr. Hiroshi Matsuura, represented by Ms Kanako Sasai, First Secretary Embassy of Japan

Ambassadors and High Commissioners from Botswana and Sierra Leone

The Chief Representative, JICA Kenya Office, Mr. Makoto Shinkawa

The Director General- KEFRI, Dr. Jane W. Njuguna

The Chief Conservator of Forests, Kenya Forest Service, Mr. Alex Lemarkoko EBS, ‘Ndc’ (K), represented by Dr Thomas Kiptoo

Distinguished Guests,

Course Participants,

Ladies and Gentlemen,

Good afternoon,

It is my pleasure to join you here at KEFRI this afternoon, to officiate at the opening of this important Regional Training for African countries entitled; **‘Promoting Climate Change Resilient Forestry in Africa’**. May I take this opportunity, on behalf of the Government of Kenya, through State Department for Forestry which is under the Ministry of Environment, Climate Change and Forestry, and on my own behalf, to welcome the participants to Kenya and to this training. I am glad to note that, this training aims to build capacity of partner countries on measures to address climate change challenges as well as other pressing environmental problems facing Africa today. The training is indeed an important occasion as it offers an opportunity for natural resource managers attending this training, to discuss measures to promote resilience and jointly chart a common approach to address environmental challenges.

I also note that this training programme comes at a time when the world is urgently looking for innovative solutions to address forest and landscape degradation, biodiversity losses and environmental pollution, challenges accelerated by climate change. To effectively address these planetary tragedies, we require coordinated regional efforts and lasting global partnerships. I therefore appreciate all of you who have gathered here today, as it is a show of commitment by African governments to collectively address environmental crisis facing our continent.

Allow me to thank the Government of Japan for the over Forty (40) Year of partnership in forestry in Kenya and more importantly to KEFRI. The partnership has transformed KEFRI into a continental research hub for Africa and centre for reference globally in Dryland forestry research and capacity building.

Ladies and gentlemen, as you may be aware, climate change presents the single most significant threat to environmental sustainability, food and water security as well as human and livestock wellbeing especially in Africa. In view of these threats, it is crucial that appropriate technologies to mitigate and adapt to climate change measures be developed and shared across our boundaries. I therefore urge our research institutions to urgently come with relevant innovations that are backed by data, for wide scale adoption in Africa. I note with appreciation that this year's Tokyo International Conference of African Development (TICAD 9), which was held in Japan in August this year, has a very relevant theme; **“Co-create Innovative Solutions”**. This theme is indeed a call for us to work together as African countries and with development partners for effective development of our region.

Africa therefore needs to collectively and be actively involved in implementation of landscape restoration measures that include ambitious commitment on restoring, expanding and maintaining our forests and tree cover. For instance, Kenya has made a commitment to attain a 30% tree cover by 2032, up from the current 12.13%. This will be achieved by growing 15 billion trees to restore 10.6 million hectares of degraded forests and other landscapes. It is worth noting that other African countries have developed country specific frameworks and initiatives on landscape restoration, as well as forest and tree cover improvement, efforts which will greatly contribute to attaining climate resilience landscapes.

Allow me, to once more sincerely thank the government of Japan, for supporting this training, which will be instrumental for Africa to share information that will go a long way to address current and emerging environmental challenges.

I call upon the participants to cascade lessons learnt in Kenya to the end users in order to reduce community's vulnerability to climate change and in turn promote climate-resilient landscapes for economic, environmental and social development.

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

Thank you.

Speech by Ms. Kanako Sasai, First Secretary Embassy of Japan to Kenya

The Principal Secretary Mr. Gitonga Mugambi, CBS, State Department for Forestry

Ambassadors and High Commissioners from Botswana and Sierra Leone

The Chief Representative, JICA Kenya Office, Mr. Makoto Shinkawa

The Director General, KEFRI, Dr. Jane W. Njuguna

The Chief Conservator of Forests, KFS Mr. Alex Lemarkoko

Distinguished Guests

Course Participants

Ladies and Gentlemen,

Good afternoon,

Let me begin by expressing my sincere appreciation to the Kenya Forestry Research Institute and JICA for organizing this valuable program. I also extend my warm thanks to all the distinguished guests joining us today, and especially to the 12 participants from across Africa namely: Botswana, Eritrea, Ethiopia, Eswatini, Kenya, Lesotho, Sierra Leone, Somalia, Zambia, and Zimbabwe. Your presence reflects a strong shared commitment to building a more sustainable and climate-resilient future.

As we all know, climate change is one of the most urgent and complex challenges of our time. Its impacts such as prolonged droughts, erratic rainfall, land degradation, and biodiversity loss are already affecting communities and ecosystems throughout Africa. At the same time, forests offer powerful solutions. They absorb carbon, regulate water cycles, preserve biodiversity, and support millions of livelihoods. This training course is timely and essential. You will explore topics such as climate-resilient forestry, seedling production, forest landscape restoration, pest and disease management, and participatory forest management. But beyond technical knowledge, this course offers something equally valuable: an opportunity for mutual learning, regional collaboration, and long-lasting professional connections.

Allow me to now share a few insights from Japan's own forestry experience. After World War II, Japan suffered from severe deforestation. In response, we launched nationwide reforestation programs, established long-term forest planning systems, and promoted community-based forest management. Today, nearly two-thirds of Japan's land area is covered by forests a remarkable achievement made possible by decades of effort.

In recent years, Japan has also focused on using forests as part of our climate and economic strategies. One major policy priority is the promotion of wood use. By using sustainably harvested timber in buildings and products, we aim to store carbon, reduce fossil-based materials, and revitalize rural forestry economies. Under our national "Wood First" initiative, public buildings are encouraged to use domestic timber. We also support innovation in engineered wood products, such as cross-laminated timber, which enable to expand the wood use for various applications including large buildings.

These approaches support climate goals while also encouraging better forest management, including thinning, replanting, and pest control. Forestry in Japan is not just about conservation it is a dynamic sector supporting a circular, low-carbon society. We hope these lessons can offer useful insights as you develop your own national strategies. Through JICA's long-standing cooperation in Africa, Japan remains committed to supporting local solutions through knowledge exchange and capacity development.

To all participants, you are not only learners you are leaders.

- Please take full advantage of this opportunity.
- Ask questions.
- Share your insights.
- Learn from one another.

In closing, I would like express my deep respect for your commitment to sustainable forestry and climate action. Let us continue working together to build forests that are not only resilient, but also, source of hope, stability, and prosperity for future generations. I wish you all a very successful and enriching training course

Thank you very much.

Remarks by Rtd. Lieutenant General Peter Kakowou Lavahun Sierra Leone High Commissioner to Kenya

It is a great honour and privilege for me to join you today during the official opening of this important regional training programme. I bring you warm greetings from the Sierra Leone High Commission.

Allow me to express my sincere appreciation to the Government of Kenya KEFRI and JICA for organizing this timely and impactful training. This initiative clearly demonstrates a strong commitment to strengthening capacity across African countries in the areas of forestry, climate change, and sustainable land management.

Across Africa, our countries continue to face similar environmental challenges. These include deforestation, land degradation, loss of biodiversity, and the increasing impacts of climate change. In Sierra Leone, like in many other African countries, our forests and natural ecosystems are under significant pressure due to human activities and changing climatic conditions.

It is therefore encouraging to see such collaborative efforts that bring together participants from different countries to share experiences, exchange knowledge, and collectively identify practical solutions to these shared challenges.

This training could not have come at a better time. It provides a valuable platform for learning, reflection, and innovation. I am confident that the knowledge and skills gained here will contribute significantly to strengthening forestry practices and enhancing climate resilience in our respective countries.

To the participants, I encourage you to take full advantage of this opportunity. Engage actively, learn from the facilitators and from one another, and build strong professional networks that will continue beyond this training.

Most importantly, I urge you to translate the knowledge gained here into action when you return home. Our countries need practical solutions, and you are now part of the team that will drive this change.

As we move forward, I also encourage continued collaboration among our countries, institutions, and development partners. Strengthening partnerships will be key to addressing the complex environmental challenges we face as a region.

In conclusion, I commend the organizers once again for this excellent initiative and wish all participants a successful and enriching training.

Thank you very much.

Remarks by Mr. Ontumetse Anthony Ontumetse Representative of Botswana High Commission to Kenya

Thank you very much for the invitation and also for giving me this opportunity to address this gathering. This training programme is indeed very timely, and I have no doubt that all participants will benefit greatly from it. As you may be aware, Botswana is geographically larger than Kenya in terms of land area. However, nearly two-thirds of our country is covered by the Kalahari Desert, which continues to expand into areas where communities live. Despite this challenge, we are proud to note that approximately 30% of Botswana's land has been set aside for conservation. This is a significant achievement that reflects our commitment to environmental sustainability.

Forestry in Botswana plays a vital role, particularly in supporting the livelihoods of rural communities. However, the sector faces numerous challenges, which include land degradation, deforestation, and increasing pressure on natural resources due to population growth, agricultural expansion, and adverse climatic conditions. Like many countries represented here today, Botswana is also experiencing the impacts of climate change that include frequent droughts, rising temperatures, and wildfires which continue to put our forests and ecosystems under significant stress.

It is for this reason that this training programme is so important. I strongly believe that it will equip participants with the knowledge, skills, and practical solutions needed to address these challenges in our respective countries. The challenges highlighted reflect the real situation we are facing on the ground, particularly the ongoing threat of desertification. We sincerely hope that through initiatives such as this, we can slow and eventually reverse these trends.

With those few remarks, I would now like to express our appreciation for the leadership present today. Your presence adds great value to this occasion, and we look forward to your remarks.

I bring you warm greetings from the High Commission. When I received the invitation to attend this event, I was truly delighted, because the challenges we face in Botswana are similar to those faced across Africa. This training could not have come at a better time. It presents a valuable opportunity not only to learn new knowledge but also to reinforce what we already know and translate it into practical action.

To the participants, I encourage you to take this opportunity seriously. Learn as much as you can, and when you return home, apply the knowledge and skills gained here to improve forest management and address environmental challenges. I would like to commend the organizers for this important initiative and express my hope that such programmes will continue in the future. My office remains open for collaboration, and I will be happy to support similar initiatives moving forward.

Thank you very much.

Remarks by Mr. Makoto Shinkawa Chief Representative JICA Kenya Office

It is my great pleasure and honour to join you today at this important opening ceremony of the regional training programme. I feel privileged to say a few words on this occasion. I have had the opportunity to work in several countries, including Sierra Leone, Ethiopia, and Kenya. I spent three years in Sierra Leone and six years in Ethiopia, and I am now honoured to be part of this initiative here in Kenya. Through these experiences, I have come to appreciate the importance of such regional collaborations.

First and foremost, I would like to express my sincere gratitude to the State Department for Forestry and KEFRI for the strong collaboration and partnership we have maintained over the past 40 years. Through this long-standing cooperation, we have jointly supported the forestry sector in Kenya, and it is encouraging to see this partnership expanding into regional training programmes that bring together participants from across Africa. We are truly pleased to see such initiatives that promote the sharing of knowledge and experiences among African countries. Platforms like this are essential for learning from one another and strengthening our collective capacity.

As many of you may be aware, the recent Tokyo International Conference on African Development (TICAD) highlighted climate change as a key priority. There was strong emphasis on how Japan and African countries can work together to build resilience among vulnerable communities that are at the frontline of the global climate crisis. In this regard, I hope that this training will provide a valuable opportunity for participants to engage with these challenges, exchange ideas, and share experiences not only learning from the host country but also contributing knowledge from your own countries. I also encourage you to build strong networks with fellow participants. These connections will be important in addressing regional challenges, particularly those related to climate change and the promotion of climate-resilient forests.

To all participants, I wish you a successful and productive training. Please make the most of this three-week programme, and I hope you will also enjoy your stay here in Kenya. It may be slightly cooler here compared to your home countries, but I hope you will have a pleasant and enriching experience throughout your stay.

Thank you very much.

Remarks by Mr. Alex Lemarkoko EBS, ‘Ndc’ (K), Chief Conservator of Forests - Kenya Forest Service Represented by Dr. Thomas Kiptoo - Kenya Forest Service

Chief Guests, Principal Secretary, State Department of Forestry, Mr. Mugambi Gitonga

Japan’s Ambassador to Kenya, His Excellency Matsuura Hiroshi
JICA’s National Leadership Team,
Chief Executive Officer Colleagues,
Forestry Professionals from across Africa,
Ladies and Gentlemen,

Good afternoon,

I am immensely delighted to join you today for the opening ceremony of this distinguished forum on promoting climate change-resilient forestry in Africa. This event is generously sponsored by the people of the Republic of Japan through the Japan International Cooperation Agency.

The forestry sector in Kenya has greatly benefited from its cooperation with the people of Japan, particularly in key areas such as capacity building, technology advancement, drought-tolerant forestry, and community engagement. These interventions have had a significant positive impact on Kenya’s ability to adapt to climate change while improving community livelihoods.

This training is a continuation of a collaboration that has been built on decades of shared commitment and a common vision for a sustainable future for Kenya’s forests, trees, and the people who depend on them.

I am delighted to see this initiative continue, as it aligns perfectly with our mission to promote sustainable forest management and climate change mitigation and adaptation.

Climate change poses significant threats to our forest ecosystems, biodiversity, and livelihoods. Rising temperatures and changing rainfall patterns are altering the delicate balance of our ecosystems, making them more vulnerable to droughts, fires, and other disasters. However, with climate-resilient forestry practices, we can reduce these risks and ensure our ecosystems continue to provide vital services.

At the Kenya Forest Service, we have integrated Climate Actions into our strategic plan to align with our Nationally Determined Contributions and the National

Climate Change Action Plan. This helps us contribute to national aspirations and international commitments.

As forest professionals, we need to develop strategies to enhance the resilience of our forest ecosystems to climate change impacts. We must also promote sustainable forest management practices that maintain ecosystem integrity while providing benefits to local communities. Finally, we must equip foresters with the knowledge and skills necessary to develop and implement these climate-resilient forestry strategies.

Climate-resilient forestry is key to preserving biodiversity and other ecosystem goods and services. It improves the livelihoods of Indigenous people and local communities who depend on forests and contributes to global efforts to mitigate climate change by sequestering carbon dioxide.

I encourage you to engage actively, share your experiences, and learn from each other throughout this training. Let's work together to build resilient forest ecosystems that support Africa's development agenda and well-being.

Thank you very much

Remarks by Dr Jane W. Njuguna, Director General Kenya Forestry Research Institute

The Principal Secretary, State Department for Forestry Mr. Gitonga Mugambi, CBS

The First Secretary Embassy of Japan in Kenya, Ms. Kanako Sasai

Ambassadors and High Commissioners from Botswana and Sierra Leone

The Chief Representative, JICA Kenya Office, Mr. Makoto Shinkawa

The Chief Conservator of Forests, Kenya Forest Service, Mr. Alex Lemarkoko EBS,

‘Ndc’ (K), Represented by Dr. Thomas Kiptoo

Course Participants

KEFRI Staff

Distinguished Guests

Ladies and Gentlemen,

Good afternoon

It is my honour to welcome you all to Kenya Forestry Research Institute (KEFRI) and to this ceremony as we officially mark the start of the second on-demand regional training course on **Promoting Climate Change Resilient Forestry in Africa**. The training is a 3-week programme jointly supported by Government of Kenya through KEFRI, and Government of Japan through JICA.

May I call upon the course participants, officials from Ministry of Environment, Climate Change and Forestry (MECCF)/ State Department for Forestry, SFS-CORECC Project JICA team, our guests, and senior KEFRI Management to introduce themselves.

I once again welcome you all and extend a warm welcome to the Officials from the Embassy of Japan, Ambassadors and High Commissioners from Botswana and Sierra Leone, JICA Kenya Office, participants and all our guests. As we launch this training, your presence here affirms the importance of collaboration and knowledge exchange across the continent and with partners.

About the training

- This training has attracted participants from 10 Africa countries namely; **Botswana, Ethiopia, Eritrea, Kingdom of Eswatini, Lesotho, Kenya, Sierra Leone, Somaliland, Zambia and Zimbabwe** to whom I say, *karibuni sana* (you are most welcome). Your presence today is a powerful reminder of our collective responsibility to safeguard our forests and allied natural resources and, is also a show of commitment by African governments to jointly address common environmental challenges.

- The aim of the training is to enhance capacity of participants on; climate change mitigation and adaptation measures, landscape restoration approaches, forestry development technologies and information dissemination skills. The training will lay great emphasis on tree seed science and tree improvement, as these are central to successful forestry and landscape restoration.
- The course has been designed to be highly interactive and practical, therefore over the next three weeks, the participants will engage in learning from KEFRI research output, as well as exchange knowledge and experiences with each other to strengthen our collective ability to safeguard Africa's forests.
- By the end of this training, it is our expectation that the participants will be better equipped to design and implement solutions that make a real difference in their respective countries and institutions to address current and emerging environmental challenges. I also hope the participants will learn beyond what is outlined in the training programme. I have in mind technologies such as JAZAMITI, a transformative application that gives real-time tree planted in the country towards our ambitious initiative of attaining a 30% tree cover by 2032 up from the current 12.13%. This innovation is a practical example of how research and technology can support climate change resilience systems.
- KEFRI is committed to being a regional leader and hub for forestry knowledge. We hope that the participants will take full advantage of the expertise available here and KEFRI and from our partners. I challenge you to engage in in-depth discussions. Challenge us as well, as this will contribute to our continued improvement (in Japanese KAIZEN)

Appreciation

- May I take this opportunity to thank the Ministry of Environment, Climate Change and Forestry through the State Department for Forestry for continued support, strategic guidance and to this training
- I sincerely thank the JICA for their support in capacity building and regional knowledge exchange as well to our journey towards IUFRO World Congress 2029. KEFRI and JICA have collaborated in promoting research in forestry for the last 40 years and JICA's unwavering and technical support has remained steadfast, for which we are very grateful
- I also appreciate the Embassy of Japan in Kenya who continues to recognize our efforts in forestry research and development
- I acknowledge the contributions of the Kenya Forest Service (KFS) and other government agencies in Kenya that are working closely with us to ensure success of this training
- I thank the diplomats from participating countries for gracing this occasion, a gesture that gives great moral support to the participants

- To the participants thank you for taking the time off to be here, and for the trust you and your institutions have in KEFRI
- Allow me to also acknowledge the KEFRI team that has worked tirelessly behind the scenes to ensure that this training will be conducted as planned.

Conclusion

Ladies and gentlemen, the journey to resilient forests and a sustainable future is a long one, but it is a journey we are on together. By strengthening regional ties and learning from each other, we accelerate our progress. Let this training course energize and equip us for the important work ahead.

With these remarks, I wish you a fruitful and engaging training experience. Enjoy your stay here at KEFRI and in Kenya.

Thank you.

Pictorial Opening Ceremony



Figure 2.1: Guest of honour during official opening ceremony



Figure 2.2: Dr. Jane W. Njuguna, Director General KEFRI making welcoming remarks



Figure 2.3: Ms. Kanako Sasai, First Secretary Japan Embassy to Kenya making opening remarks



Figure 2.4: Mr. Makoto Shinkawa, Chief Representative JICA delivering the opening remarks



Figure 2.5: Mr. George Tarus, Forest Development Secretary delivering PS remarks



Figure 2.6: Mr. Entumetse Anthony Entumetse, Representative of Botswana High Commission to Kenya making remarks



Figure 2.7: Rtd. Lieutenant General Peter Kakowou Lavahun, Siera Leon High Commissioner to Kenya making his remarks



Figure 2.8: Forest Development Secretary planting a tree during the opening ceremony during tree planting



Figure 2.9: Rtd Lieutenant General Peter Kakowou Lavahun Siera Leon High Commissioner to Kenya (left), Japan Embassy to Kenya Ms. Sasai (Middle), Mr. Entumetse Anthony Entumetse Representative of Botswana High Commission to Kenya (right) and the KEFRI DG Dr. Jane W. Junguna (far right) during tree planting



Figure 2.10: Course participants planting a tree

2.2 Official Closing Ceremony Speeches and Remarks

Speech by Mr. Gitonga Mugambi, CBS, Principal Secretary, State Department for Forestry Represented by Dr. Jesse Owino, Director of Agroforestry MECCF

The JICA Kenya Office team,
Distinguished Guests
Course Participants
KEFRI Staff
Ladies and Gentlemen,

Good afternoon,

It is with much delight that I join you here at KEFRI this afternoon to officiate at this important event, an occasion that marks the 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 12 participants, drawn from 10 African countries, namely Botswana, Eritrea, Ethiopia, Kingdom of Eswatini, Kenya, Lesotho, Sierra Leone, Somaliland, Zambia and Zimbabwe for having effectively undertaken and successfully completed the training.

Ladies and Gentlemen, I note that during this training, participants were expected to gain knowledge, understanding and skills for implementing Climate Change mitigation and adaptation measures, landscape restoration approaches, forestry development practices and technology transfer. I am happy to learn that these objectives have been fully met through: interactive presentations and in-depth discussions facilitated by a wide range of our experts from Kenya Forestry Research Institute (KEFRI), partners institutions, as well as key progressive farmers and Community Forest Associations.

I also note with much appreciation that during the training, issues on quality tree seed and tree improvement were given great prominence, as these are the cornerstones to resilient forestry and agricultural landscapes in a changing climate.

As we all know, currently the most pressing environmental crisis are brought about by climate change, biodiversity loss and landscape degradation. These challenges present a real predicament that is interfering with human health, food security and livelihoods.

Therefore, to collectively address these challenges, we should lay great emphasis on impactful, effective and sustainable collective actions that can be achieved by scaling up appropriate technologies that can quickly address current and emerging environmental challenges. Adoption of such a strategy is indeed in tandem with objectives of The Second African Climate Change Summit (ACS2) a conference held in Addis Ababa from 8-10 September this year. The Summit highlighted proven Africa-led climate solutions and the continent's bold efforts to re-green its landscapes laying the groundwork to effectively address the impacts of climate change and greener development. The summit

also offered a vital opportunity to redefine Africa's aspirations for a climate-resilient future. The Leaders Declaration called for "strengthened and sustained support to scale up the implementation of African-led climate initiatives such as the African Union Great Green Wall Initiative, the African Forest Landscape Restoration Initiative, and the Ethiopian Green Legacy Initiative. I therefore urge all participants to bring to visibility in your countries what you have learnt here in Kenya so that we all contribute to the aspirations of our continent.

Ladies and Gentlemen, the clarion call is that we must also move urgently to build the capacity of our communities to cope with negative effects of climate change through promotion of mitigation and adaptation strategies. Some of the immediate actions we need to take include; empowering communities to have alternative livelihood options to avoid over-reliance on natural resources, mainly forests and woodlands. However, we must also keep in mind that in Africa, trees and forests will always form an integral part of livelihood support system for a large percentage of our population for wood, food and fodder needs. There is therefore need to empower our communities to grow their own trees for domestic use and economic benefits and promote biodiversity conservation.

To ensure success in environmental sustainability across our borders, I urge you to develop networks among yourselves that will enable you to continuously share new information, best practices and data on climate change actions.

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 forestry research and development as well as for this training. I note with appreciation that such training programmes continue to build the capacity of African countries to timely respond to various emerging environmental challenges.

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 Africa today. It is therefore 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 and improve their resilience to climate change.

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

Thank you

Remarks by Mr. Fumihiko Suzuki, Senior Representative, JICA Kenya Office

It is my great pleasure to address you at the conclusion of this important training programme.

Over the past three weeks, participants have undergone an intensive and comprehensive learning experience. I am pleased to note that the training has successfully equipped you with both technological knowledge and practical skills that are essential for advancing sustainable forestry and climate resilience.

In particular, the course has covered key areas such as high-quality tree germplasm development, tree improvement, and the application of climate-smart forestry and agricultural technologies. These areas are critical in addressing the growing challenges posed by climate change, land degradation, and increasing demand for forest resources. I am confident that the knowledge and skills you have gained during this training will not only enhance your individual capacities but will also contribute significantly to strengthening forestry practices and environmental management in your respective countries.

I encourage all participants to apply what you have learned, share this knowledge with your colleagues, and continue building strong networks across the region. Collaboration and knowledge exchange remain vital in tackling the complex challenges facing our ecosystems today.

On behalf of JICA - Kenya, I would like to express our sincere appreciation to KEFRI, the Government of Kenya, and all partners who contributed to the successful implementation of this programme.

We remain committed to supporting such initiatives that promote capacity building, innovation, and sustainable development across Africa.

I wish you all the best as you return to your respective countries, and I look forward to continued collaboration in the future.

Thank you very much.

Remarks by Dr. MTE Mbuvi, KEFRI Senior Deputy Director Research and Development

It is my pleasure to be here today as we mark the end of this training. The training has primarily focused on identifying key priority areas related to forestry and climate change. I am pleased to note that this training has successfully brought together participants from various institutions within Africa including Botswana, Ethiopia, Eritrea, Kingdom of Eswatini, Lesotho, Sierra Leone, Somaliland, Zambia and Zimbabwe. This multi-institutional approach is critical in addressing the complex challenges facing the forestry sector today.

Capacity-building initiatives such as this training play a vital role in strengthening the link between policy, administration, and implementation within the forestry sector. They provide an opportunity to align strategies, share knowledge, and enhance institutional coordination.

I would like to emphasize the importance of sustained collaboration, not only within our country but also with neighboring countries and development partners. Strengthening networks and formalizing partnerships through instruments such as MoUs will be essential in the natural resource management, particularly in advancing areas such as *Melia volkensii* and bamboo species development.

In this regard, I would like to highlight *Melia volkensii* as a promising wood species with great potential as a plantation crop, with maturity period of 15 years. Its adoption and promotion could significantly contribute to sustainable forestry and economic development.

Finally, I wish to express my sincere appreciation to all partners for their support in the planning, organization, and successful implementation of this training programme.

Thank you very much.

Remarks by Course Participants

Gofaone Rammotokara

Botswana University of Agriculture and Natural Resources, Botswana

Ms. Rammotokara appreciated learning about diverse approaches to tree breeding across different species. She also gained insights into the causes and effects of climate change and emphasized the importance of integrating this knowledge into land restoration strategies.

Nezehty Abbay Asmerom

National Agricultural Research Institute

Ministry of Agriculture Forestry and Wildlife Research, Eretria

Ms. Abbay highlighted key lessons on forest restoration, rehabilitation of dryland ecosystems, wood and non-wood forest product development and commercialization particularly the use of biofuels from non-woody products, application of smart technologies, and the role of carbon credit systems in the forestry sector.

Miheret Semere Negash

Central Ethiopia Forestry Development Centre (CEFDC), Ethiopia

Ms. Meheret highlighted her learning on tree improvement through breeding and propagation, as well as practical experiences from field visits to farmers in arid and semi-arid areas. She also commended the facilitators for delivering high-quality training and KEFRI staff for their hospitality

Mbalenhle Primrose Baxter

Department of Forestry, Ministry of Tourism and Environmental Affairs, Kingdom of Eswatini

Ms. Primrose reported gaining knowledge on improved natural pasture with several species for sustainable livelihood for the drylands. In addition, she learnt about *Melia* propagation and the conservation of indigenous tree species such as *Vachelia tortilis*.

Elizabeth Kariuki

Kenya Forest Service, Kenya

Ms. Elizabeth described the training as highly relevant and an eye-opener, particularly on diversified forestry technologies. She emphasized the importance of extending forestry technologies into arid and semi-arid areas. She also highlighted importance for adoption of forestry technologies such as *Melia volkensii* and bamboo growing. She noted that interactions with participants from different countries enriched her understanding of climate change resilience.

Peninah Ngugi

Kenya Forestry Research Institute, Kenya

Ms. Peninah noted that she gained valuable knowledge in Participatory Forest Management (PFM) and conservation. She also learned about wood and non-wood forest product development and commercialization particularly biofuel production from agricultural residues such as sugarcane, as well as resource mobilization and the importance of capacity-building programmes.

Wato Gregory Godana**Ministry of Environment, Climate Change and Forestry (MECCF), Kenya**

Mr. Wato noted that the training enhanced his understanding of climate change, particularly carbon credits dynamics. He emphasized the importance of developing context-specific solutions and applying the knowledge gained to address climate challenges effectively.

Alex Saffa Vandi**Ministry of the Environment and Climate Change (MoECC), Sierra Leone**

Mr. Saffa noted valuable lessons in laboratory operations, farmer field visits, land restoration/rehabilitation practices through afforestation, bamboo production, and the maintenance of indigenous species.

Rethabile Mathola**Lesotho Agricultural College, Lesotho**

Mr. Mathola indicated that the training enhanced his experience in forestry and exposed him to new techniques and technologies, particularly in grass species propagation. He also gained insights into resource mobilization, proposal development and project planning and management for forestry management and learned about innovative practices such as climate change and carbon credit business.

Abdikani Yusuf Abdi**Somaliland Agriculture Society (SAS), Somaliland**

Mr. Yusuf highlighted that the training enhanced his understanding of climate change resilience in Africa. He appreciated the knowledge-sharing sessions and noted that he would advise his government on appropriate land reclamation and climate adaptation measures.

Jones Ngoza Hachilensa**Forestry Department****Ministry of Green Economy and Environment, Zambia**

Mr. Ngoza expressed his appreciation for the high-quality training and the expertise of the facilitators. He highlighted key areas of learning, including farming technologies in arid and semi-arid regions, Melia propagation, and overall course implementation. He added that he would share the knowledge gained with government officials and fellow scientists in Zambia to enhance forestry practices.

Tendai Mudzinganyama**Forest Commission of Zimbabwe**

Ms. Tendai highlighted that capacity building remains a cornerstone for strengthening climate-resilient forestry and sustainable land management in Zimbabwe and Africa at large. She noted that the training had been highly beneficial, enhancing participants' knowledge and skills in forest management, degraded landscape restoration, and responding to climate change risks. She emphasized the importance of such training in strengthening capacity and promoting sustainable forestry and land management practices.

Pictorial of Closing Ceremony



Figure 2.11: Dr. James Ndufa, DD FBCCCEM making welcoming remarks



Figure 2.12: Mr. Fumihiko Suzuki, Senior Representative JICA Kenya Office giving closing remarks



Figure 2.13: Dr. M.T.E Mbuvi, Senior Deputy Director R&D KEFRI making closing remarks



Figure 2.14: Ms. Tae Ose, Project Formulation Advisor JICA Kenya office making closing remarks



Figure 2.15: Dr. Jesse Owino, Director Agroforestry MECCF delivering closing speech on behalf of the PS



Figure 2.16: Ms. Naoko Ide, Expert on Regional Cooperation / Project Coordinator making closing remarks



Figure 2.17: Course participants during closing ceremony



Figure 2.18: Course participant making remarks



(a)



(b)

Figure 2.19 (a & b): Participants receiving course Certificates



Figure 2.20: Participants displaying their course certificates



Figure 2.21: Happy moments after completion of the training course

CHAPTER 3

3.0 Course Evaluation

3.1 Introduction

This section presents the analysis of feedback from participants on their overall perception of the on-demand training implementation. Course evaluation is a critical component of any training program, providing valuable insights into the effectiveness of the curriculum, facilitation methods, and overall learning experience. This evaluation of the second on-demand Training on Promoting Climate Change Resilient Forestry in Africa assessed six (6) key area that namely; Course objectives, Course relevance, Course curriculum, administration and management, plans after the course and recommendations. The participants were expected to respond by rating through ticking against their perceived appropriate choice, where; 1=Very low, 2=Low, 3=Moderate, 4=High, 5= Very High, or giving suggestions.

3.2 Analysis of Evaluation Feedback

Course Objective Awareness

Pre-training awareness of the course objectives was largely rated as very high (33.3%), followed by high (33.3%), while a significant proportion (25%) indicated moderate awareness, and a smaller percentage rated low awareness (8.4%), suggesting generally adequate preparedness among participants, albeit with some gaps in pre-training communication. These results indicate that there was generally adequate preparedness among participants, although some gaps in pre-training communication existed. In future, the course invitations should be sent early enough to enable participants to adequately prepare for administrative and logistics associated with international travel.

Further, with regard to the achievement of course objectives, responses were predominantly very high (50.0%) and high (41.7%), with only (8.3%) indicating moderate, demonstrating that the training successfully met its intended goals. This high rating suggests that the course content, delivery, and structure were well aligned with its goals. It implies that participants were able to gain the expected knowledge and skills, and that the training was relevant to their needs.

On the other hand, participants' expectations were fully realized, as reflected by very high rating at (50.0%) and high at (50.0%), indicating strong satisfaction and alignment between the training delivery and participant expectations. The training met participants' expectations, addressed key knowledge and skill gaps, and was applicable to their respective countries (Table 3.1).

Table 3.1 Course objectives

Table 1: Course Objectives		Rating (100%)					
No.	Question	1	2	3	4	5	Remarks
1.	To what extent were you aware of the objectives of this training course before you came to Kenya	0	8.4	25.0	33.3	33.3	100%
2.	To what extent do you think the objectives have been met?	0	0	8.3	41.7	50	100%
3.	In your opinion, to what extent were your expectations from this course met?	0	0	0	50	50	100%

Course Relevance

A total of 75% of the participants rated the training relevance as very high and applicable to their respective institutions while 25% stated that the course relevance was high (Table 3.2). Similarly, the course was perceived to strongly support professional development, with participants rating it high at (25%) and very high as (75%) indicating that it enhanced participants' skills and competencies. Further, participants stated that they intent to explore the new technologies such as Aflasafe production (KALRO) and M-star technology for long rooted seedlings (KEFRI) in their respective countries.

Participants appreciated the climate change resilience approaches, well-structured course content, expertise of facilitators, interactive learning sessions, and field experiences. Additionally, the warm hospitality and coordination by KEFRI staff and the development of practical action plans further enhanced the overall training experience (Table 3.2).

Table 3.2: Course relevance

Items		Rating (100%)					
No.	Course Relevance	1	2	3	4	5	Total rating
4.	Is the course relevant to your institution?	0	0	0	25	75	100
5.	Will the course help you develop professionally?	0	0	0	25	75	100

6	What did you like most about this course (Generally)? 1. Climate Change Resilience Approaches 2. Structured course content 3. Expertise of resource persons 4. Interactive sessions 5. Field experience 6. Warm hospitality by coordinators and KEFRI house staff 7. Development of action plans
---	---

These results indicate that the training was highly relevant and effective, with strong alignment to participants' institutional and professional needs. This suggests that the current training model should be maintained and scaled up in future programmes.

Course Curriculum

The coverage of topics was rated as very high (50%) and high (50%), demonstrating that the training content was comprehensive and adequately addressed the intended subject areas. Similarly, the allocation of time across lectures, field visits, and discussions was largely rated very high, reflecting a well-balanced integration of theoretical and practical components. Group work also received positive ratings, although with slight variation, suggesting minor scope for improvement in its organization or time allocation. The results indicate that the course curriculum was well-designed and effectively delivered (Table 3.3)

The overall course intensity was considered appropriate, with all participants rating it as high at 41.7% and very high at 58.3% indicating that the course was too intense suggesting that the training was rather packed and that they had left little time for content interrogation, reflection on key lessons, or engaging in intense discussions with facilitators and peers.

The quality of training materials was rated highly, with 66.7% indicating as very high and 33.3% as high. Though participants were adequately supported throughout the training, there is need to improve and provide more quality materials.

Regarding the total course duration, 50% rating it as moderate, 41.7% as high, and 8.3% as very high, suggesting that the duration was generally acceptable.

Table 3.3: Course curriculum

Course Curriculum		Rating (100%)					
No.	Variables	1	2	3	4	5	Total rating (3-5)
7.	Coverage of the topics	0	0	0	50	50	100
8.	Time allocation to						
	a) Lecture/ Presentation	0	0	25.0	16.7	58.3	100
	b) Group work	0	8.3	8.3	41.7	41.7	100
	c) Field visits	0	0	0	58.3	41.7	100
	d) Discussions	0	0	0	58.3	41.7	100
9.	Course Intensity	0	0	0	41.7	58.3	100
10.	Quality of training materials provided/ acquired	0	0	0	33.3	66.7	100
11.	Total course duration	0	0	50.0	41.7	8.3	100

A practical way to improve future trainings would be to make slight adjustments to the course duration by allocation more time particularly for group work. While the overall structure was effective, extending the duration slightly or redistributing time could allow participants to engage more deeply with key topics. In addition, enhancing the organization of group work to make it more structured, interactive, and outcome-oriented would improve participant engagement and learning. At the same time, it is important to maintain the strong balance between lectures, field visits, and discussions, as well as the provision of high-quality training materials, since these were key strengths of the programme.

Additionally, the most beneficial field visits were demonstration on improved natural pasture growing for sustainable livelihood in drylands by Mr. Ngaya (22.6%), Commercial forestry development in the drylands by Mr. Kituku (25.8%), Wood and Non-Wood Forest Product development and commercialization by KEFRI Karura (12.9%), KEFRI DERP (16.1%), and KALRO Katumani (12.9%; Table 3.4).

Table 3.4: Most interesting and beneficial field visits in the training programme

Field visit sites	Frequency (n)	Frequency (%)
Mr. Kituku's farm	8	25.8
Mr. Ngaya's farm	7	22.6
KEFRI-DERP	5	16.1
KEFRI Karura	4	12.9
KALRO- Katumani	4	12.9
Kereita (KENVO)	1	3.2
Nguriunditu Valley	1	3.2
KEFRI Kibwezi	1	3.2

Future trainings should prioritize field visits that are practical, livelihood improvement-oriented, and focused on dryland forestry, particularly those demonstrating on areas like value addition, commercial forestry and sustainable pasture management. Greater emphasis should also be placed on hands-on and income-generating approaches, as these were most valued by participants. Additionally, participatory forest management sessions can be strengthened through more practical demonstrations or case-based learning to enhance their relevance and impact.

Most Interesting and Beneficial Topics

The most beneficial and interesting topics as listed by the participants included; climate change adaptation and resilience, landscape restoration, indigenous tree improvement, tree seed handling, dryland forestry, partnerships and resource mobilization, action plans, carbon financing, forest health, participatory Forest Management, wood and non-wood processing, long rooted technique and entomology (Table 3.5). Key topics such as climate change adaptation, tree seed handling, and landscape restoration should be further strengthened, while successful approaches including expert facilitation, interactive sessions, and field-based learning should be sustained. The findings provide a strong basis for improving and expanding future trainings, with greater emphasis on practical, action-oriented learning and continued collaboration.

Table 3.5 interesting and beneficial topics

No.	Most interesting and beneficial topics to you in the training programme	Frequency (n)	Frequency (%)
1.	Tree seed handling	7	16.7
2.	Landscape restoration	5	11.9

No.	Most interesting and beneficial topics to you in the training programme	Frequency (n)	Frequency (%)
3.	Carbon financing	5	11.9
4.	Climate change adaptation and resilience	4	9.5
5.	Indigenous tree improvement	4	9.5
6.	Dryland forestry	3	7.1
7.	Partnerships and resource mobilization	3	7.1
8.	Participatory Forest Management	1	7.1
9.	Action plans	2	4.8
10.	Wood and non-wood processing	3	4.8
11.	Entomology	1	4.8
12.	Long rooted Technique	2	2.4

Course Applicability

The participants appreciated the knowledge and skills gained during the training. Notably, 83.3% indicated that the content was largely applicable to their institutional contexts, with particular relevance to dryland forestry, where they intend to apply the insights and techniques gained. A total of 16.7% of the participants stated that they will apply knowledge gained in development of forestry and allied natural resources in their designated areas of practice (Figure 3.1).

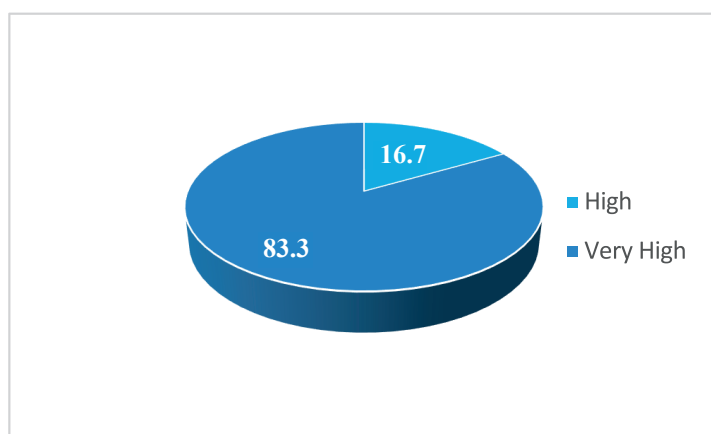


Figure 3.1: Course applicability

Administration and Management

The results indicated that the overall administration and management of the course was highly effective and well received by participants.

Pre-course information, including briefing, orientation, and communication, was generally rated positively, with 58.3% indicating very high and 16.7% as high, while 25.0% rated it as moderate (Table 3.6). This suggests that although most participants were well informed prior to the training, there is still a need to strengthen pre-course communication to ensure all participants are adequately prepared.

Regarding the preparation period after receiving the invitation, preferences varied. While 33.3% of participants were comfortable with a 7 - day preparation period, a larger proportion 66.7% preferred a longer lead time ranging from 14 to 30 days. This indicates the need to send the course invitations earlier to accommodate diverse logistical arrangements.

The general coordination and organization of the course was rated very positively, with 58.3% indicating very high and 41.7% high, demonstrating that the programme was well managed and efficiently executed.

Similarly, the selection of organizations and farmers visited during field visits was highly appreciated, with 75.0% rating it high and 16.7% very high, confirming that the field components were relevant, practical, and aligned with participant expectations.

Accommodation during field visits was also rated favorably, with 83.3% indicating high satisfaction, 8.3% very high and moderate as 8.4%, reflecting effective logistical arrangements with minimal concerns.

Communication among participants was generally strong, with 66.7% rating it as high, 16.7% as very high and 16.6% as moderate. However, the remaining proportion suggests there is still room to further enhance interaction and networking among participants (Table 3.6).

The findings demonstrate that the administration and management of the course were of a high standard, with strong performance across most aspects. Minor improvements are needed in pre-course communication, advance notice for preparation, and strengthening participant interaction to further enhance future training programmes.

Table 3.6: Administration and Management

	Rating (100%)					Total rating 3-5
	0	0	25.0	16.7	58.3	
Pre-course information (general information, briefing orientation and communication)						100

	Rating (100%)					Total rating 3-5
General coordination of the course (course organization)	0	0	0	41.7	58.3	100
Selected organizations and farmers visited during field visits	0	0	8.3	75.0	16.7	100
Accommodation during field visits	0	0	8.4	83.3	8.3	100
Communication among participants	0	0	16.6	66.7	16.7	100
Medical attention	0	0	0	50.0	50.0	100

Plans After Course

Table 3.7 highlights the key technologies and approaches that participants intend to adopt and implement in their respective countries after the training. This reflects the practical relevance and anticipated impact of the programme on forestry development and climate change resilience.

Table 3.7: Plans after course

Technology	Frequency (n)	Frequency (%)
Wood and non-wood processing	4	13.8
Long rooted seedlings technology	4	13.8
Climate change resilience	3	10.3
Participatory Forest Management approaches	3	10.3
Landscape rehabilitation	3	10.3
Biomass fuel	2	6.9
Communication skills	2	6.9
<i>Melia volkensii</i> propagation	2	6.9
Carbon credits	1	3.4
Seed selection	1	3.4

Technology	Frequency (n)	Frequency (%)
Commercialization of forest products	1	3.4
Pasture growing	1	3.4
Agroforestry	1	3.4
Aflasafe seed treatment	1	3.4

Suggested Additional Topics for Future Training

Participants recommended the inclusion of several additional topics to further strengthen the scope and impact of future training programmes. These include:

- GIS and Remote Sensing, to enhance spatial analysis and monitoring of forest resources.
- REDD+ (Reducing Emissions from Deforestation and Forest Degradation), to support climate change mitigation initiatives.
- Data Analysis, to improve evidence-based decision-making and research capacity.
- Proposal Writing, to strengthen resource mobilization and project development skills.
- Soil Testing, to support informed land management and productivity enhancement.
- Forestry Pests and Diseases, to improve forest health management and resilience
NB: thought his topic was covered in the course, this indicates that it should give more time to allow for practical and field visits on tree health.

New Technologies / Skills Learnt During the Training (general)

Participants reported gaining a wide range of new knowledge and insights during the training. Key areas of learning included:

- Commercialization of wood and non-wood forest products.
- Resource mobilization strategies.
- Development of practical action plans.
- M-Star technology.
- Carbon financing mechanisms.
- Bamboo propagation techniques.
- Seed testing methods.
- Importance of forestry research institutions.
- Aflasafe seed treatment.
- Management of invasive species.

Additional Comments

Participants provided valuable feedback and reflections aimed at improving future training programmes. Their remarks highlight both strengths of the course and areas of adjustments to enhance effectiveness, particularly in relation to time allocation, practical exposure, participant engagement, and overall learning experience.

- The training topics need more time than the one allocated in the programme.
- There is need for more hands-on practical's and more field exposure.
- Involve participating countries in forestry initiatives to encourage collaboration.
- KEFRI is leading in forestry research.
- JICA to communicate per diem rates in the course brief.
- Have breaks in between sessions.
- Create more time for recreation.
- It was a great capacity building and networking forum.
- The course was facilitated by experienced resource persons.

3.3 Potential of On-demand Third Country Training Programmes

From the experience of the first and second on-demand training courses, it was noted that demand-driven training is still highly relevant and valid for promoting the regional cooperation. Training Needs Assessment (TNA), which was conducted to understand the training needs of participating countries prior to formulating the training programmes, greatly contributed to the course relevance. Having received the high rating from the training participants in 'course relevance', this course report concluded that 'the current training model should be maintained and scaled up in future programmes.'

Based on this good practice, KEFRI decided to further promote regional cooperation activities through JICA's Third Country Training Program (TCTP) from 2026 to 2030. The KEFRI training team will be able to formulate improved training programmes making use of the lessons learned from the two pilot activities of on-demand third country training during SFS-CORECC.

Before commencing the TCTP courses, demands of participating countries/institutions would be clarified, and MoU is to be signed at the end of SFS-CORECC. This TCTP can be more demand-driven than the conventional ones. The new programme is not just conveying knowledge to the participants but is more of mutual learning or 'knowledge co-creation' among participating countries including Kenya.

CHAPTER 4

4.0 Field Visits Report

4.1 Introduction

Field visits are essential component of the training programme. The visits are designed to augment theoretical knowledge covered during lectures sessions. The field visits undertaken during the second on-demand training aimed at enhancing participants understanding of climate change resilient forestry in Africa, through observation 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; KEFRI Dryland Eco-region Research Programme (DERP) - Kitui and Tiva in Kitui County; Kenya Agricultural and Livestock Research Organisation (KALRO)- Agricultural Mechanisation Research Institute (AMRI)-Katumani in Machakos County as well as a in selected farmers' fields. During the visits, the participants were exposed to various natural resource management technologies, techniques, practices and demonstrations being both at research stations and on-farms sites visited.

4.2 Sites Visited

KEFRI Central Highlands Eco-Region Research Programme - Muguga

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

Kereita Forest

- 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.
- Demonstration of long-rooted seedlings.
- Indigenous tree improvement and breeding: The case of *Melia volkensii* and *Acacia tortilis* at KEFRI Tiva.

ii. On-farm

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

Kenya Agricultural and Livestock Research Organisation (KALRO) - Agricultural Mechanisation Research Institute (AMRI) - Katumani

Dryland agriculture for community and climate resilience: Demonstration of dryland agriculture for community and climate resilience.

- Soil and Water conservation, soil fertility.
- Climate smart agricultural technologies.
- Climate change Adaptation.
- Drought tolerant crop seeds.
- Agricultural Mechanization.
- Horticulture Nursery.

4.2.1 KEFRI Central Highlands Eco-Region Research Programme - Muguga

Visit 1: Rehabilitation of Nguriunditu Valley Forest

Introduction

Nguriunditu valley is a semi-natural forest of mixed indigenous species located in Kiambu County. The land in Nguriunditu Valley was once degraded with only grass patches with no trees, prompting KEFRI to initiate a rehabilitation project in 1989. Through concerted efforts of the adjacent communities including schools the forest was rehabilitated through indigenous tree planting. The main tree species planted included; *Prunus africana*, *Oleas capensis*, *Vitex keniensis*, *Podocarpus malungitis*, *Markhamia lutea*, *Albizia gummifera*, *Polysius kikuyuensis*, *Warburgia ugandensis* (Muthiga), *Juniperus procera*, *Pittosporum viridiflorum* (Munyamati), *Brachylaena huillensis*, and *Teclea simplicifolia*. These were among 46 species that survived out of the 56 tree species that were used for restoration. The trees were planted at a spacing of 2.5 m by 2.5 m in 7 plots. The aim of rehabilitation was to restore the forest to a close as possible to the original structure including species composition. It was expected that the restored forest would result to increased level of portable water supply from the borehole that was dug in the valley. The forest would also be a source of other services such as forest research, biodiversity and eco-tourism activities. Currently, the forest has the structure of a mature natural forest with an upper storey, middle storey and undergrowth of grass and shrubs. The increase in biodiversity has significantly increased the value of the forest.

Objectives

The objectives of the visit were to learn about:

- Rehabilitation methods, techniques and their impacts on rehabilitation efforts.
- The indigenous and climate-resilient tree species suitable for rehabilitation and restoration activities within Nguriunditu valley.
- The practical knowledge and techniques of site preparation, planting protocols, and post-planting care techniques.
- The impact of rehabilitation on biodiversity conservation and ecosystem rehabilitation.
- Reflect on long-term sustainability strategies for restored landscapes.

Activities

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

Lessons Learnt

- Restoration initiatives demonstrated that well-planned re-forestation not only increases tree cover but also enhances habitat diversity, soil stability, and overall ecosystem functionality.
- Matching indigenous and climate-resilient species to site conditions significantly improves survival rates and ensures long-term ecological compatibility.
- Meaningful involvement of local communities throughout project planning, implementation, and monitoring builds trust and long-term commitment to restoration goals.
- When communities are granted ownership or co-management rights, they develop a strong sense of responsibility for forest conservation and are more likely to safeguard resources against degradation.
- Households and groups are more interested in conservation efforts when they perceive direct, livelihood-related benefits.
- Integrating diverse community groups particularly women, youth, and marginalized members broaden participation and fosters equity.
- Understanding Ecosystem Dynamics - understanding how degraded landscapes affect biodiversity, water cycles and soil health and how re-forestation reverses these impacts.
- Species-to-Site Matching: Learnt how to select indigenous and climate-resilient tree species suited to specific ecological zones.
- While ecotourism can provide valuable income and incentives for conservation, it may also create conflicts with local land-use priorities if not properly planned and negotiated with communities.



Figure 4.1: Participants in Nguriunditu Valley with the facilitator doing introduction



Figure 4.2: Participants Group Photo in Nguriunditu Valley



Figure 4.3: Mature forest structure of Nguriunditu Forest showing upper and middle storey

Challenges

The following challenges and constraints were noted;

- Human activity interference, including waste disposal in the forest.
- Potential impacts of non-native species, such as eucalyptus.
- Uneven benefit distribution.
- Some groups feel excluded from decision-making and resource access.
- Limited financial and technical capacity.
- Lack of tools, training, and funds for effective implementation of restoration initiatives.
- Joint patrols are not always consistent or well-documented.
- Climate change impact.

Impacts Impact

The impacts of the Nguriunditu valley forest are ecological, economic and social as outlined:

a) Ecological Impacts

- Increased tree cover.
- Water catchment protection.
- Biodiversity conservation.
- Ecosystem rehabilitation.
- Increased carbon sink.

b) Economic Impacts

- Income from, seeds and seedling sales.

c) Social Impacts

- Strengthened community cohesion, youth engagement, and gender inclusion.
- Collective action in restoration strengthens community bonds and promotes peaceful collaboration.
- Restoration activities often prioritize women's involvement, promoting equity and leadership in environmental governance.

Technique

The technique identified is tree planting.

Definition

Tree planting is a technique used to establish new trees in an area, either by planting seedlings or seeds. This method aims to promote ecosystem rehabilitation, enhance biodiversity, and provide various ecological and economic benefits.

Purpose

The primary purpose of tree planting is to:

- Restore the degraded valley and promote ecosystem rehabilitation.
- Enhance biodiversity conservation.
- Improve soil health and structure.
- Mitigate climate change through carbon sequestration.

Advantages and Disadvantages of the Technique

Advantages	Disadvantages
• Promotes ecosystem rehabilitation: Tree planting can restore degraded lands and promote ecosystem services.	• High upfront costs: Tree planting can be labour intensive and requires significant upfront investment.

Advantages	Disadvantages
- Enhances biodiversity: Tree planting can provide habitat for various plant and animal species. - Improves soil health: Tree roots can hold soil in place, preventing erosion and improving soil structure. - Carbon sequestration: Trees can absorb carbon dioxide, mitigating climate change.	- Requires maintenance: Trees require regular maintenance, such as pruning and thinning to ensure optimal growth and health. - Vulnerability to pests and diseases: Trees can be vulnerable to pests and diseases, which can impact their growth and survival.

Procedures

- 1. Site preparation:** Prepare the site by removing debris, weeds, and other vegetation.
- 2. Species selection:** Select healthy seeds to raise seedlings suitable for the local climate and ecosystem.
- 3. Planting:** Plant seedlings in the prepared site, ensuring proper spacing and arrangement.
- 4. Monitoring and maintenance:** Regularly monitor the health and growth of trees and perform maintenance tasks as needed.

Dos and Don'ts of the Technique

Dos	Don'ts
- Choose tree species suitable for the local climate and ecosystem. - Prepare the site adequately to ensure optimal tree growth. - Ensure quality planting materials are raised. - 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. - Monitor and maintain trees regularly to ensure their health and survival.	- Planting trees in areas with inadequate space or resources. - Neglecting provision of regular maintenance such as pruning and thinning. - Planting invasive tree species that can harm the local ecosystem. - Don't exclude stakeholders: rehabilitation without community buy-in risks vandalism, neglect or conflict.

Way Forward

To improve the success of tree planting efforts, the following should be considered:

- Conduct thorough site assessments: Understand the local climate, soil type, and ecosystem to ensure optimal tree selection and site preparation.
- Engage of local communities: Involve local communities in tree planting efforts to promote ownership and ensure long-term sustainability.
- Regularly monitoring of tree health and growth and adaptation of management strategies to ensure optimal success rates. Use digital tools (e.g. mobile apps, GIS dashboards) for monitoring real-time tracking of survival rates, growth metrics, and ecological indicators.
- Document lessons learned and best practices for replication across KEFRI Sub-Centres.
- Host field days, exhibitions, and workshops to showcase Nguriunditu's progress and innovations.

Visit 2: Bamboo Trial: Muguga National Bamboo Trial Plot

The Muguga National Bamboo trial plot was established in 1987 by KEFRI. The trial plot consists of 16 exotic Bamboo species introduced from China. 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*. *Arundinaria alpina* (*Yushania alpina*) an indigenous bamboo species was also introduced in the trial.

Objectives

The objectives of the visit were to:

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

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 where harvesting is done from the inner culms outwards where a path is created in the centre of the clump to facilitate harvesting of culms.

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 to seed and some seeds have low germination potential.
- Bamboo has different uses of ecological and economical nature, making it attractive for adoption by farmers.



Figure 4.4: Demonstration of Bamboo varieties at Nguriunditu Valley.



Figure 4.5: Participants learning about the Bamboo at Nguriunditu Valley.

Challenges

- Poor management due to insufficient funds.
- Lack of steady market demand for bamboo products.

Impact

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

Based on the observations and lessons learnt, the participants recommended;

- Sustainable forest management practices to maintain the health and productivity of the forest.
- Community engagement and education to promote forest conservation and sustainable use.
- Careful species selection to avoid introducing non-native species that can outcompete native species.
- Create awareness to the public on importance of bamboo.
- Undertake continuous research on bamboo seeding and regeneration.
- Explore utilization of the bamboo crop for carbon trading.

Techniques observed

The techniques observed included:

Establishment of Demonstration Plots for Bamboo Management.

Definition of the technique

A demonstration plot is a designated area established to showcase best practices, technologies, and management techniques for bamboo establishment, growth, and utilization.

Purpose of the technique

- The purpose of establishing a bamboo demonstration plot is to provide a practical, hands-on learning platform where communities, CFAs, farmer, and other stakeholders can observe, practice and adopt recommended bamboo establishment and management techniques.
- It serves as a training and technology-transfer tool that showcases best practices under real field conditions, allowing beneficiaries to learn by seeing and doing. Through the demonstration plot, participants gain skills in species selection, planting, spacing, propagation methods, management routines, and harvesting, thereby enhancing awareness, knowledge, and adoption of bamboo-based livelihood and restoration interventions.

Advantages and disadvantages of the technique

Advantages	Disadvantages
• Hands-on learning improves adoption and retention of skills. • Communities see real results, building confidence in bamboo.	• Requires land that is permanently accessible for training. • Needs continuous maintenance and monitoring.

Advantages	Disadvantages
• Can showcase multiple species and techniques side by side. • Supports monitoring and evaluation of survival rates and growth. • Useful for training, field days, and extension visits.	• May require initial investment (seedlings, fencing, signage). • Results may take time depending on species.

Procedures

1. Select an accessible site with good soil, reliable water availability, and secure boundaries suitable for training and demonstration activities.
2. Design and mark the plot layout, allocating sections for different bamboo species, planting densities, and establishment techniques to be showcased.
3. Clear the site of weeds and unwanted vegetation, prepare the ground, and dig standard planting holes of appropriate depth and spacing.
4. Prepare planting materials such as rhizome offsets or culm cuttings or seedling and transport them to the site while maintaining moisture to avoid stress.
5. Plant the bamboo materials in their designated sections, ensuring correct positioning, firm soil placement, adequate watering, and application of mulch.
6. Install labels or signage indicating species names, establishment methods, and spacing arrangements to guide learning and observation.
7. Conduct regular maintenance including watering, weeding, replacing dead seedlings, pest control, and mulching to ensure healthy growth of the demonstration plot.
8. Organize and facilitate training sessions, field days, and practical demonstrations for farmers, CFAs, county officers, and other stakeholders to learn from the plot.
9. Monitor growth performance by recording survival rates, shoot development, and overall plant vigour to generate evidence for learning and evaluation.
10. Document lessons learned and share findings with community members and partners to promote adoption and scaling of successful bamboo establishment practices.

Dos and Don'ts of the technique

Do's	Don'ts
• Select a site with reliable water, good drainage, and easy access for training activities. • Use healthy and high-quality planting materials such as rhizome offsets or well-prepared culm cuttings/seedlings.	• Don't establish the plot in waterlogged, rocky, or very dry sites without irrigation options. • Don't use weak, diseased, or old planting materials as they reduce survival rates.

Do's	Don'ts
• Space bamboo adequately (e.g., 3 m x 3 m or 5 m x 5 m) depending on species and purpose. • Mulch the planting area to conserve moisture and reduce weed growth. • Do water consistently, especially during the first 2–3 months after establishment. • Label each plot section clearly to facilitate learning and comparison during training. • Protect the plot from livestock, stray animals, and human disturbance. • Conduct regular weeding to prevent competition for nutrients and moisture. • Monitor growth by recording survival rates, height, and shoot emergence. • Allow farmers and trainees to participate actively during planting, maintenance, and harvesting demonstrations. • Replace dead seedlings early to maintain uniformity and accuracy of the demonstration.	• Don't plant too deep or bury nodes incorrectly in culm cuttings, as this delays or prevents sprouting. • Don't leave soil uncovered lack of mulching leads to moisture loss and poor seedling survival. • Don't overcrowd the bamboo, as it limits growth and makes management difficult. • Don't ignore pest and disease signs, such as borers or fungal infections. • Don't allow grazing, cutting, or trampling in the demonstration area. • Don't delay watering, especially during dry spells. • Don't mix species without proper labelling, as this confuses trainees and reduces the learning value. • Don't abandon the plot after planting ongoing maintenance and monitoring are essential to keep the demonstration successful.

Recommendation

- Scale up demonstration plots in strategic community areas to enhance farmer learning and increase adoption of bamboo-based restoration and livelihood practices.
- Strengthen training and extension support by conducting regular field days, practical sessions, and follow-up visits to ensure farmers fully understand bamboo establishment and management.
- Use demonstration plots to compare species and techniques so communities can choose the most suitable bamboo types and planting methods for their local conditions.
- Allocate resources for proper maintenance of demonstration plots, including watering, mulching, weeding, and protection from livestock to ensure their success and visibility.
- Encourage farmer participation in all stages site preparation, planting, and maintenance to build skills, ownership, and confidence in bamboo cultivation.

- Document and share results from each demonstration plot to guide decision-making and replication in other communities and counties.
- Partner with institutions such as KEFRI, County Governments, CFAs, and development partners to support technical guidance, monitoring, and expansion of the technique.

Visit 3: Kenya Forestry Research Institute 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 collection is from established seed stands/sources and natural stands of both indigenous and exotic species.

Objectives

The objectives of the visits were;

- To learn the end-to-end process of tree seed management at the KEFRI Tree Seed Centre, including collection, extraction, processing, testing, storage, and distribution.
- To learn the Centre's strategies and mechanisms for ensuring the production and supply of healthy, vigorous, and genetically superior tree seeds for restoration, afforestation, and rehabilitation programmes.
- To document seed collection techniques, equipment used, and laboratory procedures, including their definitions, purposes, advantages, limitations, and practical application guidelines.
- To analyse the achievements, challenges, and lessons learned in seed collection and quality assurance, and to provide recommendations for improving efficiency, quality control, and contribution to ecosystem conservation.

Activities

The KEFRI Tree Seed Centre is involved in;

Seed Collection

- Identification, selection and establishment of seed sources.
- Conducting surveys to identify and select appropriate tree species for seed collection.
- Harvesting of tree seed from the identified and selected trees focusing on collecting high quality seeds.

Seed Processing/Seed extraction

- Cleaning and removing of debris like leaves, twigs, stones and soil from collected seeds to ensure purity and quality.
- Tree seeds are basically separated from their fruits or cones/pulps after they arrive in the seed centre.
- Drying seeds to reduce moisture content, which helps prevent mould growth and extends seed viability.

Seed Storage

- Storage is done for long term and short-term periods depending on the seed type.
- Packing and labelling seeds in suitable containers or packaging materials for better storage.
- Management and maintaining proper storage conditions to keep seeds viable for long periods.
- Mostly orthodox seeds go to long term and recalcitrant goes for short term storage units.
- Most of orthodox-type tree seeds have been stored in temperature and humidity-defined units/cold rooms.

Seed Quality Testing

Tree seeds are tested for purity, weight, moisture content and germination. Purity testing is done to remove contaminants and mixed species. Seed weight is measured to determine the number of seeds per kilogram. Moisture content is checked to confirm seeds are at the recommended level for safe storage. Germination tests are conducted to determine the percentage of seeds that can sprout successfully. These tests ensure only high-quality seeds are distributed for planting.

Seed Bank Management

Seed bank management involves keeping a detailed catalogue of all seed species, documenting their origin, collection dates and storage conditions. The centre also conducts regular monitoring of stored seeds to track their viability, update records, and adjust storage conditions where necessary to maintain seed quality over time.

Research and Development

The KEFRI Tree Seed Centre undertakes research and development on improving seed quality and conserving important tree species. This includes conducting studies to enhance seed traits and germination techniques, as well as researching effective methods for conserving rare and endangered species to support long-term biodiversity and restoration efforts.

Capacity Building

Capacity building is supported through workshops and seminars that equip partners and community members with skills in seed collection, processing and management to promote best practices and improve tree seed handling across restoration initiatives.

Tree Seed Selling and Distribution

At the KEFRI Tree Seed Centre, seeds are sold/supplied to clients that include; government agencies, NGOs, and individuals to support plantation development, reforestation, and afforestation initiatives, ensuring the availability of quality planting materials for restoration programs.



Figure 4.6: Tools used for collection of tree seeds



Figure 4.7: Sun drying of *Pinus patula* seed



Figure 4.8: Tree seed germination test in green house



Figure 4.9: Tree seed germination test in an open space



Figure 4.10: Extracting of seeds from cones



Figure 4.11: Grinder and moisture meter to test the moisture content of seeds

Lessons Learnt

- Quality tree seeds are the foundation of all afforestation or restoration program.
- For quality tree seed provision, right steps of collection, extraction and testing until distribution should be observed, if one of the steps lacks consistency then the whole process is compromised.
- Careful selection of tree seed sources/stands is the very crucial to ensure quality seed.
- Public awareness is important for the value of tree seeds and even for tree planting.
- Skilled manpower is required in every step of seed collection.
- Usually, trees which produce good quality seeds are used continuously as the seed source until they lose the fruiting vigour.
- Seeds should then be collected from at least 30 mother trees, spaced 50–100 m apart, to ensure genetic diversity and better plantation performance.
- Fruits or pods that have been damaged by insects or disease should not be collected
- Stand-alone trees should not be used for seed collection.
- Proper timing for seed collection is critical.
- A simple way of checking ripeness/maturity of a seed, is to extract some seeds from a sample of pods and cut them in half i.e do a cutting test.
- Tree seed should be collected from the entire crown of the tree.
- Equipment maintenance and trained personnel are essential to reduce losses and accidents.
- KEFRI relies on both traditional and modern equipment in seed collection and processing to ensure quality and efficiency.

Challenges

- Low awareness of tree seed by the public, leading to low understanding on importance of seed quality.
- Limited availability of specialized tree climbing and safety gear.
- Due to seed off years and climate change, there is no constant supply of seeds on annual basis.
- Accessibility challenges in remote areas where some seed sources are located.
- High labour intensity and time demands for manual collection.
- Short viability periods for some tree seed species, demanding quick processing.
- Inadequate funding for acquisition of modern seed extraction equipment and technologies.

Impact

The KEFRI Tree Seed Centre has impacted ecological, economic and social as outlined below:

a) Ecological Impacts

- Enhance biodiversity.
- Enhanced survival rates of planted trees due to improved seed quality.
- Contribution to Kenya's tree growing initiatives to achieve 15 billion trees by 2032.

b) Economic

- Income from sale of seeds.
- Employment creation.
- Improves livelihood through training and employment of seed collectors.

c) Social impacts

- Better policy for afforestation and reafforestation programs.
- Trained local communities on seed issues.

Pending Issues

- Need for mechanization to reduce manual labour burden.
- Expansion of seed orchards and clonal propagation programmes.
- Expand regional seed storage facilities and infrastructure.
- Improve the weak linkages between community collectors and formal seed centres.

Way Forward

- Capacity building, institutional, and personal training are required for advanced and updated tree seed technologies.
- Institutional collaboration in applied research, which can be used for policy formulation.
- Community engagement especially in conservation activities.
- Awareness creation for tree seed recipients.
- The programme should incorporate climate resilient tree seed species.
- Scale up investment in mechanical seed extraction machines.
- Train more community seed collectors on safe and efficient methods.
- Strengthen partnerships with universities for research on seed physiology and storage.
- Establish more regional seed collection and testing centres.
- Enhance awareness on proper seed handling among farmers and forestry practitioners.

Technique

The technique observed is tree-crown climbing for seed collection.

Technique Definition

Tree-crown climbing for seed collection refers to a specialized technique used to access and collect seeds directly from the upper branches (crown) of trees using various gears such as ropes - and - harness or ladder, sometimes with spurs for very large trees.

Purpose of the Technique

- Access seed/fruit that are only available in the crown (not on the ground).
- Ensure seed is collected at correct maturity and from selected, certified seed sources (maintaining provenance and genetic quality).
- Minimize contamination by immature or damaged seed.

Advantages and Disadvantages of the Technique

Advantages	Disadvantages
• Collectors can choose fully matured cones/fruits directly from the crown, improving germination rates. • Seeds collected from the tree are less likely to be infested, contaminated, or damaged compared to seeds found on the ground. • Enables collection from selected superior trees with desirable genetic traits (e.g., high growth rate, disease resistance). • Selective harvesting: collect from target trees (seed stands, seed orchards). • Less damage to tree compared with felling large branches or cutting. • When done professionally, avoids felling or damaging trees, making it a sustainable and environmentally friendly method. • Effective for species whose seeds shatter, disperse quickly, or are eaten by wildlife before collection from the ground. • The same plus trees (elite trees) can be accessed regularly for long-term seed supply.	• Safe climbing and seed handling demand professional training, limiting who can perform these tasks. • Potential for falls, injuries and accidents, especially in tall or hazardous trees and adverse weather conditions. • Climbing and manoeuvring in the canopy takes longer than ground-based or mechanized collection methods. • Needs more manpower and physical effort, reducing efficiency for large-scale seed harvesting operations. • Requires investment in climbing gear, safety equipment, and trained personnel, making it relatively expensive. • Very old, weak, liana-entangled, or extremely tall trees may be unsafe or impossible to climb. • Stands can be damaged while trying to reach to the trees. • Fruits might get damage in the process of collection. • Unsafe in rainy, windy or slippery conditions, causing delays in field operations.

Advantages	Disadvantages
• It enables phenotypic selection and effective seed orchard management, which are essential components of forestry research and development. • Useful in steep or rugged landscapes where mechanized or ground-based collection is impossible.	• Not practical for large scale operations. • Slower and more labour-intensive than ground collection or mechanical shaking. • Requires specialized equipment and training (harnesses, ropes, rescue procedures).

Procedure of undertaking the technique

- Identify and select the target tree species based on the seed collection objectives.
- Conduct phenological assessments to determine the correct fruiting and seed-ripening period.
- Identify and select superior (plus) trees with good form, health, vigour and high seed productivity.
- Obtain permission from landowners for off-station trees and sign agreements where required.
- Mark and record all selected trees, noting species, location, and tree code.
- Plan to collect from 25–30 well-spaced trees of the same species to ensure genetic diversity.
- Assemble and inspect all required climbing and safety equipment: ropes, harnesses, helmets, gloves, pruning tools, ladders, communication devices, and first-aid/rescue kit.
- Brief the team and ensure trained climbers and ground assistants are in place.
- Inspect each tree for safety hazards; dead or rotten branches, power lines, nests, bees or other wildlife.
- Climb and carefully collect mature fruits or cones using approved tools, placing them gently into labelled collection bags.
- Label all collected material with species name, tree code, location, collector's name and date of collection.

Dos and Don'ts of the technique

Dos	Don'ts
• Use trained and certified climbers only; ensure proper supervision. • Conduct a safety assessment of the tree and its surroundings before climbing.	• Do not climb without proper training, PPE and supervision. • Do not climb during bad weather (rain, wind, lightning).

Dos	Don'ts
• Inspect all climbing gear (ropes, harnesses, helmets, gloves, carabiners) before use. • Wear full Personal Protective Equipment (PPE) including helmet, gloves, boots and harness. • Use approved climbing and cutting tools suitable for tree canopies. • Work in teams at least one climber and one or more ground assistants. • Carry a first-aid kit and communication devices (radio/ phone). • Collect fruits/seeds gently to avoid damaging branches or shaking off immature seeds. • Label seed bags immediately with species, tree number, location and date. • Follow ethical and legal guidelines including landowner consent and environmental protocols. • Select mature fruits/cones only for better seed viability. • Ensure proper descent and safe exit from the tree. • Document and record each collection for traceability and research purposes.	• Do not use worn-out or damaged climbing equipment. • Do not climb weak, rotten, or unstable trees inspect the tree first. • Do not disturb wildlife (bird nests, bees, squirrels) in the crown. • Do not cut large branches unnecessarily only collect fruits/ cones. • Do not work alone teamwork is mandatory for safety. • Do not shake branches it may drop immature seeds and damage flowers/ fruits. • Do not overload seed bags keep them manageable and safe for transport. • Do not mix seeds from different trees without proper labelling. • Do not rush the process mistakes increase risk and reduce seed quality. • Do not leave equipment unsecured risk of falling objects. • Do not start without confirming landowner permission if off-station.

Recommendations

- Establish and enforce a standard operating procedure and safety checklist for seed-collection activities.
- Procure and maintain modern professional climbing gear, PPE and first-aid equipment, with routine inspection and replacement schedules.
- Form a dedicated seed-collection team with trained climbers, ground assistants and supervisors.
- Strengthen mapping and documentation of plus trees across seed zones, including GPS coordinates and phenological data.
- Maintain seasonal phenology calendars to plan seed-collection windows accurately

- Collaborate with county governments, CFAs, and private landowners for access to seed sources and sustainable benefit-sharing.
- Ensure genetic diversity by collecting from 25-30 well-spaced trees per species per seed zone.
- Digitize seed-collection records and labelling using forms or mobile apps for seed-source traceability.
- Schedule regular refresher training, field audits, and safety drills for continuous improvement.
- Produce awareness and extension materials promoting safe and sustainable seed-collection practices.
- Standardize and publish SOPs for climbing, seed collection across all KEFRI Centres (if not already in place) include rescue and equipment maintenance. KEFRI already has R&D procedures and seed protocols; these should be kept current and made operational at all centres.
- Digitalize collection records (GPS, photos, provenance) to improve traceability to KFSC/KEPHIS standards.
- Species-specific method sheets for thorny, brittle or very high-seeded species (indicate when to use ladder, rope, shaking or pole pruners).

Visit 4: KEFRI Pathology and Entomology Laboratory

Introduction

Trees, like all living organisms, are vulnerable to infections caused by disease-causing pathogens and attacks from pests. Throughout the tree value chain from seeds and seedlings to growing stands and harvested wood trees face risks from a variety of pests and diseases. The Kenya Forestry Research Institute (KEFRI) established its Pathology and Entomology Laboratories in 1986 with the mandate to diagnose, monitor, and address tree pest and disease challenges in order to safeguard forest health and productivity. The Pathology and Entomology Laboratories are specialized facilities within KEFRI dedicated to the study of insect pests and diseases affecting forestry and allied natural resources. The laboratories play a crucial role in advancing forestry research, pest and disease management, and knowledge sharing in Kenya and the region. The scientific findings are key in support of sustainable forest management and conservation. Activities by the laboratories include; the collection and preservation of insect specimens and diseased plant materials. To date, approximately 60,000 insect samples have been collected, with about 6,000 species already identified and catalogued, contributing significantly to biodiversity documentation and pest management strategies.

The laboratories' work involves performing scientific tests such as DNA extraction for species identification, testing for insecticide resistance, maintaining specialized equipment and supplies, and adhering to strict laboratory safety protocols. It also focuses on proper data management, report generation, and research on biological control methods for sustainable pest management. Through

these efforts, KEFRI's Pathology and Entomology Laboratories continues to play a critical role in protecting Kenya's forest resources from destructive pests and diseases.

Objectives

The objectives of the visit were:

1. To understand the roles, research functions and laboratory procedures of KEFRI's Pathology and Entomology laboratories in diagnosing and managing tree pests and diseases.
2. To learn how KEFRI's research supports sustainable forestry and agroforestry systems, including the identification and promotion of drought-tolerant, fast-growing and pest- and disease-resistant species to enhance productivity and prevent economic losses.
3. To explore KEFRI's strategies for safeguarding forest ecosystem health and biodiversity, including integrated pest management (IPM), biological control, invasive species control and biosecurity measures.
4. To strengthen knowledge and collaboration on early-warning systems, forest-health monitoring and research partnerships aimed at anticipating pest and disease outbreaks and enhancing regional capacity to manage forest health risks.

Specific Activities

Entomology Laboratory Activities

- Collection and storage of insect samples, and affected tree parts (60,000 insects collected; 6,000 identified).
- DNA extraction for insect species identification.
- Testing for insecticide resistance.
- Maintaining entomology equipment and supplies.
- Adhering to safety protocols.
- Generating entomology lab reports.
- Ensuring proper data management.
- Researching on biological control.

Pathology Laboratory Activities

- Updating and digitizing historical and new disease records into DSS.
- Diagnostic services and advisory support to forestry stakeholders for disease-related issues.
- Training and awareness programs on pests and diseases to nursery operators, communities and students.
- Research on quarantine pests and invasive tree pathogens.
- Contribution to KEFRI's Strategic Plan (2022–2027) pathology component.



Figure 4.12: Swelling on midrib of the leaf



Figure 4.13: Blue gum chalcid



Figure 4.14: *Selitricones neseri* (Parasitoid)



Figure 4.15: Participants being taken through pathology issues



Figure 4.16: Symptoms of Botryosphaeria canker disease



Figure: 4.17: Cleaning of lab apparatus for seed testing

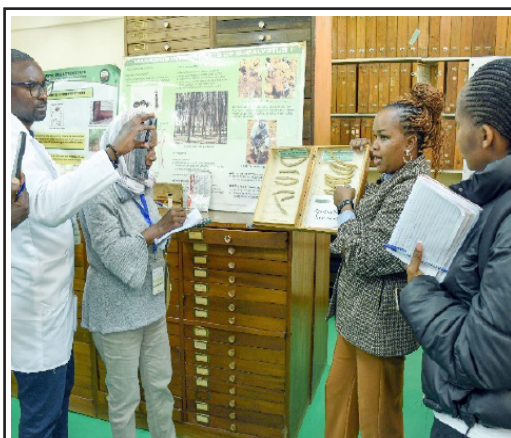


Figure 4.18: Participants being taken through biocontrol of *P. juliflora*



Figure 4.19: Participants being taken through entomology issues

Lessons Learnt

- Early detection of pests and diseases in forestry crop is critical
- Healthy seedlings are the foundation of successful forestry
- Data and documentation are important for reference
- Integrated approaches such IPM are more effective
- Quality systems enhance credibility
- Stakeholder awareness is vital
- Collaboration is necessary for early detection, effective control and management of disease and pests
- Policy gaps weaken resilience
- Resource constraints limit scale of operation
- Climate change is a risk multiplier as it favours outbreak of pest and diseases
- Soft bodied insects are collected and stored in tubes with 70 percent ethanol. Their morphological features remain the same as per the time of collection.
- Dry collection is for the hard bodied insects and are preserved using the naphthalene balls. Eg the case of the Goliath beetles collected in 1953 and is still intact
- Management of forest pathogens (Armillaria root rot, Anthracnose, Leaf Rust, Powdery mildew, Dothistroma Needle Blight)

Challenges

- Shortage of trained specialists in plant pathology, mycology, virology, and molecular diagnostics.
- Limited staffing in regional centres outside Muguga.
- Inadequate and inconsistent funding for research, surveillance and laboratory equipment.

- Heavy reliance on donor-funded projects limiting sustainability
- Outdated diagnostic tools and insufficient access to advanced molecular technologies.
- Limited use of remote sensing, drones and AI for large-scale surveillance.
- Insufficient quarantine facilities to contain invasive species.
- Unequal distribution of lab infrastructure across Kenya.
- Lack of a clear national forest health and biosecurity strategy.
- Weak integration of plant pathology findings into national forestry policies.
- Slow adoption of disease management guidelines at community and county levels.
- Low awareness among smallholder tree growers, nursery operators and community forestry groups.
- Weak extension and communication channels to stakeholders.
- Inconsistent policies, bureaucratic processes, and regulatory hurdles slow down research activities and implementation of findings
- Limited accessibility of disease records to practitioners outside KEFRI.
- Weak linkage between research outputs and practical field applications.
- Climate change is increasing the frequency and severity of disease outbreaks.
- Higher vulnerability of stressed forests to invasive and exotic pathogens.
- Limited regional surveillance and weak cross-border coordination.
- Increased risk of invasive pathogens spreading via trade and plant material movement.

Impact

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

a) Ecological Impacts

- Conserves biodiversity and forest health; safeguards ecosystem services (soil, water, carbon); strengthens climate resilience; manages invasive pathogens
- Help maintain healthy forests through early detection of pests and diseases.
- Prevent large-scale tree dieback and protect biodiversity.
- Reduce the spread of invasive species and quarantine pests.
- Improve forest resilience and ecosystem stability.
- Increase success of restoration programmes by ensuring healthy, disease-free seedlings.

b) Economic Impacts

- Protects timber yields and quality; ensures healthy seedlings; reduces replanting costs; saves on outbreak management; supports forestry industries (timber, paper, energy, exports).

- Reduce financial losses in commercial forestry by identifying problems early.
- Improve timber yield and wood quality enhancing market value.
- Lower management costs by minimizing unnecessary pesticide use.
- Increase investor and market confidence through reliable laboratory data.
- Support livelihoods and tree-based enterprises by protecting agroforestry species.

c) Social Impacts

- Secures community livelihoods; supports woodlot and restoration programs; sustains household energy and food security; enhances knowledge through citizen science; improves human well-being via ecosystem services.
- Builds community awareness through training and outreach.
- Support livelihoods by safeguarding sources of wood fuel, fruits, fodder and non-timber products.
- Strengthen partnerships among KEFRI, KFS, counties, CFAs and communities.
- Reduce chemical misuse, improving human health and safety.
- Create employment and develop technical skills among students and young professionals.

Recommendations

- Develop climate-resilient native and alternative tree species to enhance growth and survival under changing climate conditions.
- Integrate entomology and pathology research findings into restoration efforts to improve tree cover and ecosystem resilience.
- Promote nature-based solutions by increasing species richness and restoring degraded landscapes to support community livelihoods.
- Utilize modern technologies such as quantitative data tools, computational software, and Artificial Intelligence (AI) to monitor and model climate change impacts on forests.
- Employ use of drones and other advanced tools for seed broadcasting, surveillance, and monitoring forest conditions.
- Use AI-powered systems to generate data-driven insights on tree health, soil moisture and air quality for informed decision-making in forest management.
- Build strategic collaborations with government institutions, private sector partners, civil society and development partners to strengthen landscape restoration efforts.
- Engage stakeholders at all levels to inform policies and promote community-led greening initiatives targeting deforestation and land degradation.
- Invest in postgraduate training and continuous capacity building to enhance staff skills in climate-related research, data collection, on pests and diseases.
- Strengthen human resources within KEFRI and partner institutions to effectively measure, monitor, and model climate change impacts.

- Disseminate research findings and new technologies to farmers, communities, and other stakeholders to promote awareness and early detection of pests and diseases.
- Improve policies and strengthen the integration of pest and disease management in forestry planning and implementation.
- Enhance the effectiveness of Integrated Pest Management (IPM) through combined biological, chemical and cultural control strategies.
- Strengthen surveillance and diagnostic capacity for early detection and rapid response to pest and disease outbreaks.

Technique

The identified technique is **Biological Control**.

Technique Definition

Biological control (biocontrol) is a technique that uses living organisms such as predators, parasitoids, pathogens, or competitors to suppress insect pests, diseases, or invasive species.

Purpose

To manage and reduce pest and disease populations sustainably by using natural enemies instead of chemical pesticides.

Advantages and Disadvantages of the Technique

Advantages	Disadvantages
• Low development cost. • Low cost is regulatory approval. • Narrow host range. Target organism specific toxicity. • Good public acceptance because it’s safe for humans and livestock. Safe to handle. • No evolved resistance yet if any it is very slow development to resistance. • Requiring less intensive toxicological testing. • Since it’s a natural method there is no pollution to the environment especially the water bodies. • Long lasting.	• Relatively expensive. • Quality control issues. • Narrow host range and may also predate on the friendly organisms. • Required microenvironment for infectivity. • Special storage conditions. • Efficacy is usually poorer than chemical herbicides. • Short shelf life. • Takes a longer time to be effective. It does not completely eradicate the pest. • May not adapt to the area and can sometimes completely move out of the area. • Slower than chemical herbicides.

Procedures

1. Identify the specific pest or disease problem and confirm the target species through proper sample collection and laboratory identification.
2. Select suitable natural enemies based on evidence, literature, and known effectiveness against the target pest.
3. Test the chosen biological control agents in the laboratory to confirm they can successfully attack or suppress the target pest.
3. Evaluate the agent's effectiveness by comparing pest survival and damage levels with and without exposure to the biological control organism.
4. Assess potential environmental and safety risks, including possible impacts on non-target species and compliance with biosafety and quarantine standards.
5. Develop basic mass-rearing methods to enable consistent production of the biological control agent while maintaining quality.
6. Formulate a field application strategy that outlines when, where, and how the biological control agent should be released.
7. Document all findings and establish operational guidelines for practical use in nurseries, plantations, or forest sites.
8. Conduct pilot trials under semi-field or field conditions to verify performance and identify any unintended effects.
9. Monitor and evaluate the outcomes, track pest reduction and plant health, and refine the biological control strategy based on the results.

Dos and Don'ts of the technique

Dos	Don'ts
• Correctly identify the pest before selecting a biological control agent. • Use natural enemies that are specific to the target pest to avoid harming beneficial organisms. • Conduct laboratory or small-scale tests to confirm effectiveness before field application • Release biological control agents at the right time, especially when pest populations are still manageable. • Monitor pest and agent populations regularly to assess impact and adjust strategies.	• Do not transport infested plant material. • Do not release biological control agents without confirming pest identity wrong matches can cause failure or damage. • Do not use broad-spectrum pesticides immediately after releasing biological control agents they will kill the natural enemies. • Do not release agents that attack many non-target species this can harm biodiversity. • Do not introduce exotic species without approval and environmental risk assessment.

Dos	Don'ts
• Combine biological control with other IPM practices such as cultural and mechanical controls. • Educate farmers and stakeholders on correct handling and use of biological control agents. • Maintain good environmental conditions to support the survival of natural enemies. • Follow national biosafety and quarantine regulations when importing or distributing biological control agents.	• Do not ignore follow-up monitoring biocontrol success depends on continuous observation. • Do not mix biological agents improperly some agents compete or interfere with each other. • Do not rely on biological control alone when pest pressure is extremely high integrated methods work better. • Do not release agents in unsuitable environments, such as extreme weather or heavily polluted sites, where they cannot survive. • Do not store biological control agents incorrectly, as poor handling reduces their effectiveness.

Recommendations

- Select biological control agents that are highly specific to the target pest to avoid harming beneficial or non-target species.
- Conduct proper laboratory and field testing to confirm the effectiveness and safety of the biological control agent before release.
- Integrate biological control into a broader Integrated Pest Management (IPM) strategy rather than using it as a standalone method.
- Ensure continuous monitoring of pest populations and natural enemy performance after release to evaluate success and detect unintended effects.
- Maintain high standards of nursery and field hygiene to reduce pest build-up and support the effectiveness of natural enemies.
- Train farmers, nursery operators, and forest managers on the appropriate use and expectations of biological control agents.
- Follow national biosafety, quarantine, and environmental regulations when importing, mass-rearing, or releasing biological control organisms.
- Use native or locally adapted natural enemies whenever possible to enhance establishment and environmental compatibility.
- Keep accurate records of releases, monitoring data, and pest population changes to guide future interventions.
- Promote awareness that biological control provides long-term suppression, not instant eradication, and requires patience and proper follow-up.

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

Introduction

Kereita Forest, located on the southern edge of the Aberdare Range in Lari Sub-County Kiambu County, is a legally protected forest that was gazetted as part of the larger Aberdare Forest Reserve. Kereita means “*a forest with well-organized warriors*,” reflecting its historical significance. Its gazettement was carried out through official Legal Notices published in the Kenya Gazette, which formally placed the forest under government protection in line with the Forest Conservation and Management Act, 2016. The forest covers approximately 4,722.6 hectares and forms part of the southern Aberdare block. The forest is managed by Kenya Forest Service (KFS), working closely with the local communities participate through Community Forest Associations (CFAs) under Participatory Forest Management (PFM). Participatory Forest Management (PFM) is a collaborative governance model that brings together forest-adjacent communities, government agencies and other stakeholders to jointly manage forest resources. Since then, the forest has become a hub for ecotourism, with activities such as hiking, zip-lining, mountain biking, and nature walks that contribute to conservation-oriented local enterprise.

Kereita forest promote Participatory Forest Management by Kereita Integrated Community Forest Association (KICOFA) which was established in 2000 involving communities adjacent to the forest at a radius of 5 km. Further, Kereita Integrated Community Forest Association (KICOFA) and the Kenya Forest Service (KFS) signed the Participatory Forest Management Plan (PFMP) in 2010. The Kijabe Environment Volunteers (KENVO) a youth group which organized communities and identified gaps between the then Forest Department and the community later joined the KICOFA which became one of the groups of the CFA. KENVO has worked with KICOFA activities that include; water bottling, eco-agriculture, beekeeping, forest restoration, eco-tourism and fish farming.

Objectives

The objectives of the field visit were to:

- Learn about the PFM implementation process.
- Learn how CFAs engage local communities in forest management.
- Learn CFA activities implemented in Kereita Forest.
- Learn about challenges faced by the CFA and discuss practical lessons that can be applied in other community-based forestry contexts.

Activities

Key activities undertaken include:

- Forest monitoring through joint forest patrols and surveillance by CFA members and Kenya Forest Service (KFS) to curb illegal logging and encroachment.
- Tree seedling production and seedling distribution.

- Undertake reforestation in the forest and promote agroforestry among local households.
- Ecotourism development which includes nature trails and cultural tourism have created alternative income streams.
- Environmental education and awareness campaigns targeting schools, youth groups and women's associations.
- Plantation Establishment and Livelihood Improvement Scheme (PELIS).
- Bee keeping.
- Water bottling.
- Collection of medicinal herbs.



Figure 4.20: Participants being introduced to Participatory Forest Management



Figure 4.21: Participants learning about CFA activities at Kereita Forest station

Lesson Learnt

The lessons learnt include;

- Meaningful community engagement in decision-making is essential for achieving sustainable forest management and ensuring long-term community commitment.
- Clear and consistent communication among stakeholders strengthens CFA operations, enhances coordination and reduces misunderstandings.
- Community ownership significantly improves forest protection, as locals are more willing to safeguard resources they feel responsible for.
- Visible and tangible benefits motivate community participation, reinforcing support for conservation and restoration activities.
- Inclusivity enhances the effectiveness of PFM, with women's groups playing key roles in driving alternative livelihood activities such as eco-crafts and herbal gardens.
- Power dynamics shape PFM outcomes, with government agencies retaining substantial authority that can occasionally limit community decision-making power.
- Ecotourism offers both opportunities and risks, generating income but sometimes creating tension with local land-use needs and community priorities.

Challenges

The challenges faced by the CFA include;

- Conflicts of interest among community leaders that weaken cohesion and undermine collective decision-making.
- Leadership driven by personal or egocentric motives, reducing trust and accountability within the CFA.
- Unrealistic community expectations about tree cutting, permits, and access to forest resources, leading to tension with KFS.
- Significant climate change impacts affecting forest regeneration, water availability, and livelihood activities.
- Limited timeframes for implementing the PFMP, making it difficult to complete planned interventions effectively.
- Disagreements over benefit-sharing models, especially concerning tourism revenue and resource access.
- Uneven distribution of benefits, resulting in some groups feeling excluded from opportunities and decision-making.
- Low financial and technical capacity, with the CFA lacking adequate tools, training, and funds for effective management.
- Conflicts over land and resource boundaries, where zoning, fencing and permits create visible and invisible exclusions.
- Weak monitoring and enforcement systems, with joint patrols and reporting not consistently carried out or documented.
- Ongoing capacity-building needs, limiting the CFA's ability to manage forest activities sustainably.

Impacts

Implementation of PFM by the CFA in Kereita forest has led to economical, ecological and social impacts as outline;

a) Ecological Impacts

- Reduced deforestation and illegal logging, resulting from strengthened community patrols and increased community stewardship of forest resources.
- Improved forest regeneration and biodiversity recovery, supported by enrichment planting, seedling production in tree nurseries, and reduced human pressure.
- Enhanced water catchment protection, with healthier forest cover contributing to more stable water flows and reduced soil erosion.
- Increased habitat protection for wildlife, improving ecological connectivity within the southern Aberdare landscape.

b) Economic Impacts

- Growth of ecotourism enterprises, generating income for community groups involved in guiding, hospitality, and cultural tourism activities.

- Enhanced income through seedling production and sales, driven by active community tree nurseries supported by the CFA.
- Improved livelihood opportunities from sustainable forest products, including beekeeping, herbal products, and eco-friendly crafts.
- Greater financial inclusion for women and youth, as forest-based enterprises create new revenue streams for previously marginalized groups.

c) Social Impacts

- Significant increase in CFA membership, now standing at 2,046 members (722 men and 1,324 women), demonstrating growing community ownership.
- Strengthened community cohesion and collective action, as PFM structures bring diverse groups together under shared management responsibilities.
- Enhanced youth engagement through involvement in nursery work, patrols, eco-tourism, and environmental education activities.
- Improved gender inclusion, with women's groups taking leading roles in livelihood enterprises, decision-making spaces, and forest patrols.
- Greater transparency and participatory governance, as PFM processes require consultation, record-keeping, and accountability in forest-use decisions.

Pending Issues

Pending issues that need addressing include:

- Clarification of representation and responsibilities benefit-sharing mechanisms.
- Capacity building for nature reserve conservation and management.
- Review of CFA PFM-P regarding sustainable practices.
- Finalization and full implementation of the Forest Management Plan.
- Clarification of CFA roles in enforcement and benefit-sharing.
- Scaling up alternative livelihoods to reduce forest pressure.
- Integration of digital tools for mapping and reporting.

Recommendations

To ensure the sustainability of the initiative, it is recommended to:

- Strengthen community engagement through regular dialogue forums, sensitization meetings, and targeted capacity-building workshops.
- Develop and operationalize clear policies on resource management and benefit-sharing to reduce conflicts and ensure transparency.
- Strengthen CFA governance and leadership accountability, including improved financial management and internal oversight.
- Institutionalize regular joint reviews between KFS and the CFA to track PFMP implementation, address emerging issues, and improve compliance.
- Enhance collaboration with external partners NGOs, county governments, private sector to mobilise technical, financial, and material support.

- Scale up training on forest-based enterprises and climate-smart livelihood practices to diversify incomes and reduce forest pressure.
- Promote policy reforms that ensure equitable benefit-sharing, clarify user rights, and strengthen mechanisms for addressing conflicts.
- Address capacity gaps by providing tools, training, and continuous institutional strengthening for effective PFM implementation.

Technique

The identifies technique is Participatory Forest Management Planning and Implementation.

Technique Definition

It is a technique where the Community Forest Association and the Kenya Forest Service jointly develop and carry out a forest management plan through shared decision-making, clear zoning, agreed responsibilities, and coordinated actions to sustainably manage, restore, and use forest resources.

Purpose of the Technique

The purpose of the technique is to guide shared decision-making, organize forest activities, define responsibilities and ensure sustainable use and restoration of forest resources while improving community benefits and ownership.

Advantages / Disadvantages of the Technique

Advantages	Disadvantages
• Strengthens community ownership and involvement, leading to reduced illegal activities and better forest protection. • Improved resource management and sustainability. • Creates livelihood opportunities through tree nurseries, beekeeping, eco-tourism, that reduce pressure on forest resources. • Builds consensus on forest boundaries and usage. • Supports planning, monitoring and reporting. • Enhances shared decision-making, ensuring both community and government priorities are reflected in forest management.	• Time-consuming process, as planning, consultations and consensus-building require significant effort and skilled facilitation. • May exclude marginalized groups if not well managed. • Risk of disputes if maps contradict official records. • Potential for conflicts, especially if stakeholders disagree on benefit-sharing or resource access. • Dependence on strong leadership, meaning weak or self-interested leaders can undermine the process. • Limited capacity and resources within CFAs can slow down implementation and monitoring.

Advantages	Disadvantages
• Improves sustainability through careful planning, zoning and coordinated restoration activities. • Builds trust and transparency by clearly outlining roles, responsibilities and benefit-sharing arrangements. • Encourages inclusive participation, allowing women, youth, and marginalized groups to contribute to forest governance.	• Power imbalances may persist, with government agencies retaining greater authority than communities. • Implementation gaps can arise if the PFM-P is not regularly reviewed or supported with adequate funding and technical skills.

Procedures

The procedures for the technique are;

1. **Community Mobilization and Sensitization:** Introduce the PFM approach to community members, explain rights and responsibilities and mobilize stakeholders to participate.
2. **Formation/ Strengthening of the CFA:** Ensure the CFA is legally registered, has a functional governance structure, and represents all user groups (women, youth, forest-adjacent villages).
3. **Stakeholder Identification and Engagement:** Bring together KFS, CFA, county government, NGOs, user groups and local leaders to agree on roles and expectations.
4. **Resource Assessment and Participatory Forest Mapping:** Jointly assess forest condition, biodiversity, threats, water sources and community use patterns and conduct participatory mapping to identify zones (conservation, grazing, plantation, ecotourism, Non-Timber Forest Products (NTFPs) areas, etc.).
5. **Preparation of the Participatory Forest Management Plan (PFMP):** Develop a plan outlining management objective, activities, responsibilities, benefit-sharing arrangements, monitoring systems and conflict-resolution mechanisms.
6. **Signing of the PFM Agreement (PMA):** The CFA and KFS formally sign the agreement giving the CFA the mandate to participate in forest management.
7. **Implementation of PFM-P Activities**
 - Conduct restoration (planting, enrichment, protecting regeneration).
 - Support livelihoods (beekeeping, nurseries, ecotourism, NTFPs).
 - Undertake forest protection activities such as joint patrols, fire management, and enforcement of rules.
8. **Capacity Building and Training:** Provide training to CFA members on governance, financial management, restoration, enterprise development, and climate-smart practices.

9. Monitoring, Documentation, and Reporting
 - Carry out regular monitoring of forest condition, patrols, enterprise performance, and community engagement.
 - Keep clear records (minutes, patrol logs, financial reports).
10. Conflict Resolution and Adaptive Management: Address conflicts through committee structures and adjust activities based on lessons learned and emerging challenges.
11. Joint Review and Updating of PFMP: Conduct periodic reviews between KFS and CFA to evaluate progress and revise the PFMP as conditions change.

Dos and Don'ts of the technique

Dos	Don'ts
• Involve diverse groups (women, youth, elders). • Use simple, accessible tools. • Validate maps with both community and KFS.	• Do not ignore conflicts of interest among leaders. • Do not overlook the importance of clear benefit-sharing models. • Don't impose external boundaries without consultation. • Avoid technical jargon that alienates participants. • Don't skip conflict-sensitive zones, address them openly.

Recommendations

- Digitize participatory maps for integration into KEFRI's GIS systems.
- Use maps to guide restoration planning and seed zone demarcation.
- Train CFA members in basic GPS and mobile mapping tools.
- Expand ecotourism initiatives e.g. nature trails, cultural sites.
- Tree nursery development and seedling distribution.
- Develop benefit-sharing agreements (e.g., fuelwood collection, grazing zones).
- Enhance environmental education and awareness campaigns.
- Strengthening CFA skills and knowledge.
- Promote sustainable practices.

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

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 were shared. In the 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 the field site at Tiva to learn about indigenous tree improvement and breeding, the case of *Melia volkensii* and *Acacia tortilis*.

Section I: KEFRI On-station Research and Development (R&D)

Dryland forestry R&D: Overview of KEFRI Activities, Achievements and Challenges

The presentation provides an overview of KEFRI's Dryland Ecoregion Research Programme (DERP) and its role in climate-resilient forestry. It explains that 84% of Kenya consists of drylands, supporting millions of people, wildlife, and livestock. KEFRI, in collaboration with JICA since 1985, has implemented long-term research, training, and technology development programs targeting dryland forestry, agroforestry, and community livelihoods.

DERP focuses on forest productivity, tree improvement, biodiversity conservation, climate change adaptation, and socio-economic research. Key activities include development of dryland species (*Melia volkensii*, *Acacia tortilis*, *Terminalia brownii*), establishment of seed orchards, production of quality germplasm, management of pests and diseases, invasive plant species control and promotion of dryland commercial forestry. It also supports water catchment restoration using bamboo and acacia species.

The programme has recorded major achievements such as developing 19 farm forestry techniques, strengthening farmer-to-farmer and FFS extension, establishing improved *Melia* seed orchards, enhancing drought-tolerant tree breeding, and implementing community-focused restoration and value-addition initiatives. DERP continues to support the government's 15-billion tree campaign, promote bio-enterprises (gums, resins, honey, aloes), and build partnerships with county governments, NGOs, research organizations, and private sector actors.

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*.
- Impact of climate change (Drought, Flooding, phenology, pests and diseases, etc.).
- Lack of reliable water supply (Holo, Garissa and Wajir).
- Limited financial resources/Low government and donor funding.
- Inadequate nursery infrastructure.
- High rate of staff retirement without replacement.
- Aging fleet of vehicles.

Impacts

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

a) Ecological impacts

- Improved management and restoration of degraded dryland forests, woodlands, and rangelands.
- Conservation and sustainable use of dryland biodiversity, including *Melia volkensii*, *Acacia tortilis*, bamboo, gums and resins species.
- Enhanced forest health through surveillance, control of invasive species (*Prosopis*, *Ipomoea*), and management of pests and diseases.
- Increased resilience of dryland ecosystems to climate change through drought-tolerant species development, improved tree breeding, and water catchment restoration.
- Better land rehabilitation using silvo-pastoral systems, grassland restoration, and riparian ecosystem protection.

- Improved seed quality and supply, supporting large-scale landscape restoration and the 15-billion tree campaign.

b) Social Impacts

- Strengthened community livelihoods through training, extension, field days, and capacity building on nursery management, agroforestry, gums and resins, Non-Timber Forest Products (NTFPs) and dryland forestry.
- Increased community resilience to climate change through restoration, on-farm tree planting, and adoption of drought-tolerant species.
- Improved community knowledge and skills through farmer-to-farmer extension, FFS approaches, and technical capacity-building.
- Enhanced collaboration among government agencies, county governments, NGOs, CBOs, and farmers, improving social cohesion in natural resource management.
- Increased participation of pastoralist and agro-pastoralist communities in sustainable land-use practices.
- Support to local communities through establishment of viable bio-enterprises, especially gums, resins, honey, medicinal plants, and charcoal technologies.

c) Economic Impacts

- Commercialization of dryland species such as *Melia volkensii*, *Terminalia brownii*, *Osyris lanceolata*, and *Acacia tortilis*, boosting household.
- Promotion of NTFP value chains (gums, resins, honey, medicinal plants) generating employment and market opportunities.
- Improved tree seed production, quality, and distribution supporting forestry enterprises and national restoration goals.
- Enhanced livelihoods through alternative income options (bioenergy, poles, charcoal, aloe products, fruits).
- Support to Small and Medium-sized Enterprises (SMEs) and CBOs through KEFRI's model of linking research products to enterprise development.
- Contribution to Kenya's GDP and the Bottom-Up Economic Transformation Agenda (BETA) through forestry productivity, value addition, and restoration-based enterprises.

Pending Issues

- Need for more genetic improvement on *Melia volkensii* and *Acacia tortilis*.
- Limited scaling of technologies validated in Kitui to other ASAL counties of Kenya.
- Gaps in monitoring systems to support the 15 billion tree growing campaign.
- Limited long-term evidence on the effectiveness of silvo-pastoral systems across

different dryland counties.

- Research more on best restoration species mixes for degraded ASAL catchments and rangelands.
- Develop models predicting restoration success under extreme climatic variability.
- Limited application of AI, remote sensing, and drones for dryland monitoring.
- Need for research on data-driven early warning systems for drought, pests, and forest fires.
- Inadequate digital tools for real-time seed availability, seedling performance, and restoration tracking.

Recommendations

- Strengthen research on dryland tree species such as *Melia volkensii*, *Acacia tortilis*, *Terminalia brownii*, and *Osyris lanceolata* to enhance productivity, drought tolerance and commercialization.
- Scale up training for communities, farmers, extension officers, and county governments on nursery management, dryland forestry, bamboo propagation, and NTFP value-addition.
- Improve water management and rehabilitation of degraded catchments through bamboo, acacia species, and integrated silvo-pastoral systems.
- Enhance commercialization of NTFPs such as gums, resins, indigenous fruits, aloes and honey to improve community livelihoods.
- Increase investment in nursery infrastructure, water supply systems, transport facilities, and research equipment to support DERP activities.
- Promote climate-resilient forestry practices to address drought, flooding, and phenological changes linked to climate change.
- Support counties with technical backstopping and policy advice to mainstream forestry and dryland restoration in development planning.
- Upscale technologies that have shown success in Kitui and Tiva to similar ASAL landscapes across Kenya.



Figure 4.22: Participants taken through drylands research activities



Figure 4.23: Participants taken through JICA supported Baobab project



Figure 4.24: Demonstration of soil auger for planting long-rooted seedlings



Figure 4.25: Group photo of participants at KEFRI DERP-Kitui

Development of a Centre of Excellence for Dryland Forestry Research: KEFRI Pilot Forest on Drought Tolerant Species Activities at Tiva

Tiva Woodland is a key dryland research station under KEFRI, located in Lower Yatta, Kitui County, within the arid and semi-arid zone IV. The woodland is dominated by drought-resilient species such as *Acacia mellifera*, *Acacia tortilis*, *Albizia anthelminitica*, *Commiphora* spp., and *Terminalia brownii*, which play essential ecological roles in soil cover, carbon sequestration and nutrient storage. Despite its importance, the woodland faces pressures including uncontrolled grazing, poverty-driven charcoal burning, and illegal tree cutting. The research station provides numerous benefits to the surrounding community, including casual employment, access to seeds and seedlings, water access, bee forage, training opportunities, and grazing resources.

The station has made major contributions to global research and development, particularly in genetic improvement and domestication of dryland tree species such as *Melia volkensii* and *Acacia tortilis*. It hosts extensive experimental trials on spacing, provenance, drought tolerance, indigenous fruit domestication, species screening, breeding, and agroforestry innovations. It has also influenced restoration practices in Kenya and across Africa through KEFRI-JICA collaborations, farmer field demonstrations, and knowledge dissemination. Research outputs from Tiva have been widely used by institutions and

NGOs for scaling up dryland restoration technologies.

Future directions emphasize establishing Tiva as a Centre of Excellence for dryland forestry research, focusing on infrastructure development, climate monitoring, community engagement, policy support, and partnerships. The way forward calls for integrating dryland forestry into the broader ASAL economy, enhancing community involvement as key collaborators, and using Tiva's long-term research experience to guide county governments, KFS and other stakeholders in upscaling tested dryland restoration technologies.

Objectives

The main objective of visiting Tiva was to:

1. Understand the improvement, breeding, and development of high-quality indigenous dryland tree species particularly *Melia volkensii* and *Acacia tortilis* and appreciate their genetic enhancement and breeding populations.
2. Understand process of the promotion of quality plantations of *Melia volkensii* and *Acacia tortilis*, indigenous tree species in the Arid and Semi-Arid Lands (ASALs).
3. Understand the enhancement of production and distribution of improved *Melia volkensii*.
4. Understand the benefits of *Melia volkensii* and *Acacia tortilis* and their commercial use in the drylands.

Activities

- Conducting tree improvement and breeding trials for key dryland species such as *Melia volkensii*, *Acacia tortilis*, and *Terminalia brownii*.
- Establishing, managing, and maintaining seed orchards, progeny trials, provenance trials, and clonal orchards to produce high-quality germplasm for dryland forestry.
- Implementing tree establishment experiments, including spacing trials, site preparation, water harvesting techniques, micro-catchments, mulching, pruning, thinning, weeding, and coppicing.
- Conducting agroforestry and on-farm demonstration trials to support farmers with best practices for integrating drought-tolerant species on their farms.
- Monitoring climate change indicators such as growth performance, survival, species adaptation, carbon sequestration, and tree phenology under dryland conditions.
- Providing community training and extension services in nursery management, tree establishment, seed collection, and sustainable land restoration.
- Supporting seed production and distribution, ensuring availability of high-quality seeds and seedlings for the dryland restoration and contribution towards 15-billion tree campaign.
- Undertaking research on dryland forestry technologies, including invasive species management (e.g., *Prosopis*), silvo-pastoral systems, and efficient bioenergy technologies.

Challenges

- Low and unreliable rainfall (250–800 mm/year), leading to poor seedling establishment and high tree mortality.
- Limited and unreliable water supply that makes tree growing challenging.
- Overgrazing and uncontrolled livestock movement, resulting in degradation, soil compaction and destruction of young trees.
- Illegal tree cutting and charcoal burning, driven by poverty and food insecurity in surrounding communities.
- Inadequate nursery infrastructure, affecting the production and survival of high-quality dryland seedlings.
- Limited financial resources and low government/donor funding, restricting research expansion and infrastructure development.
- High staff retirement rates without timely replacement, creating human-resource gaps in specialized dryland forestry research.
- Slow uptake of adoption due to limited awareness or low extension capacity among some communities.
- Challenges in scaling up successful trials from Tiva to wider ASAL counties due to variable ecological conditions.

Impacts

The Centre of Excellence Tiva research and development activities have impacted the region ecologically, socially, and economically. The impacts include the following:

a) Ecological Impacts

- Conservation of drought-tolerant indigenous tree species such as *Melia volkensii*, *Acacia tortilis*, *Terminalia brownii*, and *Commiphora* spp., which enhances resilience in ASAL ecosystems.
- Protection and restoration of degraded dryland habitats through trials on spacing, water-use efficiency, soil management, and micro-catchment technologies.
- Contribution to biodiversity conservation by maintaining gene banks, provenance trials, and ex-situ conservation of indigenous fruit trees.
- Strengthening climate action through carbon sequestration research, permanent sample plots, and promotion of climate-smart dryland forestry.
- Prevention of land degradation by improving tree cover, reducing soil erosion, and restoring ecological balance in fragile ASAL landscapes.

b) Social Impacts

- Improved community skills through training in nursery establishment and tree growing.
- Increased community participation and ownership through collaborative research, farmer field days, and extension services.

- Contribution to food security through promotion of indigenous fruit trees and climate-resilient agroforestry systems.
- Enhanced learning and knowledge sharing for students, farmers, and extension officers through demonstrations and long-term research plots.

c) Economic Impacts

- Generation of employment for local communities through nursery work, infrastructure improvement, tree planting and maintenance of trials.
- Development of commercial tree species (*Melia volkensii*, *Acacia tortilis*) that support timber production, wood products, and emerging dryland value chains.
- Support to rural enterprise development through promotion of gums, resins, honey, indigenous fruits, and non-timber forest products.
- Strengthening of dryland seed systems and availability of high-quality germplasm, boosting commercial forestry investments.
- Enhancement of economic resilience by promoting drought-tolerant species that reduce crop failure risks and support diversified livelihood streams.

Recommendations

- Strengthen community-based restoration programs to reduce pressure from overgrazing, charcoal burning, and illegal harvesting.
- Increase investments in water harvesting and storage infrastructure to support nurseries and trials in dry areas.
- Expand breeding programs and seed orchards to ensure wider supply of improved *Melia volkensii* and *Acacia tortilis* planting materials.
- Enhance partnerships with county governments, NGOs, and international organizations to upscale proven technologies.
- Improve staffing and research capacity at Tiva to support ongoing and future dryland forestry innovations.
- Promote sustainable alternative livelihoods (honey, gums/resins, indigenous fruit value chains) to reduce dependency on destructive activities.

Indigenous Tree Improvement and Breeding - The case of *Melia volkensii* and *Acacia tortilis*

Tree breeding is presented as a central strategy for enhancing forest productivity, ecological resilience, and sustainable resource use in response to challenges such as climate variability, degradation, and increasing demand for quality planting materials. The programme aims to develop superior genotypes with improved growth performance, drought tolerance, disease resistance, and enhanced economic value.

Kenya's tree improvement initiatives have evolved from concentrating mainly on exotic species to including a wider range of indigenous species of high ecological and economic importance. Breeding techniques currently applied include phenotypic

selection, phenology monitoring, clonal propagation, progeny testing, genetic diversity studies, establishment of clonal and seedling seed orchards, recurrent selection cycles, and conservation strategies. The breeding programme for *Melia volkensii* and *Acacia tortilis*, initiated in 2012 with JICA support, has already resulted in the identification of Candidate Plus Trees, establishment of seed orchards and progeny trials, and ongoing evaluation of superior genotypes across Kenya's ASALs. Additional studies focus on pest and disease surveillance, development of management guidelines, and the use of AI for predicting seed productivity.

Despite major progress, the programme faces constraints such as limited infrastructure, resource shortages, and the need for advanced breeding technologies. Future opportunities lie in adopting genomic tools, expanding community-based breeding, integrating indigenous knowledge, and strengthening participatory approaches. Indigenous tree breeding as a pillar for sustainable forestry, climate resilience, livelihood improvement, and national restoration goals in Kenya's dryland regions.

Visit to *Melia volkensii* and *Acacia tortilis* Tree Seed Orchards

The *Melia* and *Acacia* seed orchards were planted in 2015 and 2016 respectively at 6m by 6m and 3.5m by 3.5m spacing.

Objectives

The objective of the visit was to;

- Learn on tree improvement and breeding of dryland species.

Activities

Most of the activities done include:

- Seed orchards management for production of high-quality and genetically superior seeds for planting.
- Collection of tree seeds from *Melia volkensii* and *Acacia tortilis* orchards.
- Undertake tree breeding to enhance the genetic quality, productivity, and resilience of *Melia volkensii* and *Acacia tortilis*.
- Production of assorted tree seedlings.
- Training and capacity building.



Figure 4.26: Participant taken through *Melia volkensii* breeding at KEFRI Tiva



Figure 4.27: *Vachellia tortilis* seed stand



Figure 4.28: Tree nursery connected with mist irrigation at KEFRI-Tiva



Figure 4.29: Non-mist tree nursery at KEFRI-Tiva

Lessons Learnt

The lessons learnt from this initiative included:

- Importance of Drought Tolerance: The importance of developing drought-tolerant tree species for climate resilience.
- Community Engagement: The need for community engagement and participation in tree improvement initiatives.
- Indigenous drought-tolerant species such as *Melia volkensii* and *Vachellia tortilis* are vital for climate resilience, livelihoods, and restoration in ASALs.
- Long-term partnerships, particularly KEFRI–JICA collaboration, greatly strengthen research capacity, technology development, and adoption.
- Establishing seed orchards, progeny trials, and conservation stands ensures a reliable supply of genetically improved planting material.
- Community engagement, training, and dissemination are essential for successful technology adoption and sustainable land restoration.

Challenges

Key challenges in tree improvement include:

- Illegal felling of seed orchards, experimental plots and forest areas.
- Limited land for establishment.
- Long tree breeding cycle which delays release of improved material.
- Climate change adversely affecting tree improvement activities, that is, seed production.
- Inadequate supply of quality planting material.
- Inadequate funding that affects programme development, management of trials.

Impacts

a) Ecological Impacts

- Improved conservation of drought-tolerant indigenous species such as *Melia volkensii* and *Vachellia tortilis*.
- Restoration of degraded dryland ecosystems through sustainable tree establishment and seed orchard development.
- Enhanced biodiversity protection by conserving indigenous shrubs, grasses, and wildlife-supporting habitats.
- Increased carbon sequestration through establishment of resilient dryland species and agroforestry systems.

b) Social Impacts

- Creation of casual employment for local communities in nursery work, trials maintenance, and infrastructure repairs.
- Strengthened community knowledge through training on tree establishment, agroforestry, and nursery techniques.
- Improved access to forest products such as firewood, grass, bee forage and seeds that support household needs.
- Enhanced community participation in climate-smart forestry aligned with national and global restoration goals.

c) Economic Impacts

- Increased availability of high-quality seeds for commercial plantations and smallholder tree farming.
- Promotion of indigenous tree-based enterprises (e.g., honey, poles, charcoal, gums and resins).
- Contribution to rural economic growth through improved timber productivity of *Melia volkensii*.
- Support to national economic agendas such as BETA, Vision 2030, and the 15-billion-tree campaign through research-based technologies.

Pending Issues

Some of the issues that need to be addressed include:

- Scaling up tree improvement and breeding initiatives to reach more communities.
- Securing sustainable funding for long-term tree improvement and breeding programs.
- Need for stronger linkages between research outputs and county-level implementation to upscale proven technologies and improved tree materials.
- Low adoption of dryland forestry technologies by some community members due to socio-economic constraints and limited extension reach.

Recommendations

Recommendations for indigenous tree improvement and breeding programs include:

- Increased Community Engagement: Increased community engagement and participation in tree improvement initiatives.
- Collaborative Approaches: Collaborative approaches among stakeholders to support tree improvement and breeding programs.

Techniques

The technique identified is **tree improvement and breeding of indigenous trees of *Melia volkensii***

Technique Definition

A systematic scientific approach that involves selecting, propagating, testing, and improving genetically superior trees to enhance traits such as growth, drought tolerance, wood quality, seed production, and resilience in dryland ecosystems.

It is the technique KEFRI uses to develop superior, drought-tolerant, fast-growing, and high-quality indigenous tree species such as *Melia volkensii* and *Acacia tortilis*.

Purpose of the Technique

- To develop tree species that are more productive, resilient and adaptable to changing environmental conditions.

Advantages and disadvantages of the technique

Advantages	Disadvantages
• Improved productivity and resilience of tree species. • Enhanced livelihoods for local communities through increased access to quality tree resources.	• Potential loss of genetic diversity if not managed properly. • Tree improvement and breeding programs can be resource-intensive and also take a long period.

Procedures

Tree improvement and breeding involve several steps:

- Identification of Objectives: Defining the breeding objectives, such as improving growth rate, wood quality, disease resistance, or drought tolerance.
- Selection of Parent Trees: Selecting superior parent trees based on desirable traits, such as growth rate, stem form, wood quality, and disease resistance.
- Seed Collection and Germination: Collecting seeds from selected parent trees and germinating them in a nursery or greenhouse.
- Progeny Testing: Establishing progeny trials to evaluate the performance of offspring from selected parent trees, assessing traits like growth rate, stem form, and wood quality.
- Data Collection and Analysis: Collecting data on various traits from progeny trials and analysing it to identify superior genotypes.
- Selection of Superior Genotypes: Selecting superior genotypes based on progeny test results, considering factors like genetic gain, adaptability, and stability.
- Breeding and Seed Production: Breeding selected superior genotypes to produce improved seed for deployment, using techniques like controlled pollination or grafting.
- Seed Orchard Establishment: Establishing seed orchards with selected superior trees to produce high-quality seeds for distribution to farmers and other stakeholders.
- Field Trials: Conducting field trials to evaluate the performance of improved trees under different environmental conditions, assessing traits like growth rate, yield, and disease resistance.
- Deployment and Adoption: Deploying improved trees to farmers, foresters, and other stakeholders, promoting adoption and use of improved tree varieties.
- Monitoring and Evaluation: Monitoring and evaluating the performance of improved trees in various environments, identifying areas for further improvement and optimizing breeding strategies.

Dos and Don'ts of the technique

Dos	Don'ts
• Define specific breeding goals and objectives. • Select tree species that are well-suited to the breeding program's goals and environment. • Incorporate diverse genetic material to ensure a broad genetic base.	• Failing to maintain genetic diversity can lead to reduced fitness and adaptability. • Neglecting environmental factors can result in trees that are not well-suited to specific conditions.

Dos	Don'ts
• Evaluate tree performance in various environments and conditions. • Continuously monitor breeding program progress and adapt strategies as needed. • Ensure compliance with relevant laws, regulations, and ethical standards.	• Tree breeding is a long-term process; do not rush the process as this can lead to sub-optimal results. • Do not use poor seed quality that can compromise breeding program success.

Recommendations

The way forward for indigenous tree improvement and breeding programs involves:

- Strengthening community engagement and participation in tree improvement initiatives.
- Promoting sustainable forestry practices through the use of improved tree species.

Demonstration on Long Rooted Seedling to Enhance Tree Survival

M-StAR long-rooted seedlings (LRS) is a technology for improving tree survival and growth in Kenya's arid and semi-arid lands (ASALs). Since drylands experience erratic rainfall, rapid water loss from surface soils, and harsh planting conditions, conventional seedlings often fail to survive. KEFRI, in partnership with JIFPRO, tested long-rooted seedlings grown in 15 cm, 30 cm, and 60 cm M-StAR containers to determine how container depth affects seedling performance. Nursery trials showed that deeper containers produced more vigorous seedlings with greater height, biomass, and root collar diameter, due to larger rooting space and better access to moisture and nutrients. Field trials at Tiva further confirmed that *Melia volkensii* and *Dalbergia melanoxylon* seedlings grown in long containers had higher survival because their deep roots accessed stable soil moisture reserves. Soil moisture data showed that deeper layers maintain moisture even during dry periods, supporting the logic of using deep-rooted seedlings. The study concludes that M-StAR long-rooted seedling technology is highly promising for dryland restoration but must be applied species-specifically and complemented with additional management strategies such as pest control. Overall, the technology improves reforestation success in ASALs by enabling seedlings to reach deeper, more reliable moisture zones that enhance resilience to drought and climate stress.

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 are activities 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 will favour 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 4:30 (a & b): Participants being taken through long rooted seedlings experiment at KEFRI - DERP Kitui

Challenges

- Water shortage to implement some of the technologies such as the M-StAR technology.

Pending issue

- Undertake more research on the technology.

Technique

The identified technique is M-StAR technology;

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

Purpose of the Technique

- Enhance survival rate of out 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.
- 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 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. using local materials.

Section II: On-Farm

Visit 7: On-farm Commercial Forestry Development in the Dryland of Kibwezi, Makueni County-Case Study of Melia Growing On-farm by Mr. Jonathan Kituku

Mr. Jonathan Kituku is a leading dryland commercial forestry farmer in Kibwezi, Makueni County, known for large-scale on-farm *Melia volkensii* production. Trained by KEFRI since the early 2000s on Melia propagation, nursery management, and plantation establishment, he has expanded his woodlots to more than 17,000 trees. Melia was selected because of its fast growth, drought tolerance, and resistance to pests such as termites, making it ideal for ASAL conditions. Besides being a long-term timber enterprise, the woodlot provides intermediate benefits, including seed sales, firewood from prunings, and seedlings from his expanded nursery enterprise, which has become a major source of income. The farmer's adoption of integrated agro-silvopastoral practice such as producing and baling natural grass under Melia plantations further supports his livelihood, especially during dry seasons. Mr. Kituku has also diversified into livestock, forage production, and apiculture, turning his farm into a model of climate-resilient commercial forestry. His exemplary performance earned him the Head of State Commendation, and he now mentors many farmers, with his children actively managing parts of the enterprise.

Objectives of the visit were;

- To learn about farmers experience on climate change mitigation.
- Observe adaptive measures on climate change.
- To acquire knowledge and skills on tree varieties adaptive to dry land.
- Share of experiences on climate change adaptation.
- Commercial farming on dry land for improvement of livelihoods.

Activities

- Commercial farming of *Melia volkensii* tree species.
- Production and selling of tree seeds and seedlings.
- Demonstration and building capacity of farmers on climate change adaptation measures.
- Restoration of land through agroforestry practice that include animals rearing, trees and grass growing.
- Production and collection of tree seeds.



Figure 4.31: Participants hold a discussion at KEFRI- Kibwezi tree nursery



Figure 4.32: KEFRI staff demonstrating long-rooted seedling to the participants at KEFRI - Kibwezi



Figure 4.33: Participants learning about *Melia volkensii* growing on-farm at Mr. Kituku's farm



Figure 4.34: Participants observing *Melia* tree harvested from the farm



Figure 4.35: Participants having a discussion during farm visit at Kibwezi



Figure 4.36: A group photo at Mr. Kituku's farm

Lesson Learnt

- The farmer has consistently expanded the planting of *Melia volkensii*, establishing it as a major on-farm enterprise.
- *Melia* trees are commercially grown for timber, seed, and intermediate products such as firewood, providing both short-term and long-term income.

- The farmer applies several climate-smart practices such as drought-resilient species selection, water harvesting, and integrated agro-silvopastoral systems to adapt to climate variability.
- The farmer actively recruits and trains other farmers in Melia establishment, nursery management, and silvicultural practices.
- Dissemination of new skills and knowledge acquired from KEFRI enables farmers in the region to adopt improved forestry and land-use technologies.
- There is a need for regular access to genetically improved Melia seeds from KEFRI to enhance productivity and maintain high-quality plantations.
- Training and technical guidance from KEFRI have enabled the farmer to transform previously low-productivity land into a highly productive, multi-enterprise farm using appropriate technologies and good silvicultural practices.
- Although breaking Melia seed dormancy is complex, the farmer has fully mastered the process and now supplies high-quality processed seed to individual farmers, nurseries, and commercial companies.
- Neighbouring farmers are increasingly adopting Melia farming, creating a stronger collective bargaining position in the timber and seed markets and reducing exploitation by middlemen.

Challenges

- Invasion of animals to the farm.
- Drought (climate change).
- Water scarcity.

Impacts

The following impacts have been observed by the farmer:

a) Ecological

- Enhanced landscape restoration by rehabilitating degraded dryland areas.
- Improved soil structure and texture through increased organic matter and root penetration.
- Promoted soil and water conservation by reducing runoff and enhancing infiltration.
- Enhanced soil fertility through leaf litter accumulation and nutrient recycling.
- Increased tree cover across the farm and surrounding landscape.
- Improved the micro-climate by creating cooler, shaded environments under Melia trees.
- Strengthened resilience and adaptation to climate change through climate-smart forestry practices.

b) Social Impacts

- Improved nutrition and food security as land productivity increased through diversified agroforestry activities.
- Strengthened community integration and cohesion as neighbours adopted similar tree-growing practices.
- Gained prestige and recognition after receiving a presidential award for outstanding tree-growing efforts.
- Enhanced mentorship and youth capacity building by transferring skills to younger family members and local trainees.
- Expanded networking with farmers, CBOs, NGOs, and institutions involved in natural resource management.
- Increased community knowledge through continuous learning from visiting groups and exchange programmes.
- Strengthened continuity in tree farming by involving family members in farm management and decision-making.

c) Economical

- Livelihood improvement and diversity.
- Improved income through sale of various tree products.

Recommendations

- Establish cooperatives for easier market linkage.
- Train more farmers on tree growing in ASALs for climate change mitigation.
- Explore how farmers can benefit from carbon market.
- Create awareness and encourage more farmers to take up Melia farming.
- Empower farmers by providing access to credit facilities, quality seeds, markets and frequent trainings.
- Provide community outreach, training, and technical expertise access for communities.
- Build stronger public-private and regional partnerships to allow good working relationship.
- Strengthen seed certification to boost quality.
- Improve capacity building on tree pests and disease management.

Technique

- The identified technique is Agroforestry.

Technique Definition

- Diverse system of land management that integrates production of trees and shrubs with crops or livestock on the same land.

Purpose of the Technique

- Adaptation to climate change through commercial farming.

Dos and Don'ts of the technique

Dos	Don'ts
• Improve technical ability to manage diverse production system. • Clean the area. • Seek for markets. • Establish conducive environment for all plantations and livestock. • Proper management and monitoring of farming. • Keep records for income. • Ensure good selection of seeds and seedlings. • Mobilize the community members to plant trees in order to reduce exploitation by middle men and vandalism. • Establish market for products before they are ready.	• Compromise the quality of seeds. • Don't venture in integrated farming if there are no enough funding and skills.

Advantages and Disadvantages of the Technique

Advantages	Disadvantage
• Production of trees tolerant to climate change. • Diversified farming of trees, crops and livestock. • Good income generation. • Creation of jobs.	• Climatic challenge (drought). • Low emergency and survival rate of plants and trees. • Long waiting period between tree establishment and harvesting . • Labour intensive.

Procedure

1. Learn about how to plant trees and grass.
2. Identify good varieties that are suitable for dry areas.
3. Plant trees at optimal spacing to for planting grass in between the rows.
4. Allow trees to provide cover to grass while grass keep cover to the soil.
5. Practice cut and carry of livestock feed (understorey grass) to avoid direct grazing in the tree plantation area.

Pending Issues

- Centralized seed processing centre as most work is done at one KEFRI centre.
- Limited funding for capacity building on different techniques such as seed viability test.
- Low adoption rate for innovation of new skills.
- Capacity building on new skills.
- Improve awareness to farmers and local forest groups on species-site matching.

Recommendations

- Water harvesting/storage techniques should be improved to capacitate irrigation.
- Improve access to seed sources to ensure quick transportation of seeds may to testing centers.
- Improve public awareness and capacity building on the importance of new techniques.
- Do more research and improve genetic testing of seeds for dry areas.
- Engage stakeholders.

Visit 8: Improved Natural Pasture Growing for Sustainable Livelihood in Drylands - Case Study of J. Ngaya - Kibwezi

Natural pastures are vital for land management in dry land as they provide cover hence improving soil structure which is good for erosion resistance. The existence and improvement of grass species help also in feeding animals and producing seeds.

Objectives of the Visit

- To learn about farmers techniques and experiences on improved pasture management practices.
- Observe adaptive measures on climate change in dry lands.
- To acquire knowledge and skills on grass varieties suitable for dry land.
- Sharing of experiences on grass management and seed collection.
- Familiarize with commercial farming of grass species on dry land.

Activities

- Collection, sorting and storing of seeds for grass species.
- Selling of grass seeds to enhance livelihoods in the dry land.
- Demonstration and training farmers on grass seeds for dry land area.
- Land management by planting trees and grass.
- Making char coal by wood from the pruned branches of trees.
- Collection of seeds.
- Training other farmers for climate change mitigation by planting grass.



Figure 4.37: Participants being briefed on pasture farming by the farmer.



Figure 4.38: Participants taken through grass varieties by the farmer.



Figure 4.39: Participants taken through grass seeds.



Figure 4.40: Participants taking a transect walk through pasture farm.



Figure 4.41: Participants learning how to harvest grass seed in the farm.



Figure 4.42: Group photo with farmer.

Lesson Learnt

- Improvement of natural pasture by mixed cropping of different grass species.
- Conservation agriculture.
- Production of seeds and harvesting.
- Selective harvesting of grass seeds.
- Commercial selling of grass seeds.
- Mitigation of climate change by incorporating pasture land with trees.

Challenges

- Free grazing of animals in the pasture farm.
- Lack of rainfall leading to high drought periods (climate change) and pasture drying up.
- Termites damage which reduces quality and quantity of seeds.

Impacts

a) Ecological Impacts

- Improvement of biodiversity by plantation of grass and trees.
- Reduced soil erosion.
- Degraded land now rehabilitated.

b) Social Impacts

- Demonstrations on new farming techniques for adaptation to climate change.
- Access to pasture and hay thereby reducing land use conflicts.
- Social cohesion as other farmers grow pasture for own use and sale and lessen conflicts over communal grazing lands.

c) Economic Impacts

- Through production of quality seeds, the farmer has improved his income and livelihoods.
- Creation of employment.

Recommendation

- Provide community outreach, training, and technical expertise access for communities.
- Build stronger public-private and regional partnerships to allow good working relationship.
- Strengthen seed certification to boost quality.
- Improve capacity building on grass pests and diseases management.

Technique

- Grass seed harvesting by hand.

Technique Definition

- A process of collecting seeds by hand picking after it is maturity.

Purpose

- To select good matured seeds for commercial purposes.

Dos and Don'ts of the technique

Dos	Don'ts
• Collect good/mature seeds. • Use clean and dry equipment. • Label seeds properly. • Handle seed gently to avoid damage. • Store seed properly in a well aired elevated storage.	• Don't collect unripe seeds. • Don't use wet containers. • Avoid collecting after rainfall. • Don't mix seeds of different species. • Don't collect seeds affected by diseases. • Never store without cleaning.

Advantages and Disadvantages of the Technique

Advantages	Disadvantages
• Ensured selection of seeds (enable to choose healthy seeds). • Reduced damage on the grass during harvest. • Helps to avoid contamination of seeds. • Flexible as it allows work in difficult areas.	• Risk of injuries to the personal where seed is harvested in the terrains. • Variations in seed quality and size of seeds collected. • Labour intensity and time consuming (requires skilled labour). • Low volume yield per person per day.

Procedure of the Technique

1. Identify mature seeds for collection.
2. Identify correct time for collecting seeds and prepare the related equipment.
3. Ensure direct collection of seeds from the plant.
4. Label seeds accordingly to their variety types.
5. Carry seeds and store them temporarily in ventilated bags.
6. Clean the seeds.
7. Air dry seed to reduce moisture content.
8. Store seed in airtight containers to avoid contamination.

Recommendations

- Improvement of seed handling infrastructure.
- Improvement of community awareness and adoption capacity.
- Promotion of sustainable harvesting techniques.
- Improvement of seed quality control.
- Establishment of seed value chain collaboration with other partners.
- Develop monitoring and evaluation tools to monitor species diversity and quality.

Visit 9: Dryland Agriculture for Community and Climate Resilience-Agricultural Mechanization Research Institute (AMRI)-Katumani

The visit collectively emphasized the unique challenges and opportunities within Arid and Semi-Arid Lands (ASALs), highlighting that these regions cover a major portion of Africa, receive low and erratic rainfall, and rely primarily on pastoralism, agro-pastoralism, and rainfed agriculture. Solutions proposed for improving livelihoods in these areas centered on sustainable water management, adoption of climate-smart agriculture, use of drought-tolerant crop varieties, agroforestry, afforestation, solar-powered irrigation, community capacity building, and continuous dryland research. Adaptation and mitigation measures discussed included; flood barriers, drought-tolerant crops, water harvesting, renewable energy technologies, energy efficiency, carbon capture, and resilient infrastructure.

The soil and water conservation highlights the importance of protecting soil. Dryland challenges outlined included; erosion, nutrient depletion, low soil moisture, and land degradation. Climate-smart conservation practices recommended included terracing, zai pits, half-moon structures, tied ridges, conservation tillage, drought-tolerant crops, land rehabilitation, and combined use of organic and inorganic soil amendments. Aflatoxin control was also addressed through Aflasafe KE01, a biocontrol product applied before maize flowering to suppress aflatoxin contamination, with emphasis on proper timing, uniform broadcasting and institutional collaboration.

Crop health research is vital for developing pest- and stress-resistant varieties, monitoring emerging threats, supporting soil and plant microbiome health, guiding farmers, and ensuring food safety. Integrated pest management and mycotoxin surveillance were highlighted as key elements for protecting crops under climate stress. Climate-smart technologies were defined as tools and practices that enhance productivity, resilience, and low-emission agriculture. Examples included drought-resistant varieties, conservation agriculture, water harvesting, precision farming, digital tools for weather and pest alerts, greenhouses, solar irrigation, drones, biogas digesters, hay baling, and silage making.

Objectives

The objectives of the visit were to:

- Learn about dryland agriculture.

Activities

- The organization is involved in:
- Development and testing of drought-tolerant crop varieties (maize, sorghum, millet, pigeon peas, green grams, cowpeas).
- Production and distribution of certified seeds for ASAL farming communities.
- Soil and water conservation research, including tied ridges, zai pits, terraces, and rainwater harvesting.
- Research on climate-smart agriculture and dryland farming technologies.
- Crop protection research, including management of pests, diseases, and aflatoxins.
- Production and promotion of Aflasafe KE01 for aflatoxin reduction.
- Agronomic trials for improved crop management practices (spacing, fertilizer use, planting dates).
- Farmer training and capacity building on climate-smart technologies.
- Demonstration plots for showcasing new varieties and technologies.
- Monitoring and evaluation of on-farm technology adoption in ASAL areas.
- Collaboration with partners on dryland food security and resilience projects.
- Agricultural Mechanization Program.

Lessons Learnt

- The Seed Centre is committed to producing high-quality seeds tailored to the needs of smallholder farmers.
- Breeding efforts strive to develop varieties with desirable traits such as bird resistance sorghum and has improved performance under harsh climatic conditions.
- Rigorous quality control at every stage of seed production and processing to ensure purity, viability and reliability is very important.
- Aflasafe's role in lowering aflatoxin levels in food crops was emphasized as a major contribution to food safety and public health.
- Improved food safety was linked to enhanced food security and better community wellbeing.
- Farmers feedback is important on designing machinery and technologies.
- Grafting is critical in producing vigorous, high-yielding fruit trees.
- The use of pest and disease-resistant rootstocks is essential for improving orchard performance and reducing losses.
- Mechanisation is an important driver for improving efficiency and productivity on smallholder farms.
- The importance of designing adaptable equipment that fits diverse farming systems, crops, and local conditions was emphasized as critical for uptake and impact.



Figure 4.43: Participants taken through KALRO research activities



Figure 4.44: KALRO Seed Unit



Figure 4.45: Seed sorting at KALRO.



Figure 4.46: Seed drying at KALRO.



a)



b)

Figure 4.47 (a & b): Participants taken through machines at KALRO Mechanisation unit.

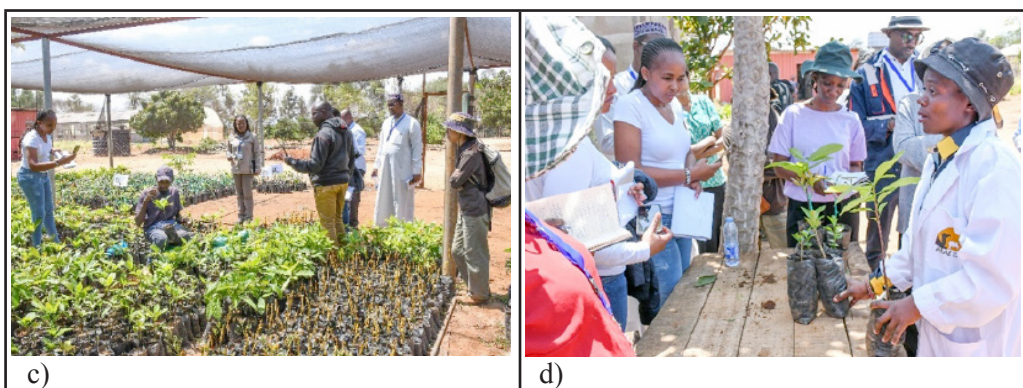


Figure 4.48 (c & d): Participants at KALRO fruit tree nursery.



Figure 4.49: Visit to the Aflasafe processing unit.



Figure 4.50: Packed Aflasafe meant for use in Kenya.



Figure 4.51: Group photo at Aflasafe factory-KALRO.



Figure 4.52: Group photo at KALRO.

Challenges

Some challenges faced by the centre include:

- Limited resources and funding constrained the centre's ability to scale out research, production and outreach activities.
- Adoption of improved crop varieties among smallholder farmers remained low despite availability and demonstrated benefits.
- Maintaining strict quality control and consistency in seed, Aflasafe, and other products was demanding and required continuous monitoring

- Ensuring Aflasafe reached smallholder farmers, especially in remote areas, remained a major challenge.
- Affordability and accessibility of improved technologies and products limited uptake among resource-constrained farmers.
- Frequent maintenance and repair needs for mechanisation equipment made sustained use difficult for farmers.
- Continuous training and capacity building were required to ensure farmers and operators could correctly use, manage, and benefit from the technologies.
- Equipment and technologies needed to be adapted to specific local contexts, crops, and farming systems, which required additional design and testing.

Impacts

a) Ecological Impacts

- Strengthened pest and disease management, reducing crop losses and enhancing ecosystem health.
- Enhanced soil and water conservation through sustainable land management practices.
- Improved soil fertility by integrating organic matter, fertilizers, and conservation agriculture.
- Reduced aflatoxin contamination in soils through the use of Aflasafe and better crop-handling practices.

b) Social Impacts

- Improved food and nutrition security through adoption of climate-smart crops and resilient farming practices.
- Improvement of crop yields and productivity.
- Enhanced overall community wellbeing through better production systems and reduced climate-related risks.
- Reduced human exposure to aflatoxins, improving household health and food safety.
- Strengthened climate change adaptation by adopting drought-tolerant and early-maturing crop varieties.
- Support of smallholder farmers through the provision of high-quality seeds.

c) Economic Impacts

- Increased agricultural yields through proper land management, climate-smart practices, and use of quality seed.
- Increased income for households due to higher productivity, reduced losses, and diversified climate-smart enterprises.

Pending Issues

Some pending issues that need to be addressed include:

- Scaling up the use of improved crop varieties among smallholder farmers to enhance productivity.
- Ensuring farmers have consistent access to high-quality certified seeds across seasons.
- Increasing the production capacity of Aflasafe to meet rising national and regional demand.
- Enhancing adoption and correct use of Aflasafe among smallholder farmers to reduce aflatoxin contamination.
- Expanding farmer uptake of improved fruit tree varieties to boost nutrition and income.
- Ensuring reliable availability and distribution of high-quality fruit tree seedlings.
- Strengthening the uptake of mechanisation technologies among smallholder farmers to improve efficiency.
- Addressing affordability and accessibility constraints that limit farmer acquisition of mechanisation technologies.

Recommendations

Based on our visit, we recommend that:

- KALRO should continue strengthening its engagement with smallholder farmers to better understand their needs and design appropriate, farmer-centred solutions.
- High-quality seeds should be made more accessible and affordable by expanding distribution channels and reducing production and delivery constraints.
- The Aflasafe Factory should continue improving seed treatment technologies and materials to enhance product efficiency and safety.
- Promotion and wider adoption of Aflasafe among smallholder farmers should be prioritized through awareness campaigns and demonstrations.
- KALRO should continue refining the Aflasafe production process to meet growing national demand.
- The organization should explore innovative strategies to lower the cost of Aflasafe and improve last-mile delivery.
- Continuous improvement of grafting techniques and protocols is necessary to enhance the survival and performance of fruit trees.
- Adoption of grafting technologies among smallholder farmers should be encouraged through practical demonstrations and extension support.
- Training and capacity-building on grafting and fruit tree production should be expanded to farmer groups and nursery operators.
- High-quality fruit trees should be made more affordable and accessible through increased production and improved distribution systems.

- Adoption of improved silo storage technologies should be promoted to reduce post-harvest losses and improve food safety.
- Training and capacity-building on proper silo storage use, management, and maintenance should be strengthened.
- Mechanization technologies should be made more accessible and affordable to smallholder farmers through subsidies, leasing models, or farmer cooperatives.
- KALRO should continue customizing mechanization solutions to suit different farming systems, crops, and regional contexts.

Technique

The identified technique is Aflasafe Biological Control Technique.

Definition of Technique

A biological control technique that uses non-toxic, competitive strains of *Aspergillus flavus* to displace and suppress aflatoxin-producing fungi in maize and other crops, thereby reducing aflatoxin contamination in the field.

Purpose

To reduce and prevent aflatoxin contamination in crops by using beneficial (non-toxic) fungal strains that outcompete and suppress aflatoxin-producing fungi in the field, thereby improving food safety, human health, livestock health, and marketability of agricultural produce.

Procedures of the Technique

The procedures for using Aflasafe KE01;

1. Apply Aflasafe in the field 2–3 weeks before flowering or at the 7th leaf stage of maize.
2. Ensure the field is clean and well-managed before application.
3. Broadcast Aflasafe uniformly across the field by hand.
4. Use the recommended rate of 4 kg per acre.
5. Apply when the soil is moist or when rain is expected soon after application.
6. Walk systematically across the field as you spread the Aflasafe to ensure even distribution of the granules.
7. Keep the product in its original package until use and shake gently before broadcasting.
8. After application, avoid disturbing the field (no deep cultivation or heavy disturbance).
9. Monitor the crop for signs of fungal infection and ensure good post-harvest handling to maintain safety.

Dos and Don'ts of the technique

Dos	Don'ts
• Apply at the correct growth stage - 2–3 weeks before flowering or at the 7th leaf stage. • Use the recommended rate - 4 kg per acre. • Broadcast evenly across the entire field to ensure uniform coverage. • Apply on moist soil or when rain is expected soon, to activate the spores. • Store Aflasafe properly in a cool, dry place to maintain product quality. • Follow safety precautions such as washing hands after handling the product. • Integrate with good crop management practices like timely weeding, use of clean seed, and proper drying. • Work collaboratively with extension officers for monitoring and correct application.	• Do not apply after flowering, as it becomes ineffective. • Do not mix Aflasafe with fertilisers, pesticides, or water - it must be applied dry. • Do not apply during heavy rainfall to avoid washing away the product. • Do not over-apply or under-apply - incorrect dosage reduces effectiveness. • Do not broadcast in standing water or flooded fields • Do not store the product in sunlight or humid conditions, as this damages the fungal strains. • Do not apply on extremely weedy fields, since weeds block the grains from reaching the soil. • Do not rely on Aflasafe alone- combine with good drying, shelling, and storage practices to prevent aflatoxin.

Advantages and Disadvantages of the Technique

Advantages	Disadvantages
• Reduces aflatoxin contamination in crops such as maize by suppressing toxic fungal strains. • Improves food safety for households and markets. • Enhances food security and better nutrition • Strengthened support to smallholder farmers through access to effective biocontrol solutions.	• Requires correct timing (2–3 weeks before maize flowering), otherwise effectiveness drops. • Uniform field distribution is necessary, which can be labour-intensive for large farms. • Does not replace good agronomic practices, so farmers must still manage moisture, pests, and soil fertility.

Advantages	Disadvantages
• Increased crop yields and overall farm productivity. • Enhances marketability of grain because aflatoxin - safe produce attracts higher prices. • Protects human and animal health by lowering exposure to carcinogenic aflatoxins. • Improves soil and crop health by promoting beneficial, non-toxic fungal communities. • Supports climate-smart agriculture as it reduces crop losses associated with climate-driven aflatoxin outbreaks. • Easy to apply (broadcasting at 4 kg per acre). • Cost-effective compared to post-harvest aflatoxin management.	• Can be ineffective in poorly managed or highly contaminated fields. • Requires specialized technical knowledge and skills for proper use. • Can be time-consuming and labour - intensive depending on the scale and method applied. • Requires awareness and training, as misuse reduces the benefits. • Dependent on product availability, which can be limited in remote ASAL areas. • Weather risks, such as heavy rains after application, may wash away the product and reduce its efficacy.

Recommendations

- Strengthen farmer awareness and training on correct timing and application rates to maximize Aflasafe effectiveness.
- Promote integration of Aflasafe with other good agricultural practices such as proper drying, sorting, and storage to fully minimize aflatoxin contamination.
- Encourage farmers to adopt climate-smart and drought-tolerant crop varieties alongside Aflasafe use for enhanced crop resilience.
- Improve access and availability of Aflasafe in local agro-dealer shops, especially in remote ASAL regions.
- Support continuous monitoring, surveillance, and evaluation of aflatoxin levels to track Aflasafe effectiveness and refine application strategies.
- Advocate for multi-sector collaboration among agriculture, health, research institutions, and private sector actors to enhance awareness and adoption of Aflasafe.
- Facilitate government support through subsidies or cost-sharing programs to make Aflasafe more affordable for smallholder farmers.

CHAPTER 5

5.0 Implementation Action Plans

Action plan is a roadmap for achieving a specific targeted plan or tailored interventions. The action plan development process involves problem identification; documentation of causes and effects; provision of solutions and interventions; stakeholders, resource analysis; and timeframe for implementation of identified activities. This chapter presents the action plan outlines prepared by individual participants, which are expected to be integrated into existing institutional work plans.

5.1 Action Plan on Enrichment Planting in Low-regenerating and High Seedling Mortality Sites in Nata-Gweta District using *Sclerocarya birrea*

Name: Gofaone Rammotokara
Email Address: grammotokara@buan.ac.bw
Country: Botswana
Organization: Botswana University of Agriculture and Natural Resources
Position: Range and Forest Resource Technician

Background on the current status of *Sclerocarya birrea* in Nata-Gweta District

The resource assessment of *Sclerocarya birrea* (marula) was conducted in 2024 in Nata-Gweta District. The assessment generated comprehensive data on the current distribution of marula resources, the quantity and yield of the species, and the potential for regeneration within the district. Overall, the marula resource survey sought to determine whether a commercially viable marula resource exists in Nata-Gweta District.

The assessment revealed that the lowest marula tree densities were recorded in Nata, Tsokootshaa, Maposa and Manxotae. Overall, Nata-Gweta District exhibited a moderate yield per village. However, some villages, including Sepako and Manxotae, recorded zero yield. In addition, Nata, Manxotae, and Sepako showed low juvenile tree counts, indicating poor regeneration and limited recruitment. These findings suggest that several sites are at high risk of population decline or collapse if no intervention measures are implemented.

Problem Statement

Despite the ecological and socio-economic importance of *Sclerocarya birrea* (marula) in Nata-Gweta District, recent assessments indicate a serious decline in its population sustainability in the villages of Nata, Sepako, and Manxotae. The assessment revealed low regeneration rates, characterized by limited juvenile trees, alongside high seedling mortality in these areas. This situation suggests that the natural recruitment of marula

is insufficient to replace aging and harvested trees. If the current trend persists, marula populations in Nata, Sepako and Manxotae face a high risk of long-term decline or local population collapse, threatening livelihoods that depend on marula-based products and undermining conservation and commercialization efforts. Therefore, there is an urgent need to identify and implement targeted interventions to enhance regeneration, reduce seedling mortality, and ensure the sustainable management of marula resources in Nata–Gweta District, Botswana. Target study sites included fenced areas, farms and residential areas.

Causes, Effects and Solutions

The causes, effects and solutions for Low-regenerating and High Seedling Mortality *Sclerocarya birrea* (marula) at Nata, Sepako and Manxotae villages in Nata-Gweta District are as follows:

Causes of low-regenerating and high seedling mortality sites

The causes include:

- Overgrazing by livestock.
- Destruction of young seedlings by elephants.
- Frequent fires and droughts.
- Competition with other vegetation (mophane woodland).
- Lack of community-based protection measures (e.g., fencing).

Effects of low-regenerating and high seedling mortality sites

The effects include:

- Poor recruitment into juvenile stage.
- Risk of population collapse in certain areas within Nata-Gweta that include Sepako, Manxotae.
- Reduced long-term sustainability of marula resources.
- Decline in fruit yields, affecting household income and marula-based value chains.

Solutions to Low-regenerating and High Seedling Mortality Sites

Enrichment planting in low-regeneration sites (target fenced areas, farms and residential areas);

- Awareness campaigns on sustainable grazing.
- Protection of seedlings through fencing and fire management.
- Awareness campaigns on fire control.
- Planting in areas where marula thrives (site matching).
- Community-based monitoring and care of young marula trees.

- Plant in fenced areas such as farms and residential areas.

Long Term Goal

- To ensure sustainable regeneration and population stability of marula trees in Nata-Gweta, with active community participation.

Short Term Goal

- To establish and protect marula seedlings in Nata, Sepako and Manxotae villages within 5 years (2025-2030).

Objective

- To raise 10,000 seedlings of *Sclerocarya birrea* in Nata, Sepako and Manxotae and successfully plant and manage 5,000 trees in 30 farm fields and 20 residential areas with 80% of planted sites actively maintained by year 3.

Table 5.1: Implementation Action Plan on Enrichment Planting in Low-Regeneration Sites (target fenced areas, farms and residential areas).

Activities	Human Resources	Financial	Physical resources	Responsible person	Timeframe	Expected Re-sults	Performance Indicator
1. Identify and map farms and residential areas to plant marula	Labour costs (Professional fees)	Transport Refreshments Accommodation	GPS, Survey tools,	Gofaone Rammotokara (Lead) District Forestry Technical Staff Village Development Committee Chairperson (VDC)	3 weeks (Dec 2025-March 2026)	Farm fields and residential areas identified and mapped	Baseline survey report completed Number of hectares mapped
	BWP 25,000	BWP 20,000	BWP 10,000				
2. Community mobilization and Household Enrolment & Commitment	Professional fees.	Transport Refreshments Accommodation Fuel	Training materials meeting halls	Gofaone Rammotokara (Lead) District Forestry Technical Staff Village Development Committee Chairperson (VDC)	2 Weeks (March 2025- April 2025)	Target 100 community members Register at least 50 households and farmers to adopt seedlings	Number of people mobilized List of interested farmers and household

Activities	Human Resources	Financial	Physical resources	Responsible person	Timeframe	Expected Results	Performance Indicator
	BWP 10,000	BWP 15,000	BWP 20,000				
3. Establishment of tree nurseries	Professional fees Labour	Transport Refreshments Accommodation	Polythene tubes, water tanks, Tools, Seeds of morula	Gofaone Rammotokara (Lead) District Forestry Technical Staff Village Development Committee Chairperson (VDC)	1 month (September 2025-October 2025)	5000 seedlings raised and ready for planting	Number of seedlings produced; % survival in nursery
	BWP 10,000	BWP 15,000	BWP 10,000				
4. Training & capacity building for selected farmers	Facilitators Transport	Refreshments Accommodation Allowance Venue costs	Training materials Meeting halls	Gofaone Rammotokara (Lead) District Forestry Technical Staff Village Development Committee Chairperson (VDC)	2 weeks (Nov 2025)	50 community members trained Tree planting manuals, cultivation protocols developed	Number of people trained; % applying skills learned
	BWP 20,000	BWP 50,000	BWP 20,000				

Activities	Human Resources	Financial	Physical resources	Responsible person	Timeframe	Expected Re-sults	Performance Indicator
5. Provision of Inputs & support Seedling planting and protection	Professional fees	Transport Refreshments Accommodation	Polythene tubes, water tanks, Tools Seeds of <i>marula</i>	Gofaone Rammotokara (Lead) District Forestry Technical Staff Village Development Committee Chairperson (VDC)	3 weeks (Dec 2025, rainy season)	5000 seedlings provided and ready for planting Simple guides/manuals on seedling care shared	Number of seedlings produced; Number of seedling care and management manual Number of seedlings planted
	BWP 15,000	BWP 25,000	BWP 20,000				
6. Community-Based Monitoring & Mentorship	Professional fees	Transport field visits, Accommodation	Data sheets Printing Stationery	Gofaone Rammotokara (Lead) District Forestry Technical Staff Village Development Committee Chairperson (VDC)	Year 2(June 2026) Beginning of year 2	Village monitoring teams including youth/women formed Household visits for survival checks and technical advice conducted	Number of Village monitoring team formed Number of visits conducted

Activities	Human Resources	Financial	Physical resources	Responsible person	Timeframe	Expected Results	Performance Indicator
	BWP 20,000	BWP 25,000	BWP 5,000				
7. Incentives & Recognition	Professional fees	Transport Accommodation	Certificates design costs Cost of small tools Ceremonial costs	Gofaone Rammotokara (Lead) District Forestry Technical Staff Village Development Committee Chairperson (VDC)	Year 2 (Dec 2026)	Reward households with highest survival rates (certificates, small tools)	Number of certificates issued Number of tools issued
	BWP 10, 00	BWP 15,000	BWP 5,000				

5.2 Action Plan on Mitigating Land Degradation in Moliq, Eritrea

Name: Nezehty Abbay Asmerom
Email Address: ntshtiabay@gmail.com
Country: Eritrea
Organization: National Agricultural Research Institute
Position: Forestry Research Unit Head

Problem Statement on Land Degradation in Moliq, Eritrea

Moliq in Eritrea is facing increasing environmental challenges characterized by widespread land degradation, declining soil fertility and the loss of vital ecosystem functions. Over the years, unsustainable land-use practices such as deforestation, overgrazing, unregulated farming, and human settlement expansion have altered the natural landscape, leaving the land vulnerable to erosion, reduced productivity, and diminished biodiversity. The situation is further aggravated by the impacts of climate change, including erratic rainfall patterns, prolonged dry spells, and extreme weather events, which accelerate soil degradation and hinder natural regeneration processes.

Without targeted interventions, the land in Moliq faces continued decline, threatening local livelihoods and the long-term sustainability of its ecosystems.

Causes, Effects, and Solutions of Degraded Land of Moliq

Causes of Degraded Land of Moliq

- Overdependence on firewood and charcoal.
- Clearing of land for farming.
- Overgrazing.
- Droughts and climate variability.
- Weak enforcement of forestry laws and policies.
- Limited awareness and education.

Effects of land degradation in Moliq, Eritrea

The main effects of land degradation include:

- Deforestation and fuelwood scarcity.
- Soil erosion, declining crop yields.
- Drying of rivers, reduced water availability and crop failure.
- Illegal logging, uncontrolled grazing, encroachment of forests and woodlands.
- Communities undervalue forests, leading to neglect of restoration.

Solutions to the degraded land in Moliqui, Eritrea

Following are the suggested solutions to the degraded land in the area:

- Promote drought-tolerant tree species, efficient cook stoves, alternative energy (Adhanet) and fast-growing fuelwood plantations.
- Adopt agroforestry and conservation agriculture.
- Restore water bodies and soil by constructing soil and water conservation structures.
- Expand enclosures to promote natural regeneration.
- Plant drought-tolerant *Acacia senegal* tree species.
- Develop water harvesting systems such as dams and roof catchments.
- Strengthen community and individual forests.
- Conduct environmental education, strengthen school greening programs and train communities on sustainable forest use.

Long Term Goal

- To restore the degraded area and expand forest cover at Molqui village.

Short Term Goal

- To establish plantations of *Acacia senegal* in 3 years.

Objective

- To plant 50,000 seedlings of drought-tolerant *Acacia senegal* and to rehabilitate seriously degraded areas.

Table 5.2: Implementation Action Plan on Planting Drought-Tolerant *Acacia senegal* Trees in Molqui Village

Activity	Resources needed			Responsible person	Time-frame	Expected Results	Performance Indicator	Budget	Source of fund
1. Site identification & baseline survey	Human Resources	Technical staff		Zonal Forestry representatives and Community	2 – 4 months	Priority degraded sites identified and mapped	Baseline survey report completed; number of hectares mapped		
	Financial	Transport							
	Physical	GPS, survey tools							
2. Seedling Raising	Labor		Seed, Nursery equipment	Responsible person for nursery	3-4 month	Healthy and vigorous seedling Raised	60,000 seedlings raised		
3. Establishment of Plantations	Human		Labor	Sub zoba MoA, community	1- 3 years	60,000 seedlings planted	Number of seedlings planted; % and hectare of land rehabilitated		
	Financial		Seedlings	Students and youth groups					
	Physical		Planting equipment Digging 50,000 holes						

Activity	Resources needed			Responsible person	Time-frame	Expected Results	Performance Indicator	Budget	Source of fund
4. Community mobilization & training	Human	Facilitators		MoA trainers, County extension staff,	Months 3-6	200 community members trained on tree planting & management	Number of people trained; % applying skills learned		
	Financial	Transport							
	Physical	Training materials, meeting halls							
5. Tree planting campaigns	Financial	Transport		Youth groups, schools, local leaders	Months 1-2 (rainy seasons)	50,000 trees planted on farms, schools, and communal lands	Number of trees planted; % survival rate after 1 year		
	Physical	Planting materials							
6. Tree management & protection	Human	community patrols		Forest guards, forestry officers	1-3 years	High survival and growth rate of planted trees	Tree survival rate 60% reduction in browsing damage		
	Financial	Transport							
	Physical	Materials for forest protection,							

Activity	Resources needed			Responsible person	Time-frame	Expected Results	Performance Indicator	Budget	Source of fund
7. Monitoring & evaluation	Human	Labour		Project M&E team, Zonal forestry offices	Bi-annual (over 3 years)	Continuous learning and adaptive management	Bi-annual monitoring reports; evidence of replanted gaps		
	Financial	Transport, field visits, Allowances							
	Physical	Data, staff							
Total Budget								700,000 Nakf	Gov of Eritrea

5.3 Action Plan on Mitigating Carbon Stock Reduction from Natural Forest in Highlands of Ethiopia

Name: Miheret Semere Negash
Email: meharialebachew25@gmail.com
Country: Ethiopia
Organization: Central Ethiopia Development Center
Position: Researcher

Background on Carbon Stock Reduction from Natural Forest in Highlands of Ethiopia

The highlands of Ethiopia, once rich in natural forests, are facing significant reductions in carbon stocks due to widespread deforestation and forest degradation. Unsustainable land-use practices, including agricultural expansion, fuelwood collection, illegal logging, and infrastructure development, have led to a decline in forest cover and, consequently, the forests' ability to store carbon. This loss not only accelerates greenhouse gas emissions but also threatens biodiversity, soil fertility, and essential ecosystem services. The continued decline of forest carbon stocks underscores the urgent need for sustainable forest management and restoration strategies to mitigate climate change and preserve ecological integrity in the region.

Problem Statement

Human activities are driving a rapid increase in carbon emissions, contributing to the degradation of natural carbon sinks and exacerbating climate change. Major sources include fossil fuel combustion, deforestation, industrial activities, and agricultural practices such as fertilizer use and methane emissions. These activities have far-reaching effects, including global warming, increased climate variability, extreme weather events, habitat loss, heightened extinction risks, and adverse human health impacts such as respiratory diseases. Without effective mitigation, these impacts will intensify, threatening ecosystems, livelihoods, and public health. Addressing this problem requires urgent implementation of low-carbon energy technologies, afforestation and reforestation efforts, forest protection, and the adoption of environmentally friendly industrial and agricultural practices to reduce emissions and enhance carbon sequestration.

Causes, Effects and Solutions to Carbon Stock Reduction from Natural Forest in Highlands of Ethiopia

Causes of Carbon Stock Reduction from Natural Forest in Highlands of Ethiopia

Fossil fuel combustion is a major driver of carbon emissions, as the burning of coal, oil, and natural gas for energy production, transportation, and industrial processes releases

large quantities of carbon dioxide into the atmosphere. This continuous release disrupts the natural carbon cycle and significantly contributes to the increase in atmospheric carbon levels.

Deforestation contributes to carbon stock reduction by removing trees that act as natural carbon sinks. When forests are cleared for agriculture, settlement, or fuelwood, the capacity of the ecosystem to absorb carbon dioxide is reduced. Additionally, the cutting and burning of trees release stored carbon back into the atmosphere, further intensifying carbon emissions.

Industrial activity is another significant source of carbon emissions due to processes such as cement production, steel manufacturing, and chemical processing. These activities often depend on fossil fuels and release large amounts of carbon dioxide and other greenhouse gases, thereby increasing atmospheric carbon concentrations.

Agriculture also plays a role in carbon emissions through practices that release greenhouse gases such as methane and nitrous oxide. Methane is commonly emitted from livestock and rice cultivation, while nitrous oxide results from the use of synthetic fertilizers. Furthermore, the conversion of land for agricultural use reduces vegetation cover, limiting the capacity for carbon sequestration.

Effects of Carbon Stock Reduction from Natural Forest in Highlands of Ethiopia

Global warming results from the accumulation of greenhouse gases in the atmosphere, leading to a steady increase in average global temperatures. This warming disrupts natural systems, alters energy balances, and intensifies environmental stress across ecosystems. Climate change manifests through increased seasonal variability, including unpredictable rainfall patterns, prolonged droughts, and more frequent and intense flooding events. These changes disrupt agricultural calendars, reduce water availability, and increase vulnerability of both human and natural systems.

Extreme weather events associated with climate change heighten the risk of species extinction by destroying habitats and altering ecological conditions beyond the tolerance levels of many species. As ecosystems become unstable, biodiversity declines and some species may not adapt or migrate quickly enough to survive.

Human health is also affected, particularly through an increase in respiratory diseases linked to changing weather patterns, higher temperatures, and air pollution. Climate-related factors such as heatwaves and increased allergens can worsen existing health conditions and strain healthcare systems.

There is also a rise in the incidence of pests and diseases as changing climatic conditions create favourable environments for their spread and survival. Warmer temperatures and altered rainfall patterns can expand the range of pests and pathogens, affecting crops, livestock, and human populations.

Solutions of Carbon Stock Reduction from Natural Forest in Highlands of Ethiopia

Energy solutions focus on reducing dependence on biomass and fossil fuels by promoting low-carbon technologies such as solar, wind, and improved energy-efficient stoves. These alternatives help lower pressure on natural forests for fuelwood and reduce overall carbon emissions.

Afforestation enhances carbon sequestration by increasing tree cover through planting initiatives. Establishing trees on degraded or previously non-forested lands helps absorb atmospheric carbon dioxide, restore ecological balance, and improve soil and water conservation.

Forest protection and restoration are critical for maintaining existing carbon stocks and recovering degraded forest ecosystems. This involves strengthening forest governance, enforcing regulations against illegal logging, promoting community-based forest management, and implementing restoration practices such as assisted natural regeneration.

Environmentally friendly technologies support sustainable land and resource use by minimizing environmental degradation. These include climate-smart agricultural practices, efficient irrigation systems, and sustainable harvesting techniques, all of which reduce emissions while enhancing resilience and productivity.

Long term goal

- To increase the carbon stock potential of highland forests in Ethiopia.

Short term goal

- Increase forest carbon sequestration capacity by 50% from 2025 to 2030.

Objective

- To promote afforestation which covers an area 2000 ha through planting of native trees species.

Table 5.3: Implementation Action Plan on Mitigating Carbon Stock Reduction from Natural Forest in Highlands of Ethiopia

Activity	Resources (Funds)	Responsible person	Timeframe	Expected Results	Performance Indicators
Conduct baseline assessment of carbon stock	1 mil. ETB 300,000 ETB (Government budget)	Researcher	Oct, 2025 - Nov, 2025	Carbon stock stored in biomass	Report on carbon stock potential of the forest component (Ton of C/ha)
Tree planting	5000 Tree planting activities	Researcher	June, 2026 - Aug, 2026	>2Million planted trees	A report on: Number of trees planted, Survival rate Mortality rate
Beating up	100,000ETB 10% of planted tree	Researcher	Sep, 2026 - Oct, 2026	Replaced trees based on the mortality rate	A report on the number of trees planted to replace
Conduct carbon stock estimation	1000,000 ETB	Researcher	Oct, 2026 - 2030	Carbon stock stored in biomass	Report on survival rate and annual carbon sequestration rate

5.4 Action Plan on Conservation of Biodiversity in the Kingdom of Eswatini

Name: Mbalenhle Primrose Baxter
Email Address: mbhekeninxumalo@gmail.com
Country: Kingdom of Eswatini
Organization: Ministry of Tourism and Environmental Affairs
Position: Forester

Introduction

Kingdom of Eswatini, a small landlocked country in Southern Africa, is rich in biodiversity, including unique flora and fauna found in its forests, grasslands, wetlands, and savannas. However, the country faces a significant threat from biodiversity loss, which undermines ecosystem health, food security, and socio-economic development.

Problem Statement

The Kingdom of Eswatini, rich in unique forests, grasslands, wetlands, and savannas, is facing significant biodiversity loss. Key drivers include deforestation, overgrazing, overexploitation of wildlife and plants, invasive species, pollution, climate change and urbanization. These pressures have led to habitat loss, declining species populations, soil degradation, and reduced ecosystem resilience, threatening livelihoods and socio-economic development. Urgent interventions, such as afforestation, sustainable grazing, invasive species control, pollution management, and climate adaptation are needed to conserve biodiversity and maintain ecosystem health.

Causes, Effects and Solutions of Loss of Biodiversity in the Kingdom of Eswatini

Causes of Loss of Biodiversity in the Kingdom of Eswatini

Loss of biodiversity is caused by various causes which include:

- Deforestation and habitat loss mainly due to farming, fuelwood and settlements.
- Overgrazing by livestock.
- Overexploitation (hunting, fishing, tree over harvesting).
- Invasive alien species that include *Lantana camara*, *Chromolaena odorata*.
- Pollution (from agriculture and industry).
- Climate change (manifested through droughts, floods, rising temperatures).
- Urbanization and infrastructure development.

Effects of Loss of Biodiversity in the Kingdom of Eswatini

The loss of biodiversity has led to various effects such as:

- Loss of habitats, decline in wildlife populations, soil erosion.
- Land degradation, reduced native plant species, soil infertility.
- Decline in species, food insecurity, reduced medicinal plants.
- Displacement of indigenous plants, reduced biodiversity.
- Water and soil contamination, fish and wildlife deaths.
- Habitat stress, species migration/extinction, reduced ecosystem resilience.
- Habitat fragmentation and loss of migration corridors.

Solutions to Loss of Biodiversity in the Kingdom of Eswatini

The identified solutions to loss of biodiversity are:

- Promote afforestation and reforestation with indigenous species and strengthen protected areas.
- Adopt sustainable grazing systems; rotational grazing and rangeland restoration.
- Enforce regulations; promote community-based natural resource management (CBNRM).
- Control and eradicate invasive species and promote indigenous species planting.
- Promote organic farming, proper waste management and pollution control measures.
- Develop climate adaptation strategies; protect wetlands and ecosystems.
- Implement Environmental Impact Assessments (EIAs).
- Promote green urban planning.

Long Term Goal

- To restore 5,000 hectares of degraded land in Eswatini through the planting of one million indigenous tree seedlings, and to strengthen the management effectiveness of 80% of protected areas in order to enhance biodiversity conservation and climate resilience by 2033.

Short Term Goal

- To establish 5 indigenous tree nurseries in 2 years for restoring 2000 ha of degraded land through pilot reforestation project, and train 100 people to strengthen management in protected areas.

Objective

- To increase forest cover through afforestation and reforestation within 3 to 10 years.

Table 5.4: Implementation Action Plan on Promotion of Afforestation and Reforestation with Indigenous Species; Strengthen Protected Areas

Activities	Resources needed			Responsible person	Timeframe	Expected Results	Performance Indicator
1. Establishment of indigenous tree nurseries	Human Resources	Financial	Physical	MTEA - Forestry ENTC NGOs Private sectors Schools	01 April 2026 to 30 March 2028	At least 5 indigenous tree nurseries established. Increased community involvement in tree planting. Enhanced capacity for large scale afforestation and reforestation	Number of nurseries established, and seedlings produced annually. The % survival rate of seedlings. Number of communities benefiting from nurseries. Hectares restored using nursery seedlings.
	Forestry officers Nursery attendants Construction workers, communities	Government allocations Private sector partnerships Donors; GEF, UNDP, FAO E20,35M	Nursery site (land), Fencing materials, Shade nets, poles, tools, Storage facilities, Transport, Irrigation system, water tanks, potting bags				

Activities	Resources needed			Responsible person	Timeframe	Expected Results	Performance Indicator
2. Raise and plant indigenous seedlings in the degraded areas	Human	Financial	Physical	Lead: MTEA-Forestry Partners: ENTC, local communities, NGOs, academic institutions, schools, private sector.	Short-term 01 April 2026 to 30 March 2029: Raise 300,000 seedlings and plant them in 1,500 hectares of degraded land. Medium-term 01 April 2020 to 30 March 2025: Scale up to 600,000 seedlings for 3,500 hectares. Long-term (01 April 2026 to 30 March 2036 years): Reach 1 million seedlings for 5,000 hectares restored.	Increased forest cover in degraded landscapes. Improved biodiversity and ecosystem services. Communities engaged in sustainable land restoration. Reduced soil erosion and climate vulnerability. Enhanced water catchment protection.	A report on no. of - seedlings raised and planted. - Hectares of degraded land restored - communities involved in planting. - The % survival rate of planted trees - The % increase in forest cover.
	Forestry officers, nursery attendants, extension staff, community volunteers, NGOs, school clubs	Government budget allocations, donor support (GEF, UNDP, FAO), private sector/CSR funding E1.67M	Indigenous seedlings, nursery facilities, planting tools (hoes, spades, watering cans), transport for seedlings, protective fencing, irrigation systems, monitoring equipment.				

Activities	Resources needed			Responsible person	Timeframe	Expected Results	Performance Indicator
3. Conduct training and awareness campaigns for communities.	Human	Financial	Physical	Lead: MTEA-Forestry Partners: ENTC, NGOs, local chiefs, schools, private sector, community-based organizations.	Short-term 01 April 2026 - March 2029: Conduct at least 20 training workshops and 10 awareness campaigns across regions. Medium-term 01 April 2029- 30 March 2032: Integrate environmental education into schools and community development programs.	Conduct at least 20 training workshops and 10 awareness campaigns across regions. Integrate environmental education into schools and community development programs	Attendants register. Number of trainings, workshops, campaign conducted participants trained. The % increase in community participation in afforestation activities. Reduction in cases of illegal forest use reported.
	Community leaders, trainers/facilitators, Media personal Local school	Government budget, donor funding (FAO, UNDP, GEF), NGO grants, private sector sponsorship. E732,000	Venues Posters Brochures Burners Audio-visual material, transport, ICT Tools, land for demonstration seedlings				

Activities	Resources needed			Responsible person	Timeframe	Expected Results	Performance Indicator
4. Develop and implement management plans for degraded areas	Human	Financial	Physical	Lead: MTEA-Forestry Partners: ENTC, local communities, chiefs, NGOs, academic institutions, private sector.	Short-term 01 April 2026 – 30 March 2029: Develop management plans for at least 3 priority degraded areas. Medium-term 01 April 2029 – 30 March 2032: Implement and monitor plans across 5–7 degraded areas. Long-term 01 April 2029- 30 march2032: Scale up to cover all major degraded ecosystems in Eswatini.	Clear, actionable management plans developed and adopted. - Improved restoration and protection of degraded areas. - Increased community participation in land rehabilitation. - Reduced land degradation, soil erosion, and biodiversity loss.	Number of management plans developed and approved. Number of degraded hectares under active management. The % of plans fully implemented. Community participation rate in restoration activities. Improvement in vegetation cover and biodiversity in targeted areas.
	Forestry officers, land-use planners, conservation experts, GIS specialists, extension staff, community representatives, NGOs	Government allocations, donor funding (GEF, UNDP, FAO), private sector/CSR contributions E1.59M	Mapping and survey equipment (GPS, GIS software), vehicles for fieldwork, training facilities, nursery seedlings, protective fencing, restoration tools				

Activities	Resources needed			Responsible person	Timeframe	Expected Results	Performance Indicator
5. Strengthen law enforcement to prevent deforestation and encroachment	Human	Financial	Physical	Lead: MTEA-Forestry Partners: ENTC, Royal Eswatini Police, local chiefs, judiciary, NGOs, community-based organizations.	Short-term 01 April 2026- 30 march 2029: Train rangers and strengthen enforcement mechanisms. Medium-term 01 April 2030 – 30 march 2033: Roll out regular patrols and community reporting systems in priority areas. Long-term 01 April 2030 to 30 march 2033: Maintain zero tolerance for deforestation and ensure sustainable land management.	Reduced rates of illegal logging, encroachment, and forest degradation. - Stronger collaboration between communities and law enforcement. - Protected areas safeguarded from illegal use. - Increased accountability and compliance with forestry laws.	Number of enforcement officers/rangers trained. Number of patrols conducted annually. Number of illegal activities detected and prosecuted. The % reduction in deforestation and encroachment cases. Area of protected forests safeguarded.
	Forestry officers, law enforcement agencies, legal experts, local chiefs, community scouts	Government funding, donor support (GEF, UNDP, FAO), private sector/CSR contributions E2.22M	Patrol vehicles, uniforms, communication radios, GPS units, drones for surveillance, legal and training materials, monitoring equipment.				

Activities	Resources needed			Responsible person	Timeframe	Expected Results	Performance Indicator
6. Monitor & evaluate progress	Human	Financial	Physical	Lead: MTEA-For-estry, M&E Unit). Partners: ENTC, NGOs, academic institutions, donor agencies, local communities.	Short-term 01 April 2026 to 30 March 2029: Establish M&E framework and conduct baseline assessments. Medium-term 01 April 2030- 30 March 2033: Carry out mid-term evaluations and progress reviews. Long-term (01 April 2024- 30 March 2028: Conduct final impact assessments and publish progress reports.	Reliable data on progress of afforestation & reforestation activities. Timely identification of challenges and gaps. Improved accountability and decision-making. Evidence-based reporting to donors, government, and communities. Enhanced transparency in conservation projects.	Existence of an operational M&E framework. Number of monitoring missions conducted annually. The % of project sites with updated progress reports. Number of mid-term and final evaluations completed. Improvements in survival rate of planted seedlings and forest cover trends.
	M&E specialists, forestry officers, GIS technicians, extension staff, community representatives, NGO staff	Government budget for monitoring, donor funding (UNDP, FAO, GEF), private sector/CSR contributions E1.02M	Monitoring tools (GPS, GIS software, drones, field data sheets, mobile apps), vehicles for site visits, computers, reporting templates, training facilities.				

Sustainable Management Key Principles for the Action Plan

- Conservation of resources: Avoid overexploitation of forests, water, and wildlife.
- Restoration and protection: Replant trees, restore degraded lands and protect endangered species.
- Balanced use: Use resources for economic and social benefits without harming the environment.
- Community involvement: Local communities participate in decision-making and benefit from resource use.
- Monitoring and regulation; Laws and policies ensure responsible harvesting, farming, and development. Examples in Eswatini: Forestry: Planting indigenous trees and controlling logging to maintain forest cover.
- Agriculture: Practicing crop rotation, organic farming, and agroforestry to sustain soil fertility.
- Wildlife management: Establishing protected areas and regulating hunting to preserve species.
- Water resources: Harvesting rainwater, protecting wetlands, and reducing pollution.

5.5 Action Plan on Restoration and Conservation the Mau Forest Complex as a Climate-Resilient Water Tower and Livelihood Source in Kenya

Name: Wato Gregory Godana
Email Address: watagodana@yahoo.com
Country: Kenya
Organization: Ministry of Environment, Climate Change and Forestry
Position: Assistant Director Forest Management and Conservation

Introduction

The Mau Forest Complex, the largest indigenous forest in Kenya, is a critical ecosystem that serves as a key water tower for several major rivers, supports rich biodiversity, and sustains the livelihoods of surrounding communities. Over the years, unsustainable land-use practices, including deforestation, illegal logging, and agricultural encroachment, have led to severe forest degradation, resulting in reduced water supply, loss of biodiversity, soil erosion, and diminished climate resilience. Restoring and conserving the Mau Forest is therefore essential not only for maintaining ecological integrity and water security but also for enhancing community livelihoods through sustainable resource use. This action plan outlines targeted interventions to restore degraded areas, promote climate-resilient forest management, and ensure that the Mau Forest continues to provide critical ecosystem services and socio-economic benefits for present and future generations.

Problem Statement

The Mau Forest Complex in Kenya is facing severe degradation due to deforestation, illegal logging, and agricultural encroachment. This has led to reduced water supply, loss of biodiversity, soil erosion, and decreased climate resilience, threatening both the environment and the livelihoods of communities that depend on its resources. Without immediate restoration and conservation interventions, the forest risks further decline, undermining its role as a vital water tower and a source of socio-economic benefits.

Causes, Effects and Solutions

Causes

- Deforestation and illegal logging.
- Agricultural encroachment.
- Charcoal production and fuelwood collection.
- Climate change (erratic rainfall, droughts).
- Poor governance and weak enforcement.
- Invasive plant species.

Effects

- Loss of forest cover, reduced biodiversity, soil erosion.
- Habitat destruction, fragmentation of forest, reduced water catchment.
- Depletion of forest resources, loss of carbon stock.
- Reduced water availability, forest stress, increased vulnerability to fires.
- Uncontrolled exploitation and continued forest degradation.
- Displacement of native flora, reduced biodiversity.

Solutions

- Enforce forest protection laws, promote community forest monitoring, and sustainable logging practices.
- Promote sustainable agriculture, buffer zones, and agroforestry practices.
- Introduce alternative energy sources (e.g., biogas, solar) and promote efficient cookstoves.
- Implement climate-resilient forest management and reforestation with native species.
- Strengthen forest governance, community participation and stakeholder collaboration.
- Control and eradicate invasive species and restore native vegetation.

Long Term Goal

- Restore and conserve the Mau Forest Complex as a climate-resilient water tower and livelihood source.

Short Term Goal

- Strengthen community-based restoration, protection, and sustainable livelihood systems in 5 pilot blocks.

Objectives

1. Increase national tree/forest cover and landscape resilience (supporting Kenya's restoration commitments e.g., 5.1M ha restoration and 15 billion trees campaign).
2. Reduce deforestation drivers (agricultural conversion, charcoal/illegal logging, fires) by 40% in targeted landscapes within 5 years.
3. Improve livelihoods for 200,000 households through agroforestry, sustainable wood fuel value chains and payment-for-ecosystem-services (PES) by year 5.
4. Establish an operational national MRV and community MRV system for forests and reporting to NDC/REDD+ within 24 months

Table 5.5: Implementation Action Plan on Restoration and Conservation of Mau Forest

Activities	Resources needed	Responsible person	Collaborator	Timeframe (months)	Expected Results	Performance Indicator
Conduct landscape baseline & planning						
Map 10,000 ha degraded areas - Hold County & community consultations - Develop restoration plan	GIS tools, facilitation funds, technical experts	State dept forestry director	KFS	1-2	Priority restoration zones identified & LRP completed	ha mapped; consultations; LRP published
Strengthen nursery capacity						
Assess nursery stock - Train 100 operators - Establish 10 community nurseries	Seeds, tools, training materials	State dept forestry director	KEFRI, CFAs, NGO	1-3	10 functional nurseries supplying climate-resilient species	nurseries; operators trained; seedlings available
Mobilize communities & CFAs						
Register/strengthen CFAs - Governance & finance training - Sign MoUs with KFS	Training materials, legal support, facilitation	State dept forestry director	KFS, CFAs, County govts	2-4	CFAs with legal backing & co-management MoUs	CFAs with MoUs; members trained

Activities	Resources needed	Responsible person	Collaborator	Timeframe (months)	Expected Results	Performance Indicator
Implement reforestation & Assisted Natural Regeneration (ANR)						
Plant 2M seedlings - ANR on 2,000 ha - Community patrols	Seedlings, tools, labour, patrol kits	State dept forestry director	CFA, KFS, NGOs	3-6	4,000 ha restored; improved survival rates	CFAs with MoUs; members trained
Promote agro forestry for livelihoods						
- Train 1,000 farmers - Distribute seedlings - Establish 20 demo farms	Agro-forestry seedlings, demo inputs	State dept forestry Officers	County, Agriculture dept	4-6	Farmers adopt diversified agro forestry	Farmers trained; Demo farms; Adoption rate
Support sustainable energy alternatives						
Distribute 5,000 cookstoves - Pilot 2 sustainable charcoal groups - Promote briquettes	Cook stoves, kilns, briquette machines	State dept forestry Director	Ministry of Energy, NGO, PRIVATE	5-7	Reduced wood fuel pressure; clean energy uptake	Cook stoves; Groups; briquette start-ups
Strengthen law enforcement						
- Deploy 100 scouts - Pilot digital permits - Conduct patrols	Scout gear, ICT systems, transport	State dept forestry officer	KFS, CFAS, County GOVT	6-8	Illegal logging incidents reduced	scouts; patrols; % reduction in illegal activities

Activities	Resources needed	Responsible person	Collaborator	Timeframe (months)	Expected Results	Performance Indicator
Pilot PES & REDD+ finance						
- Launch 2 PES schemes - Draft REDD+ concept - Establish revolving fund	Scout gear, ICT systems, transport	State dept forestry Officers	Treasury, KFS, water companies	7-9	Sustainable financing initiated	scouts; patrols; % reduction in illegal activities
Build capacity & research						
- KEFRI trials on resilient species - Pest/disease training - Fire drills	Research funds, training kits	Forestry officer	KEFRI, Universities	9-11	New knowledge applied; community capacity built	trials; trainees; drills
Establish MRV & review						
- Run MRV cycle - Publish Year 1 report - Hold review workshop	Satellite imagery, ground data, facilitators	Forest director	KFS, NGOs	10-12	MRV operational; lessons shared; Year 2 plan ready	Feedback report

5.6 Action Plan on Advancing Sustainable Forestry, Climate Resilience and Landscape Restoration in Kenya

Name: Penina Ngugi
Email Address: pengugi@kefri.org
Country: Kenya
Organization: Kenya Forestry Research Institute
Position: Research Scientist

Introduction

The Kenya Forestry Research Institute (KEFRI) plays a fundamental role in advancing sustainable forestry, climate resilience and landscape restoration across the country. However, the effective implementation of its mandate continues to face persistent resource constraints ranging from limited financial allocations and human capacity to infrastructural gaps. These challenges not only hinder the delivery of research outputs and stakeholder services but also compromise KEFRI's ability to scale innovations and respond to emerging environmental priorities.

To address these constraints, this action plan proposes a strategic shift toward strengthening resource mobilization through three interlinked approaches:

1. Building strategic partnerships with government agencies, county governments, private sector actors and civil society organizations to co-finance and co-implement priority programs.
2. Enhancing donor engagement by building institutional capacity in proposal development, grant management and reporting ensuring alignment with national and global funding priorities.
3. Commercializing selected research outputs, including certified seeds, technical manuals and forestry technologies, to generate revenue, increase innovation uptake and promote institutional sustainability.

Problem Statement

Kenya faces increasing challenges related to forest degradation, climate change impacts, and declining ecosystem services, which threaten livelihoods, biodiversity, and national development goals. Advancing sustainable forestry, climate resilience, and landscape restoration requires strong scientific research, innovation, and coordinated stakeholder engagement. While the Kenya Forestry Research Institute (KEFRI) plays a central role in generating forestry research, technologies, and policy support, the effective implementation and scaling of its mandate are constrained by limited financial resources, inadequate human capacity, and infrastructural gaps. These constraints restrict KEFRI's ability to deliver timely research outputs, support stakeholders, and respond to emerging environmental and climate priorities. Without strengthened resource mobilization and institutional sustainability, efforts to promote sustainable forestry, enhance climate resilience, and restore degraded landscapes in Kenya will remain fragmented and insufficient.

Causes, Effects and Solutions

Causes

- Limited financial allocations for forestry research and landscape restoration initiatives.
- Inadequate human capacity and specialized skills to meet expanding environmental and climate demands.
- Infrastructure gaps affecting research delivery, innovation scaling, and outreach.
- Weak engagement with donors, private sector actors, and non-state partners.
- Underutilization of opportunities to commercialize research outputs and technologies.

Effects

- Slow adoption and scaling of sustainable forestry and climate-resilient innovations.
- Reduced effectiveness of landscape restoration programs.
- Limited support to national and county governments in addressing forest and climate challenges.
- Missed opportunities for revenue generation and institutional sustainability.
- Reduced capacity to respond to emerging issues such as climate variability, land degradation, and biodiversity loss.

Solutions

- Strengthening strategic partnerships with government agencies, county governments, private sector actors, and civil society organizations to co-finance and co-implement priority programs.
- Enhancing donor engagement through improved institutional capacity in proposal development, grant acquisition, project implementation, and reporting.
- Commercializing selected KEFRI research outputs, including certified tree seeds, forestry technologies, and technical manuals, to generate sustainable revenue.
- Investing in human capacity development and research infrastructure to support innovation and service delivery.
- Aligning forestry research and resource mobilization efforts with national development plans and global climate and restoration frameworks.

Long-Term Goal

- Establish a sustainable resource mobilization framework that supports KEFRI's research, training, and restoration mandates across all sub-Centres.

Short-Term Goal

- Enhance institutional capacity to attract funding and partnerships for priority programs.

Objective

- Strengthen resource mobilization through partnerships, donor engagement and commercialization of research outputs.

Table 5.6: Implementation Action Plan on Advancing Sustainable Forestry, Climate Resilience and Landscape

Activity	Resources Needed	Responsible Person	Time Frame	Expected Results	Performance Indicator	Sustainability measures
Map potential donors, partners, and markets for KEFRI products	Budget for stakeholder forums, exhibitions, and training	Director	Oct 2025 - Oct 2026	Increased number of funded projects and partnerships	Number of new partnerships and MoUs signed	Develop and maintain a centralized digital database of donors and partners, Embed donor and partner mapping into KEFRI's strategic work plan
Develop a resource mobilization strategy and donor engagement toolkit	Skilled personnel in fundraising, marketing, and partnership development	Corporate Services	Jan 2027 - Dec -2029	Improved visibility of KEFRI innovations and services	Amount of funds mobilized annually	Assign mobilization and planning unit to manage, update and champion the tools Train staff across department and sub-Centres on how to use the strategy and toolkit effectively Track usage of toolkit developed at staff engagement levels
Organize stakeholder forums and exhibitions to showcase KEFRI innovations	ICT tools for donor tracking and proposal development	Heads of Research Programs, Sub-Centre Officers in Charge	Jan 2030 - Dec 2031	Increased awareness and visibility, strengthened partnerships and collaborations, improved uptake of innovations	Number of new partners or MoU signed, number of innovations showcased, number of training materials distributed, number of stakeholders trained	Allocate dedicated budget for stakeholder engagement in institutional plans. Establish long term collaboration agreements to support recurring forums and exhibitions Build repository of exhibition materials (banners, brochures, demo kits)

Activity	Resources Needed	Responsible Person	Time Frame	Expected Results	Performance Indicator	Sustainability measures
Train staff on proposal writing, grant management, and commercialization	Legal and policy support for commercialization protocols, training materials	Resource Mobilization Unit	Jan-June 2032	Strengthened institutional capacity in fundraising and donor relations	Number of training sessions, conducted, number of staff trained, number of donor proposals developed	Include proposal writing and commercialization outputs in staff appraisal systems Track number of proposals developed, grants secured by trained staff Allocate dedicated budget for ongoing trainings and mentorship
Pilot commercialization of selected research outputs (e.g., certified seeds, manuals, technologies)	Technical writers and editors, training facilitators, demonstration plots, budgets, M&E tools	Director corporate services, Heads of research program, Sub centre officers, Resource mobilization lead	Jul 2032-July 2033	Enhanced visibility and uptake of innovations, Revenue generation, Improved capacity among staff and stakeholders	Number of manuals distributed, number of technologies deployed, number of stakeholders trained	Periodically review and update manuals and technologies to reflect new research findings and user needs Involve sub-Centres in identifying locally relevant innovations for commercialization

5.7 Action Plan on Restoration of Degraded Landscapes in ASALS in Kenya

Name: Elizabeth Muthoni Kariuki

Email Address: ngatializ@gmail.com

Country: Kenya

Organization: Kenya Forest Service

Position: Forest Conservator

Introduction

Kenya is located in East Africa with 29 ASAL (Arid and Semi-Arid Lands) counties that cover over 80% of the country's landmass and house approximately 16 million people, with the majority living in rural areas. These regions are characterized by high poverty rates, vulnerability to climatic shocks and recurrent droughts. Communities almost wholly depend on wood fuel. Strengthening Forestry Sector Development and Community Resilience to Climate Change through Sustainable Forest Management and Landscape Restoration (SFS-CORECC) project is operating in 8 of the 29 counties being Tharaka- Nithi, Embu, Meru, Kilifi, Kitui, Kwale, Makueni and Taita- Taveta. Intervention is to strengthening forest sector to create community resilience to climate change effects through Sustainable Forest Management (SFM) and Landscape. Activities include commercial forestry through planting of drought tolerant species (Melia, Acacias and fruits).

Problem Statement

The ASAL counties of Tharaka-Nithi, Embu, Meru, Kilifi, Kitui, Kwale, Makueni, and Taita-Taveta are experiencing accelerating landscape degradation driven by recurrent droughts, declining tree cover, and heavy dependence on wood fuel. In these counties, prolonged dry conditions, unsustainable land-use practices, and pressure on remaining forest resources have resulted in soil erosion, reduced land productivity and loss of ecosystem services. The degradation has weakened household livelihoods, intensified poverty, and reduced the capacity of communities to cope with climate variability and climate-related shocks. Existing restoration efforts remain inadequate to reverse the scale of degradation across these landscapes. Without targeted restoration of degraded lands through sustainable forest management and the establishment of drought-tolerant tree species, environmental decline in these counties will continue to undermine climate resilience and sustainable development.

Causes, Effects and Solutions

Causes

Causes of landscape degradation include:

- Lack of community ownership, weak policy frameworks and poor governance leading to overexploitation of natural resources (tragedy of the commons)

- Limited technical capacity and inadequate skilled staff, resulting in weak climate change mitigation
- High poverty levels contributing to deforestation and heavy dependence on natural resources

Effects

These challenges have resulted in several adverse effects, including:

- Overexploitation of natural resources.
- Increased malnutrition among communities.
- Soil erosion and land degradation.
- Drying of riverbeds and reduced water availability.
- Limited capacity of communities and institutions to respond to climate change impacts.

Solutions

To address these issues, solutions include:

- Raise awareness and lobby for the integration of climate change considerations into policies and planning.
- Build technical capacity through Training of Trainers (ToTs) on climate change.
- Promote sustainable livelihood and conservation practices, including fruit tree planting, water harvesting technologies and production of alternative energy sources such as briquettes.

Long Term Goal

- To Sustainably manage forests and landscape restoration by achieving and maintaining over 30 percent tree cover and community resilience in the 8 pilot counties of SFS-CORECC Project by 2028, vision 2030 and National determined contributions among others.

Short Term Goal

- To increase tree cover and strengthen community capacity for sustainable forest management and landscape restoration in the eight SFS-CORECC pilot counties within one year through targeted planting of drought-tolerant species and climate-resilient practices by 2026.

Objectives

General Objective

- To restore degraded landscapes in Kenya's ASAL regions in order to enhance ecosystem functionality, strengthen climate resilience, and improve sustainable livelihoods through sustainable forest management and landscape restoration.

Specific Objectives

1. To rehabilitate degraded ASAL landscapes through the establishment of drought-tolerant tree species such as Melia, Acacia, and suitable fruit trees.
2. To strengthen sustainable forest management practices that reduce pressure on natural forests and wood fuel resources.
3. To enhance community resilience to climate change impacts, particularly drought, through commercial forestry and diversified livelihood options.
4. To support the implementation of SFS-CORECC interventions in target ASAL counties by promoting climate-smart forestry and landscape restoration approaches.

Table 5.7: Implementation Action Plan on Restoration of Degraded Landscapes in ASALS in Kenya

Objective	Activities	Resources Needed	Responsible	Time Frame	Expected Results	Performance Indicators
Strengthen FLR frameworks	Launch CC initiative, integrate actions	Email, transport, venue, stationery	CFC, Commissioner, CEC Env.	10–30 Oct 2025	8 launches; 8 action plans adopted	Integration of plans into county CC plans
Plant 64,000 fruit trees	Tree planting & CC awareness	Fruit seedlings, fuel, labour, transport	CFC, CEC Env., Community	10–30 Oct 2025	64,000 fruit trees planted	Survival reports, school greening
Build CC capacity of 40 officers per county	Training of TOTs for 2 days	Transport, venue, DSA, facilitators	KEFRI, KFS, MoECCF	Dec–Jan 2025	8 training reports; 320 trained	Effective implementation of plans
Restore degraded ASALs – 16 Ha Melia sites	Plant Melia, adopt-a-plot, fencing, watering	Seedlings, labour, transport, DSA, funds	KFS, CFA, KEFRI	Mar–May 2026	16 Ha Melia established	Melia sites adopted & maintained
Establish nurseries – 480,000 seedlings	Support production of Melia, acacia & fruits	Polytubes, seeds, greenhouse, labour, fuel	CFC, Forester, KEFRI	Mar–May 2026	480,000 seedlings raised	Enough quality seedlings produced

5.8. Action Plan on Reducing High Carbon Emissions in Lesotho

Name: Rethabile Mathola
Email Address: rethabilemathola@gmail.com
Country: Lesotho
Organization: Lesotho Agricultural College
Position: Principal Lecturer

Introduction

Lesotho is a landlocked country located in Southern Africa, entirely surrounded by South Africa with nine official borders. It covers a total land area of approximately 30,355 km², whereby over 80% of the country situated above 1,800 meters above sea level. The location therefore subjects Lesotho to be the coldest country in Africa hence there is core challenge of burning firewood which result in carbon emissions.

Problem Statement

Lesotho is experiencing high carbon emissions primarily from fossil fuel combustion, deforestation, unregulated industrial and agricultural activities. These emissions contribute to climate change, exacerbate environmental degradation and threaten human health and livelihoods. Without effective mitigation strategies and adoption of low-carbon technologies, Lesotho risks worsening climate impacts, including extreme weather events, reduced agricultural productivity and increased vulnerability of communities to environmental shocks.

Causes, Effects and Solutions for High Carbon Emissions in Lesotho

Causes

The main drivers of high carbon emissions in Lesotho stem from human activities, population pressures and environmental factors:

- **Urbanization:** Migration from rural areas to cities increases demand and overuse of resources.
- **Overexploitation of resources:** High demand for natural resources leads to their rapid depletion.
- **Climate change impacts:** Severe cold weather forces people to rely heavily on firewood for heating.
- **Pollution:** Industrial and power station emissions from combustion of inorganic materials release large amounts of carbon.
- **High population growth:** Rapid population increase drives higher consumption of energy and natural resources.

Effects

The consequences of these causes have far-reaching impacts on the environment and human well-being:

- Environmental degradation: Loss of green spaces and degradation of natural habitats.
- Extinction of resources: Depletion of natural resources reduces availability for future generations.
- Deforestation: Forests are cleared for housing and other land uses altering ecosystems.
- Soil pollution: Contamination affects plant growth and ecosystem health.
- Increased energy consumption: Higher demand for electricity, heating, cooling and transportation fuels carbon emissions.

Solutions

Addressing high carbon emissions requires coordinated environmental, social and technological interventions:

- Allocation of resources: Improve equitable distribution of resources to reduce overuse.
- Agroforestry practices: Promote sustainable agriculture, permaculture, smart agriculture and regenerative farming.
- Reforestation: Plant trees to restore degraded forests and enhance carbon sinks.
- Renewable energy: Transition to clean energy sources such as solar, wind and hydroelectric power.
- Sustainable resource management: Implement practices that minimize resource use and promote efficiency

Long Term Goal

- To mitigate the effects of climate change in Lesotho.

Short Term Goal

- Improve agroforestry practice by cover by 50% from 2025 to 2030.

Objective

- To promote biodiversity by planting diverse tree species in 5000 hectares.

Table 5.8: Implementation Action Plan on Mitigation of Climate Change in Lesotho

Activity	Resources (Funds, experts)	Budget	Partners (Funders)	Responsible person	Timeframe	Expected Results	Performance Indicators
Awareness campaign for Agroforestry	Community farmers and schools	M 50,000	Roll SADP MAFSN	Mr. Mathola (natural resource officer)	05 October 2025-15 October 2025	100 farmers educated	Report of the campaign
Capacity building/ Training about Agroforestry practice	Students/LAC staff(trainers)	M2,000.00	IFAD ROLL Gov. of Lesotho	Mr. Mathola (natural resource officer)	1 August 2025- 2 August 2025	100 farmers trained	-Attendance list -Training report
Tree Planting	Tree seedlings	M 500,000	Gov. of Lesotho Renoka Organisation	Mr. Mathola (natural resource officer)	1 October, 2025 – 23 December, 2025	50, 000 trees	-A report on number of trees planted -Percentage survival rate
Crop selection	Crop scientist	M 3,000.00	Gov. of Lesotho	Mr. Mathola (natural resource officer)	2 October 2025- 3 October 2025	3 crop species planted	-Report on planted crops - emergency percentage
Monitoring and Evaluation	Coordinator, Supervisor, Trainers	M5000,00	Gov. of Lesotho	Forest officer	5 August 2025- 31 August 2030	Farm visits and monitoring teams	Number of monitoring reports and visits

Table 5.8.1: Sustainable Management Activities/Practices

Activities	Explanation
Climate Smart Agriculture	Diversification of cropping systems by planting adaptable trees and crop species
Rangeland and livestock management practice	Rotational grazing, reseeded, promotion of silage and diversification of livestock will help for good management
Good approach on forestry, soils and biodiversity	Soil management practices such as organic soil management that include adding manure, practice agroforestry
Water resources and watershed management	Integrated watershed management approach will help good protection of resources
Renewable energy and sustainable livelihoods	Clean energy help to mitigate climate change as emissions are compromised
Disaster risk and climate services	Awareness and risk assessment are important to mitigate disasters

5.9 Action Plan on Sustainable Forest Management and Climate-Resilient Landscapes Restoration in Sierra Leone

Name: Alex Saffa Vandí
Email: vandialexsaffa123@gmail.com
Country: Sierra Leone
Organization: Ministry of Environment and Climate Change
Position: Conservator of Forests

Introduction

Sierra Leone’s forests and landscapes play a vital role in sustaining rural livelihoods, regulating water systems, supporting biodiversity, and buffering communities against the impacts of climate change. However, decades of deforestation, shifting cultivation, mining activities, urban expansion, and weak enforcement of environmental regulations have significantly reduced the country’s forest cover and degraded many of its ecosystems. These pressures have exposed communities to increasing climate-related risks such as flooding, landslides, soil erosion, and declining agricultural productivity. With climate change intensifying rainfall variability, sea-level rise, and extreme weather events, the need for effective landscape restoration and sustainable forest management has become more urgent than ever.

Causes, Effects and Solutions

Table 5.9.1 outlines causes and effects of unsustainable forest management, climate change and landscape degradation that hinder climate-resilient and landscapes restoration in Sierra Leone. Further, solutions/intervention to unsustainable forest management, climate change and landscape degradation are also provided in the same table.

Table 5.9.1: Causes, effects and solutions for sustainable forest management and climate-resilient landscapes restoration in Sierra Leone.

Problem	Causes (Problems/ Drivers)	Effects (Impacts)	Solutions (Interventions)
Limited technical capacity of staff	Limited technical capacity of forestry staff	Weak forest governance, unsustainable practices, low policy implementation	Conduct training; train 200 staff in sustainable forest management, GIS, and climate-smart forestry
	Lack of community resilience strategies	Increased vulnerability to climate change, forest degradation, and livelihood insecurity	Establish 5 community pilots in agroforestry, water harvesting, and restoration to build resilience

Problem	Causes (Problems/ Drivers)	Effects (Impacts)	Solutions (Interventions)
	Weak forest monitoring and enforcement	Rising deforestation and illegal logging	Operationalize GIS/ remote sensing for 70% of forests; strengthen patrols and enforcement tools
	Poor alignment with forestry/ climate policies (REDD+, NDCs, restoration strategies)	Missed targets and weak international reporting	Develop 3 policy reporting tools; build institutional capacity for compliance and reporting
	Low community engagement and benefit-sharing	Conflicts over resources, weak ownership, low adoption of SFM	Strengthen 10 Community Forest Associations; sign 5 benefit-sharing agreements
	Limited knowledge transfer within institutions	Training benefits do not cascade, leading to isolated impacts	Conduct 5 in-house trainings annually; reach 500 secondary beneficiaries through workshops and demonstrations

Long Term Goal

- To achieve sustainable forest management and climate-resilient landscapes restoration in Sierra Leone.

Short Term Goal

- To strengthen forestry staff capacity, enhance community resilience, and operationalize monitoring and reporting systems within the next three years.

Objective

- To train at least 200 forestry staff by 2028, and establish five community pilot projects on climate-smart forestry.

Table 5.9.2: Implementation Action Plan on Sustainable Forest Management and Climate-Resilient landscapes restoration in Sierra Leone

Strategic Objective	Key Activities	Resources Needed			Responsible Actors		Time Frame	Expected Results	Performance Indicators	Source of Funds
Strengthen Technical Capacity	Conduct training on sustainable forest management (SFM), landscape restoration, and climate-smart forestry practices.	Human	physical	Financial	Ministry Environment & Climate change	Collaborators	Year 1–2 Jan 2026– Dec 2028	Staff acquire modern forestry and restoration skills	Number of staff trained; % applying new skills	GOSL FAO EU JICA
	Organize exchange visits and mentorship programs.	Training Experts, Trainers	Training materials ICT tools	Transport funding	Forestry Department,	KEFRI experts, CFAs, Community leaders		Communities adopt resilience practices; reduced vulnerability	Number of households adopting climate-smart practices; survival rate of planted trees	
Improve Climate Resilience of Forest Communities	- Pilot climate-smart forestry projects (e.g., agroforestry, dryland restoration).	technical expertise Farmers, and Other Forest users	Demonstration sites, seedlings, community mobilization	Funding needs	Forestry Dept.	KEFRI experts, CFAs, Community leaders	Year 1–3 Jan 2026– Dec 2029	Improved forest monitoring and reduced Illegal activities	% increase in forest cover monitored number of enforcement actions taken	GOSL Action Aids, EU UNDP Local Council
	Integrate nature-based solutions into community adaptation plans.									

Strategic Objective	Key Activities		Resources Needed			Responsible Actors	Time Frame	Expected Results	Performance Indicators	Source of Funds
			Experts	Policy manuals, reporting templates, and training workshop						
Support Implementation of Forestry & Climate Policies	- Train staff on NDCs, REDD+, and restoration strategies.					KEFRI Experts NGOs, Local chiefs, CFAs	Year 2–3 Jan 2027– Dec 2029	Communities empowered in forest governance and conflict reduced	Number of functional CFAs; % of community members engaged	GOSL FAO EU UNDP JICA
	-Develop reporting tools and guidelines for policy compliance					Forestry Dept,				
Promote Community-Based Forest Management (CBFM)	- Train staff in participatory approaches and conflict resolution.		Training experts	Community meeting venues,	facilitation funds support funds	KEFRI, Training Unit	Year 1–3 (continuous)	Knowledge cascaded across sectors and institutions, strengthened	Number of secondary trainings held; number of beneficiaries reached	GOSL NGO's FAO Local Council
	Facilitate community forest associations (CFAs) and benefit-sharing schemes.					Forestry Dept.,				

Strategic Objective	Key Activities	Resources Needed			Responsible Actors	Time Frame	Expected Results	Performance Indicators	Source of Funds
Facilitate Knowledge Transfer & Capacity Building	- Organize in-house staff workshops and peer-to-peer learning.	training facilitators Trainers	Workshop venues, demonstration plots	Funding needs	Forestry Department,		Staff acquire modern forestry and restoration skills	Number of staff trained; % applying new skills	JICA GOSL FAO EU
	Conduct field demonstrations and local stakeholder trainings.				KEFRI experts				

5.10 Action Plan on Forestry Restoration in Somaliland

Name: Abdikani Yusuf Abdi
Email: jfgalaydh@gmail.com
Country: Somaliland
Organization: Somaliland Agricultural Society
Position: Climate Change Officer

Introduction

Somaliland is located in the northwestern part of Somalia in the Horn of Africa, covering an estimated area of about 176,000 km². It is bordered by Djibouti to the northwest, Ethiopia to the south and west, the Gulf of Aden to the north, and Somalia to the east. The region is largely arid and semi-arid, with low and erratic rainfall, frequent droughts, and fragile ecosystems. Livelihoods are mainly based on pastoralism, agro-pastoralism, and livestock trade, which remains the backbone of the economy, supported by the strategic Port of Berbera. Forests in Somaliland are mainly composed of dryland woodlands and bushlands rather than dense forests, dominated by drought-tolerant species such as *Acacia*, *Commiphora*, and *Boswellia* (frankincense). These woodlands are vital for pastoral livelihoods, providing fodder, fuelwood, charcoal and valuable non-timber products like frankincense and myrrh. However, forest resources are under increasing pressure from charcoal production, overgrazing, land degradation, and recurrent droughts linked to climate change. As a result, tree cover is declining, leading to soil erosion and reduced ecosystem services. Strengthening sustainable forest management and restoration is therefore critical for climate resilience and livelihood support in Somaliland.

Problem Statement

Somaliland's forestry resources, largely composed of fragile dryland woodlands and bushlands, are experiencing rapid degradation due to unsustainable charcoal production, overgrazing and increasing pressure on fuelwood resources. Recurrent droughts and climate variability have further reduced tree cover, weakened natural regeneration and accelerated land degradation. The continued loss of key species such as *Acacia*, *Commiphora* and *Boswellia* threatens pastoral livelihoods, biodiversity, and vital ecosystem services, including soil stabilization and climate regulation. Without targeted restoration and sustainable forest management interventions, forest degradation in Somaliland will persist, undermining climate resilience, economic opportunities, and the long-term sustainability of natural resource dependent communities.

Causes, Effects and Solutions of Forest Restoration in Somaliland

Table 5.10.1 summarizes the key factors contributing to low forest cover in Somaliland, highlighting the main causes, their associated environmental and socio-economic effects and the solutions required to support forest restoration and sustainable management efforts.

Table 5.10.1: Causes, Effects and Solutions of Forest Restoration in Somaliland

Problem	Causes	effects	Solutions
Low forests in Somaliland	Deforestation due to agriculture, livestock grazing, and charcoal burning.	Loss of biodiversity	Implement reforestation projects
	Overexploitation of wood for cooking and constructing houses	Soil erosion	Promote alternative energy sources (e.g.; solar energy and gas stove for cooking)
	Climate change impacts	Decreased water quality and availability	Enforce sustainable land management practices (e.g; soil and water conservation)
	Limited access to forestry resources.	Negative impacts on local livelihoods and economy	Establish community forestry initiatives

Long Term Goal

- To mitigate the effects of climate change in Somaliland.

Short Term Goal

- Increase forest cover by 10% from October 2025 to November 2028.

Objective

- To restore degraded sites by 3,000,000 trees in the forest land through reserved areas.

Table 5.10.2: Implementation Action Plan on Restoration of Somaliland Forestry

Activity	Resources (Funds, experts)	Responsible person	Collaboration	Timeframe	Expected Results	Performance Indicators	Sustainability
Strengthening the Somaliland forestry section	Government with Partners (\$ 96,000 and above	Director of the Forestry and experts	Regional Government Community and Partners	Oct, 2025- Oct,2027	Upgrading skills of forestry staff and Community	Training reports completed	Forestry Department
Assessing forest expansion, forestry, and new a forestation area.	Government with Partners (\$ 54,000)	Director of the Forestry and Forestry Experts	Regional Government Community and Partners	Nov, 2025 – Dec,2028	The results of these assessments are the best way for forests to develop.	Assessment report completed	Forestry Department
Tree planting Land preparation	Government and Donors (\$286,000)	Forestry guide And Community	Regional Government Community and Partners	November, 2025 – April, 2028	Planting more than 3,000,000 trees	land preparation and planting and planting rate report	Forestry Department

5.11 Action Plan for Enhancing Biodiversity in Natural Forests of Chikankata District, Zambia

Name: Jones Ngoza Hachilensa
Email: jhjoneshachile7@gmail.com
Country: Zambia
Organization: Zambia Forestry Department
Position: Climate Change Officer

Introduction

Zambia is a landlocked country in Southern Africa with a total land area of 752,614 km². Of this area, approximately nine million hectares (12%) are suitable for cultivation, while about 16 million hectares (21%) are suitable for rangeland grazing. As of 18 September 2022, the total population was 19,693,423, consisting of 10,036,163 females and 9,657,260 males. The majority of the population, 10,900,054 people, resides in rural areas, while 8,793,369 live in urban areas. Zambia's population has more than quadrupled from 4,056,955 in 1969 to 19,693,423 in 2022, reflecting an estimated annual growth rate of about 2.8%.

Problem Statement

Chikankata District in Zambia is experiencing low biodiversity in its natural forests, driven by unsustainable land-use practices, deforestation and overexploitation of forest resources. Clearing of forests for agriculture, fuelwood collection, and timber harvesting has led to habitat loss, species decline, and reduced ecosystem resilience. This decline in biodiversity threatens critical ecosystem services, including soil fertility, water regulation, and carbon sequestration, while undermining the livelihoods of communities that depend on forest resources. Without targeted conservation and restoration interventions, the natural forests in Chikankata District risk further degradation, with long-term consequences for both environmental sustainability and local socio-economic development.

Causes, Effects and solutions of Low Biodiversity in Zambia

Table 5.11.1 summarizes the key factors contributing to low biodiversity in natural forests, highlighting the main causes, their associated effects on ecosystems and human livelihoods, and the corresponding solutions needed to promote forest conservation, restoration, and sustainable management.

Table 5.11.1: Causes, effects and solutions of low biodiversity in Chikankata District, Zambia

Causes	Effects	Solutions
Land use changes: Forest clearance for agriculture, resettlement, and logging reduces habitat for many species.	Loss of Ecosystem Services: Reduced biodiversity can lead to decreased carbon sequestration.	Community Engagement and Education: Raising awareness and involving local communities in conservation efforts to promote sustainable forest management and biodiversity conservation
Overexploitation of Resources: Overhunting and unsustainable logging deplete species populations.	Increased Vulnerability: Ecosystems with low biodiversity are more susceptible to disturbances, such as pests, diseases, and climate change.	Conservation Efforts: Protecting and restoring habitats and promoting sustainable forest management
Climate Change: Changes in temperature and precipitation patterns alter species distributions and disrupt ecosystem processes.	Extinction Risk: Low biodiversity increases the risk of species extinction, which can have cascading effects on ecosystems	Ecological Restoration: Restoring degraded habitats and promoting native species recovery.
Increase in population: clearing of land for settlements has reduced habitat for many species	Negative Impacts on Human Livelihoods: Loss of biodiversity can affect forest products, water quality and agricultural productivity	Sustainable Forest Management: Managing forests to maintain ecosystem integrity and biodiversity while providing economic benefits

Implementation Action Plan on Establishment of three Botanic Reserves and Ecological Monitoring Plots through Assisted Natural Regeneration

Long Term Goal

- To mitigate the effects of climate change in Chikankata District

Short Term Goal

- Increase forest cover by 30% from 2025 to 2030

Objective 1

- To establish three Botanic Reserves and Ecological Monitoring Plots through Assisted Natural regeneration

Table 5.11.2: Implementation Action Plan on establishment of three Botanic Reserves and Ecological Monitoring Plots through Assisted Natural regeneration

Activity	Resources (Funds, experts)	Responsible person	Time- frame	Expected Results	Performance Indicators	Budget (ZMK)
Planning and Preparation - Conduct Literature Review - Identify Potential Sites	- Access to scientific databases and literature - GIS, remote sensing data, and field equipment	Research Officer	Oct, 2025-Dec, 2025	Comprehensive literature review report List of potential sites with priority ranking	- Number of relevant studies reviewed, quality of report - Number of potential sites identified, accuracy of site assessments	50,000
Site Selection and Boundary Demarcation - Field Surveys - Boundary Demarcation - Community Engagement	- Field equipment, transportation, and personnel (Hire staff, including botanists, ecologists, and conservation biologists. - GPS equipment, cameras, mapping software, and signage materials	Research Officer	Jan, 2026-Mar, 2026	- Site assessments and boundary demarcation - Clearly defined reserve boundaries	- Accuracy of site assessments, quality of boundary demarcation - Accuracy of boundary demarcation, quality of signage	100,000

Activity	Resources (Funds, experts)	Responsible person	Time- frame	Expected Results	Performance Indicators	Budget (ZMK)
Establishing Eco- logical Monitoring Plots • Plot Design • Plot Establishment	- Field equipment, transportation, and personnel - Statistical software and field equipment	Research Officer	April, 2026- June, 2026	- Plot design and sampling protocol - Established plots with baseline data	- Quality of plot design, accuracy of sampling protocol - Quality of plot establishment, accuracy of baseline data	200,000
Management and Monitoring • Management Plan • Regular Monitoring • Data Analysis • Adaptive Management	Conservation expertise, management software, and personnel - Field equipment and transportation.	Chief Research Officer	July, 2026- sept, 2026	Comprehensive management plan - Regular monitoring reports	- Quality of management plan, effectiveness of conservation strategies - Quality of monitoring data, timeliness of reports	300,000

Sustainability Measures for Botanic Reserves and Ecological Monitoring Plots

- Ecological Sustainability.
- Biodiversity Monitoring: Regularly monitor biodiversity to ensure ecosystem health.
- Social Sustainability.
- Community Engagement: Engage with local communities to raise awareness and build support for conservation efforts.
- Economic Sustainability.
- Sustainable Funding: Secure sustainable funding sources to support conservation efforts.

Implementation Action plan on Establishment and Manage Three Tree Nurseries in Chikankata to Promote Sustainable Forest Management

Long Term Goal

- To mitigate the effects of climate change in Chikankata District- Southern province.

Short Term Goal

- Increase forest cover by 30% Chikankata from 2025 to 2030.

Objective 2

- To establish and manage three tree nurseries in Chikankata to promote sustainable forest management.

Table 5.11.3: Implementation Action plan on establishment and manage three tree nurseries in Chikankata to promote sustainable forest management.

Activity	Resources (Funds, experts)	Responsible person	Time-frame	Expected Results	Performance Indicators	Budget (ZMK)
Planning and Preparation - Community Engagement - Site Selection	Community outreach materials, transportation Site assessment tools,	District Forestry Officer	Apr, 2026 - May, 2026	Community buy-in and participation - Selected sites for tree nurseries	- Number of community members engaged, level of community support - Suitability of sites, accessibility, and security	50,000.00
- Nursery Establishment - Nursery Infrastructure - Seed Collection and Propagation	- Nursery equipment, materials, and labour - Seed collection equipment, propagation materials	District Forestry Officer	June, 2026 - July, 2026	Functional tree nurseries Propagated tree seedlings	- Quality of infrastructure, functionality, and safety - Quality and quantity of seedlings	200,000.00
Nursery Management - Seedling Care - Community Training	- Nursery equipment, materials, and labour - Training materials, equipment, and personnel	Research Officer	Aug, 2026 - Dec, 2026	Healthy and thriving seedlings - Trained community members	Seedling survival rate, growth rate, and quality - Number of community members trained, level of knowledge transfer	300,000.00

5.12 Action Plan for Mitigating Land Degradation, Forest Loss and Climate Change Impacts in Shurugwi District, Zimbabwe

Name: Tendai Mudzinganyama
Email address: tendaimudzinga107@gmail.com
Country: Zimbabwe
Organization: Forestry Commission of Zimbabwe
Position: District Forestry Extension Officer

Introduction

Shurugwi District, located in Zimbabwe's Midlands Province, is experiencing increasing environmental pressures characterized by land degradation, deforestation, and the impacts of climate change. Communal areas, which support agriculture, livestock and forest-based livelihoods, are particularly vulnerable due to unregulated mining activities by both large-scale companies and artisanal miners. These activities have accelerated soil erosion, river siltation, and the loss of vegetation cover, undermining ecosystem productivity and community resilience. The situation is further compounded by climate variability, including rising temperatures, erratic rainfall and prolonged droughts, which reduce natural regeneration and strain local resources. This action plan seeks to provide targeted interventions to restore degraded lands, rehabilitate mined-out sites and promote sustainable forest and landscape management, involving both communities and mining stakeholders to enhance environmental sustainability and livelihood resilience in Shurugwi District.

Problem Statement

Shurugwi District in Zimbabwe is facing severe environmental challenges due to extensive land degradation, deforestation and the impacts of climate change. Unregulated mining by both large-scale companies and artisanal miners in communal areas has intensified soil erosion, river siltation, and the loss of vegetation cover, undermining land productivity and reducing natural regeneration. These pressures threaten the livelihoods of communities that depend on agriculture, livestock, and forest resources, while also diminishing the resilience of local ecosystems to climate variability and extreme weather events. Without coordinated restoration and sustainable management interventions, environmental degradation in Shurugwi District will continue to escalate, compromising both ecosystem health and community well-being. Therefore, establishment of community tree and grass nurseries and rehabilitation of mined out sites through tree and grass planting, involving mining companies and the community.

Causes, Effects and Solution

Causes

The environmental degradation in Shurugwi District is driven by several key factors that include:

- Unregulated mining activities by large-scale companies and artisanal miners.
- Deforestation for fuelwood, timber, and land clearance.
- Climate change impacts, including rising temperatures, erratic rainfall, and prolonged droughts.
- Unsustainable land-use practices in communal areas.

Effects

These causes have led to significant ecological and socio-economic consequences:

- Land degradation, including soil erosion and reduced soil fertility.
- Loss of forest cover and vegetation, resulting in decreased biodiversity.
- River siltation and contamination of water sources.
- Reduced natural regeneration and weakened ecosystem resilience.
- Negative impacts on community livelihoods dependent on agriculture, livestock, and forest resources.

Solutions

Addressing these challenges requires targeted interventions and collaborative efforts such as:

- Establishment of community tree and grass nurseries to support reforestation and restoration.
- Rehabilitation of mined-out and degraded sites through tree and grass planting.
- Promotion of sustainable land and forest management practices.
- Engagement of communities and mining companies in conservation and restoration activities.
- Development of climate adaptation strategies to strengthen ecosystem and community resilience.

Implementation Action Plan on Establishment of 5 Community Tree Nurseries and Raise a Total of 50 000 Mixed Indigenous Tree and Grass seedlings in Shurugwi District

Long Term Goal

- To mitigate the effects of climate change in Shurugwi District .

Short Term Goal

- To increase forest cover from 30% to 60% in 3 years.

Objective 1

- To establish 5 community tree nurseries and raise a total of 50 000 mixed indigenous tree and grass seedlings in Shurugwi District.

Table 5.12.2: Implementation Action Plan on establishment of 5 community tree nurseries and raise a total of 50 000 mixed indigenous tree and grass seedlings in Shurugwi District

Activity	Resources	Responsible Person	Time Frame	Expected Results	Performance Indicators	Sustainability Plan
Identify suitable locations for nursery establishment	Funds: \$500usd (site survey, transportation)	District Forestry Officer	October 2025 (1 month)	5 suitable locations identified	1. Number of locations identified. 2. Suitability of identified locations	1. Develop sustainable businesses model plans for nurseries 2. Capacity Building
Select and train communities on tree seedling production including seed treatment and tree improvement	Funds: \$3 000usd (nursery establishment, trainings, cuttings and seed)	District Forestry Officer	November 2025 to June 2025	5 functional community tree nurseries 500 community members trained	1. Number of community nurseries established 2. Number of community members trained 3. Quantity of tree seedlings produced	
Monitoring and Evaluation	Funds: \$1 500usd (M&E activities, reporting)	District Forestry Officer and Provincial Manager	Throughout the project phase	Effective monitoring of seedling production and quality Timely identification and addressing of challenges Evaluation of nursery establishment impact on community engagement and tree planting goals	1. Number of seedlings produced 2. Quality of seedlings (survival and growth rate) 3. Community engagement and participation in nursery activities	

Implementation Action Plan on Rehabilitation in Shurugwi District

The action plan on rehabilitation of 25 ha at 5 mined out sites through planting a total of 100, 000 mixed tree and grass drought tolerant species is outlined below;

Long Term Goal

- To mitigate the effects of climate change in Shurugwi District.

Short Term Goal

- To increase forest cover from 30% to 60% in 3 years.

Objective 2

- To rehabilitate a total of 25 ha at 5 mined out sites through planting a total of 100, 000 mixed tree and grass drought tolerant species in Shurugwi District.

Table 5.12.2: Implementation action plan on rehabilitation of 25ha at 5 mined out sites through planting a total of 100,000 mixed tree and grass drought tolerant species in Shurugwi District

Activity	Resources	Responsible Person	Time Frame	Expected Results	Performance Indicators	Sustainability Plan
Identify suitable mined out sites for rehabilitation through tree and grass planting. Consultation meetings with responsible miners shall be held where possible.	Funds: \$1000usd (site survey, transportation)	District Forestry Officer, Site Mine Manager (where possible)	1 to 30 October 2025	Suitable mined out sites identified	Number of mined out sites identified	Community engagement 2.Capacity Building
Prepare 5 mined out sites where possible	Funds: \$1000 (site preparation)	District Forestry Officer, Site Mine Manager (where possible)	1 to 30 November 2025	5 mined out sites prepared for tree planting	1. Quality of site preparation	
Plant and maintain trees and grasses	Funds: \$2000 (tree and grass seedlings, planting maintenance transportation)	District Forestry Officer, Site Mine Manager	November 2025 to February 2025	5 rehabilitated mined out sites with healthy trees and grasses.	1. Number of trees and grasses planted 2. ,Survival rate of trees planted	

Activity	Resources	Responsible Person	Time Frame	Expected Results	Performance Indicators	Sustainability Plan
Monitoring and Evaluation	Funds: \$1500usd (M&E activities)	District Forestry Officer, Provincial Manager	Throughout the whole rehabilitation phase	Effective monitoring of rehabilitation progress Timely identification and addressing of challenges Evaluation of rehabilitation impact on biodiversity	1. Progress of rehabilitation (vegetation growth) 2. Community engagement and participation in rehabilitation activities	

CHAPTER 6

6.0 Information Materials

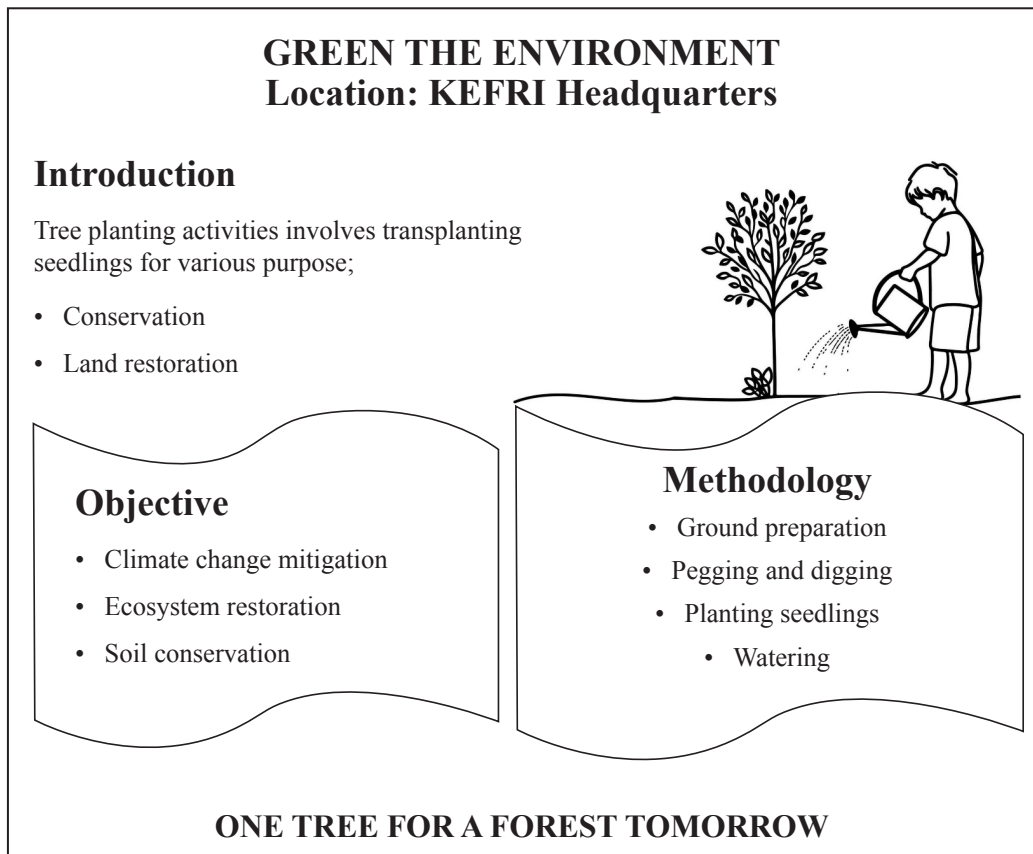
6.1 Introduction

Information materials are essential tools used to communicate knowledge, convey ideas, and provide education in various fields. They are versatile resources, carefully crafted to suit specific audiences and objectives, and they can take many 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 the dissemination of critical information, whether in education, health, business, or environmental projects. Information materials have been print-based. They may include books, manuals, guides brochures, leaflets, posters among many others.

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

6.2 Posters

Group 1



Group 2



Ministry of
Environment
Climate Change &
Forestry



NATIONAL TREE PLANTING DAY

Date: 21st September, 2025

Time: 10.45 a.m. – 1.00 p.m.

Venue: KEFRI Headquarters

Guest of Honour: Her Excellency the Cabinet Secretary



***Melia volkensii* - Tree of the year**
Go green for a better life

Contact: treeplanting@kefri.org

Website: www.mof.go

Tel: +25471234567

6.3 Brochures

During the training the participants learnt and developed brochures as outlined below:

Group 1

TREE PLANTING DAY 2025 Restoring Landscapes, Empowering Communities Date: 19.11.2025 Venue: KEFRI Muguga Introduction Tree planting is a community driven event aimed at increasing green spaces improving air quality, fostering environment Objectives 1. Promote awareness on climate change and sustainable land use 2. Restore degraded landscapes through indigenous and agroforestry species	Activities - Opening ceremony - Tree planting sessions - Demonstrations - Youth engagement - Panel discussions - Exhibition Impact Goals - Plant over 5000 seedlings - Build capacity of community - Document lessons for future - Share knowledge Contacts and participation To confirm attendance or partner with us, please contact <u>info@kefri.org</u> +254702328549	Who should attend - Local community - County and national government - Environmental NGOs - KEFRI staff Whether you are nature lover, student, family or organization- Everyone is welcome Join us for a greener tomorrow, help us make a lasting impact
---	--	---

Group 2

 PROMOTION OF TREE OF THE YEAR: MELIA VOLKENSII FOR CLIMATE CHANGE RESILIENCE 	Tree of the Year: <i>Melia volkensii</i> for Climate Change Resilience Scientific name: <i>Melia volkensii</i> Local name: Mukau Description A fast-growing drought tolerant tree, height up to 6-20m tall, about 40cm diameter Importance - High quality timber Environmental benefits - Soil improvement Benefits - Fast growing rate - Drought tolerant - Termites resistance How to plant and care 1. Seed Collection Collect ripe fruits (brown patches) 2. Seed processing Depulp or dry seed thoroughly before extraction. 3. Planting Plant seedlings in well drained soils with a spacing of 5x5 or 10x5 4. Watering Water lightly in extreme dry spells.  Melia nursery
--	---

6.4 Flyers

During the training the participants learnt and developed fliers as outlined below:

Group 1

**Join us at the National
Tree Planting Day
Celebration**

Venue : KEFRI Muguga

Date: 19/11/2025



SAVE THE DATE

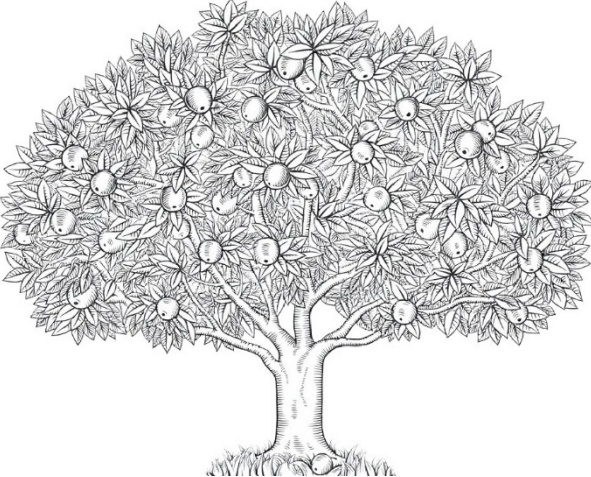
Theme: Re-greening the environment

Purpose: To restore the environment for climate resilience

Group 2

MINISTRY OF FORESTRY AND STATE DEPARTMENT OF
REHABILITATION

HAPPY NATIONAL TREE PLANTING DAY



4 ways of participating in tree planting

Plant a tree in the backyard	Volunteer in a tree organization
Sponsor a tree planting campaign	Community tree planting campaign

Contacts: treeplanting@kefri.org

Website: www.mog.gov

Tel: +25471234567

CHAPTER 7

7.0 Country Reports

7.1 Promoting Climate Change Resilient Forestry in Botswana

Gofaone Rammotokara

Botswana University of Agriculture and Natural Resources

Introduction

Botswana is a semi-arid, landlocked country in Southern Africa with a land area of approximately 581,730 km². It is well endowed with forests, wildlife and mineral resources, but has limited soils suitable for arable agriculture. Eighty percent (80%) of the settlements and economic activity are concentrated along a 200-kilometer- wide strip along the country's eastern border, where the most fertile soil and transportation corridors are located. Forests play a very important role in the national economy as a source of fuelwood, timber for construction, as well as food and fibre for people and livestock. The traditional relationship between people and natural resources is the extensive silvo-pastoral practice where animals are grazed in communally managed forests, woodlands and rangelands. The major ecological regions include the Kalahari Desert, the Okavango Delta, and the Makgadikgadi–Nxai salt pans (Statistics Botswana, 2022). The climate is marked by high variability in rainfall, frequent droughts and increasing temperatures (World Bank, 2024).

The 2022 Population and Housing Census recorded 2,346,179 people. Estimates for mid- 2025 put the population at around 2.5 to 2.6 million (Statistics Botswana, 2022). The economy is dominated by diamond mining, tourism linked to the Okavango and Chobe ecosystems, livestock production, and a growing services sector.

In the pre-colonial era, land in Botswana was managed communally under the authority of Tribal Chiefs. However, with the establishment of the British Protectorate in 1885, land tenure systems were restructured into three categories: native land (now Tribal land), crown land (now State land), and privately-owned freehold land (allocated in blocks like the Tuli Block for settler agriculture). Approximately 70% is tribal/communal grazing land, 25% state land, and 5% is freehold land leased for large-scale commercial ranching. Also, 92% of livestock is in the traditional cattle post system on communal grazing land. Livestock (mainly cattle) rearing is the main economic activity over large parts of Botswana and constitutes 70–80% of the agricultural GDP.

Like other countries, Botswana has adopted guidelines provided by the Intergovernmental Panel on Climate Change (IPCC) for land use classification, land use conversion and reporting (IPCC, 2006). According to this classification there are six land use categories, which are Forest, Croplands, Grasslands, Other land, Settlement and Wetlands. The land use categories for Botswana and their respective status as reported in the Botswana land degradation monitoring system are presented in Table 7.1. In terms of land use change,

available data indicates that forest land reduced by 0.16% (340 Km²) between 2000 and 2019; grasslands reduced by 0.37% (1,224 Km²) for the same period; while wetlands area reduced by 3.04% (267 Km²). The land area occupied by settlements increased by 26.06% (1,006 Km²) over a period of 20 years or so compared with only 2.71% for croplands, which are the areas dedicated to arable agriculture. It is therefore necessary to examine such land use patterns along with other factors in order to propose land restoration interventions that are both socially and economically feasible.

Table 7.1: Initial (2000) and current (2019) land use summary

	Initial Land use area (sq. km)	Current land use area (sq. km)	Change in area (sq.km)	Change in area (%)
Forest	208,485.73	208,145.79	-339.94	-0.16
Grasslands	332,413.27	331,189.59	-1,223.68	-0.37
Croplands	11,772.26	12,091.02	318.76	+2.71
Wetlands	8,773.28	8,506.33	-266.95	-3.04
Settlement	3,859.90	4,865.73	1,005.83	+26.06
Other land	14,407.13	14,913.12	505.99	3.51
Total	579,711.57	579,711.58	0.01	28.70

Forest and woodland resources are central to rural livelihoods. World Bank statistics indicate about 26 to 27% forest cover using Food and Agriculture Organization definitions (World Bank, 2024). Key ecosystems include mopane woodlands, acacia savannas, and riverine forests in the Chobe and Okavango systems (FAO, 2013). These resources provide fuelwood, poles, and non-timber forest products such as devil’s claw and *Sclerocarya birrea* (marula) (Ministry of Environment, 2018).

Botswana faces severe land degradation challenges leading to decline in forest cover (Figure 7.1). The main causes of land degradation include; overgrazing, bush encroachment, wildfires, and recurrent droughts exacerbate soil erosion and desertification risks. The United Nations Convention to Combat Desertification reports that 66% of land is vulnerable to desertification (UNCCD, 2023). The country has pledged over 45 million hectares towards achieving Land Degradation Neutrality, with more than 1.4 million hectares already rehabilitated (UNCCD, 2023).

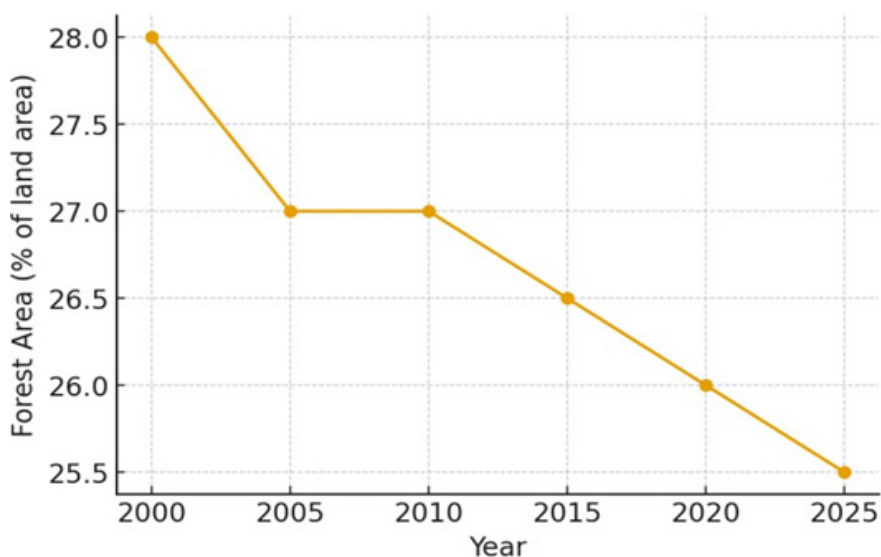


Figure 7.1: Forest Cover Trends in Botswana (2000–2025). Source: World Bank (2024).

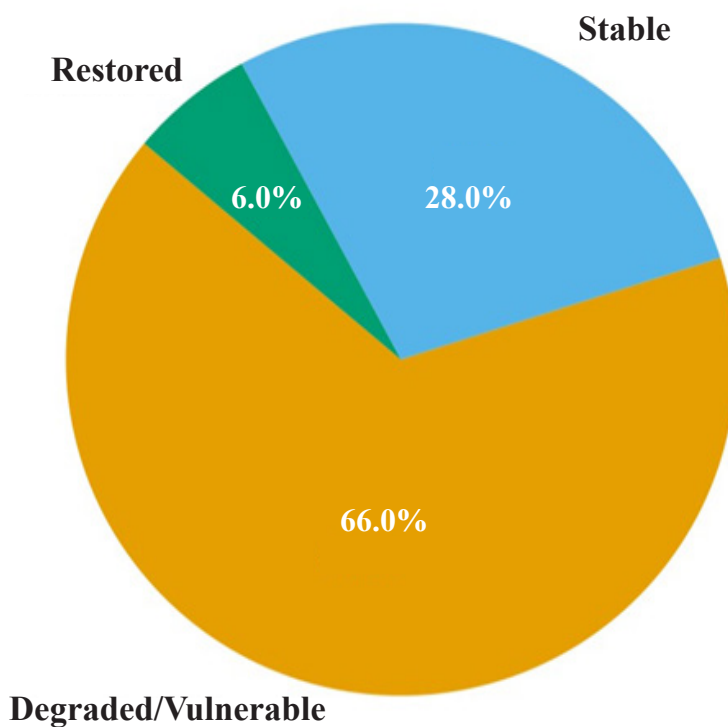


Figure 7.2: Land Degradation Status in Botswana. Source: UNCCD (2023)
Recent and/or Current Programmes/Projects

Climate Change Mitigation and Adaptation

- National Climate Change Policy (2021) and the National Climate Change Strategy and Action Plan (2018) are frameworks that mainstream climate risk and coordinate sectoral responses.
- Nationally Determined Contribution (updated 2021): economy-wide measures in energy, transport, waste, adaptation actions across water, agriculture, health, and ecosystems.
- Temo Letlotlo (since 2023): this is an agricultural support package that encourage climate-smart practices, crop diversification, and offer supervised credit and input subsidies to smallholder farmers.
- Horticulture Impact Accelerator Subsidy (IAS) and complementary drought relief and livestock resilience schemes (e.g., Thuo Letlotlo).
- Water security measures (e.g., North–South Carrier augmentation, dam development, groundwater development, demand management) to buffer climate variability.

Landscape Restoration Programmes (Forest/Agricultural Landscapes)

- UNCCD Land Degradation Neutrality (LDN) Target Setting and implementation: national commitment covering ~ 45 million ha; >1.4 million ha reported as rehabilitated ‘bright spots’.
- Participation in the African Forest Landscape Restoration Initiative (AFR100) with a pledge (200,000 ha) toward restoration of degraded forests and lands.
- Rangeland restoration and bush encroachment control pilots in communal and ranching systems; promotion of reseedling and rotational grazing where feasible.
- Community-Based Natural Resource Management (CBNRM) and NTFP (‘veld products’) governance to incentivize sustainable harvesting and value addition.
- Fire management strategies at district/community level (e.g., Nata Fire Management Strategy) with equipment handovers and training supported by partners.

Forestry Development

- Department of Forestry and Range Resources (DFRR) has various projects on woodland management, community forestry, fuelwood efficiency, and wildfire prevention/response.
- Use of Forest Conservation Strategy (2013–2020, under update) as a guiding tool to sustainable utilization, fire management, and institutional roles.
- Okavango–Chobe landscape initiatives integrating wildlife corridors, riverine forests, and tourism concessions with community benefits.

Major Achievements, Challenges and Opportunities

Major Achievements

Achievements include:

- Significant progress on Land Degradation Neutrality (LDN) which was a process established with targets and are reported as rehabilitated through (SLM).
- Expansion of climate-smart agriculture support and extensive conservation coverage (Temo Letlotlo; horticulture Impact Accelerator Subsidy) UNCCD, 2023).
- Strengthened community fire management pilots and equipment provision in high-risk areas.
- High share of land under some form of conservation status (parks, game reserves, WMAs).
- Supporting Agency: The Department of Forestry and Range Resources (DFRR) is responsible for reforestation efforts.
- The Department of Forestry and Range Resources runs 21 established nurseries across the country, producing approximately 500,000 seedlings annually for sale to the public.
- Community Engagement: The DFRR also facilitates community-based backyard nurseries to increase seedling accessibility and empower communities economically.
- Reforestation Activities: The initiative includes various activities like the National Tree Planting Day, community woodlots, agroforestry projects, school planting, and land reclamation projects.
- Seedlings are sold at subsidized prices to encourage public participation in tree planting effort.

Key Challenges

Botswana is facing several environmental challenges that threaten the sustainability of its ecosystems and resources. The country’s arid climate, coupled with human-induced pressures such as population growth, deforestation, overgrazing, and unsustainable water use, has resulted in significant environmental degradation. Climate change further exacerbates these issues, impacting agriculture, wildlife, and water availability. Table 7.2 presents a summary of key environmental issues in Botswana, their causes, and impacts.

Table 7.2: Key environmental issues threatening Botswana’s environment

Key Environmental Issues	Causes and impacts
Water Resources Depletion	Botswana experiences chronic water scarcity, exacerbated by a growing population and urbanization. Groundwater is heavily relied upon, leading to concerns about sustainability and recharge rates. Droughts which occur every 10-12 years further strain water resources.

Key Environmental Issues	Causes and impacts
Rangeland degradation and desertification	The Kalahari Desert covers much of the country, limiting arable land and contributing to land degradation. Overgrazing, increasing livestock numbers, and poor farming practices.
Impact of climate change	Climate change intensifies existing issues, increasing the risk of drought, affecting water availability, and altering vegetation and wildlife habitats. Vulnerable sectors include agriculture, water.
Declining numbers of some wildlife species	Illegal hunting, habitat destruction and climate change threaten Botswana's rich biodiversity, including endangered species. The rising elephant population in the north has also contributed.
Deforestation and Unsustainable Resource Use	Although deforestation is not deemed a significant problem overall, high reliance on wood for fuel accounting for 70% of energy supply has led to local depletion of forest resources.

Policy, Legislation, Strategies and Guidelines

These frameworks provide the legal and institutional basis for forestry development, landscape restoration, and climate adaptation.

They include:

- National Climate Change Policy (2021).
- Updated Nationally Determined Contribution (NDC, 2021).
- Forest Conservation Strategy (2013–2020; update in progress).
- Agricultural Resources Conservation Act & Utilization of Veld Products Regulations (2006).
- Protected Areas policies and management plans; Okavango Delta and Makgadikgadi frameworks.
- Relevant cross-cutting frameworks: Vision 2036, National Development Plans, Integrated Water Resources Management plans.

The following table summarizes the key elements of Botswana's commitment to LDN and alignment with broader Sustainable Development Goals.

Table 7.3: key elements of Botswana’s commitment to Land Degradation Neutrality (LDN)

Key Environmental Issues	Causes and impacts
Water Resources Depletion	Botswana experiences chronic water scarcity, exacerbated by a growing population and urbanization. Groundwater is heavily relied upon, leading to concerns about sustainability and recharge rates. Droughts which occur every 10-12 years further strain water resources.
Rangeland degradation and desertification	The Kalahari Desert covers much of the country, limiting arable land and contributing to land degradation. Overgrazing, increasing livestock numbers, and poor farming practices.
Impact of climate change	Climate change intensifies existing issues, increasing the risk of drought, affecting water availability, and altering vegetation and wildlife habitats. Vulnerable sectors include agriculture and water.
Declining numbers of some wildlife species	Illegal hunting, habitat destruction and climate change threaten Botswana’s rich biodiversity, including endangered species. The rising elephant population in the north has also contributed.
Deforestation and Unsustainable Resource Use	Although deforestation is not deemed a significant problem overall, high reliance on wood for fuel accounting for 70% of energy supply has led to local depletion of forest resources.

Opportunities and Challenges to Capacity Building

Opportunities exist in partnerships with regional bodies such as the Southern African Development Community, and support from development partners including the United Nations Development Programme and the Global Environment Facility (UNDP, 2021). Other opportunities include: (i) scaling community-inclusive fire management (early dry-season burns, firebreaks, preparedness drills) linked to grazing and wildlife needs; (ii) Expanding climate information services and early warning systems tailored to farmers and community forest committees; (iii) Investing in wood energy efficiency (improved stoves/charcoal alternatives) and agroforestry on homesteads and farm fields; and (iv) Leverage CBNRM and veld-product value chains (e.g., Devil’s Claw, marula, thatching grass) with permit systems and traceability; and lastly results-based financing for restoration (payment for ecosystem services, carbon projects where feasible) and restoration-friendly procurement in tourism concessions.

Challenges include limited technical capacity at district level, insufficient monitoring systems and financing constraints (World Bank, 2024).

Areas of Particular Training Needs

Training is needed in climate-smart forestry, carbon monitoring and reporting, rangeland restoration, geographic information system and remote sensing applications, and community engagement for restoration initiatives (FAO, 2013; UNCCD, 2023).

- Community-inclusive fire management and prescribed burning in rangelands.
- Forest/woodland inventory methods for drylands; use of remote sensing and GIS.
- Rangeland restoration (rotational grazing design, bush control, reseeding) and drought-resilient fodder systems.
- Agroforestry design for semi-arid zones; NTFP enterprise development and quality standards.
- Climate risk screening for forestry/agriculture projects; safeguards and gender-responsive approaches.
- Project finance: accessing climate funds, carbon methodologies suitable for savannas.

7.2 Promoting Climate Change Resilient Forestry in Eritrea

Nezehty Abbay Asmerom

National Agricultural Research Institute

Introduction

The immediate development priority of Eritrea is to meet the basic needs of its population through achieving economic stability, rehabilitating and expanding infrastructures. The Government formulated Macro Economic Policy in 1994, which clearly set forth the path for enhanced national development.

Geographical Location

Eritrea is located in the Horn of Africa (North-eastern part of Africa) and covers an area of 124,320 km². The country borders Sudan in the West and North, Ethiopia in the South, Djibouti in the Southeast, and the Red Sea in the East. It is divided into six regions (*zobas*) namely: Maekel, Anseba, Gash-Barka, Debub, Semenawi KeihBahri and Debubawi KeihBahri. These Zobas are sub divided into 53 sub-Zobas. The country has a coastal line of 1,200 km stretched along the Red Sea Coast. It has more than 350 small and medium sized islands on the Red Sea. The elevation ranges from 120 m below sea level, in the southern arid region to over 3000 m Above sea level in the central highland.

The population of Eritrea is about 6 million, which is growing at the rate of 2.9 % per annum. Out of this, about 80% live in the rural areas and derive their livelihood from agriculture. The country has nine linguistic groups which include Afar, Bilen, Tigre, Saho, Tigrigna, Kunama, Nara, Bdawiet and Rashaida (MOA, 1993).

Climatic and Ecological Conditions

Eritrea's climate is most influenced by altitude and topography, which cause variations in temperature. It has diverse climate and complex soils, as it is a country of great geographical diversity. Eritrea is divided into six major agro-ecological zones based on climate, land forms, soil and vegetation. About 72% of the country is classified as very hot, with mean annual temperature exceeding 24°C, while not more than 14% is classified as mild or cool with mean annual temperature below 21.5°C.

It has a very high potential for growing a variety of temperate and tropical crops owing to the diverse agro-climatic and soil type endowment. Its climate is most influenced by altitude and topography, which cause variations in temperature. The rainfall is bimodal which include summer from June to September in the highlands and western lowlands; and winter rains from November to February in the eastern and coastal areas. The rains are characterised with extreme variability within years and variations over short distance. The country is vulnerable to the adverse effects of climate mainly, due to its geographical location.

Economic Activities

Agriculture is an important sector in the country, which has a major impact on the overall economy serving both as a source of food and raw materials for industry including cotton, skin, hides and oil seeds. The country earns foreign exchange through the export of live animals, skin, hides, gum Arabic and incense. In 1994, crop production, livestock, forestry and fishery contributed about one-third of the Gross Domestic Production (GDP) (FAO, 1996). Despite the fact that 80% of the population is engaged in agriculture, which is the main source of their livelihood, its contribution to GDP is low as farmers are poorly equipped with modern agricultural inputs and machineries.

Land and Tree Tenure

There are three categories of land ownership in Eritrea namely Dominale (state ownership), Dessa (Communal/village ownership) and Tsilmi/Risti (family ownership). The most common land ownership category in the highlands of Eritrea is Dessa. Under this ownership, a family or a household has the usufruct of land for a limited number of years and then land is redistributed among family members on rotation basis of every 5 to 7 years. However, it is a system that avoids exhaustive land disputes that lead to bare fallow, which are beneficial to neither of the litigating parties. Although it is fair and egalitarian in nature, it does not present an opportunity for long-term investment with a lifetime usufruct guarantee on the land which refrain farmers from planting perennial trees on their farms for fear of losing their right to reap the benefits of their investment after the expiry of their tenureship.

The major land-use/land-cover types in the country are grazing land, woody vegetation, cropland and barren land. Grazing land and woody vegetation, account for the largest proportion of the land cover system. Depletion of land productivity, caused by over grazing, infertile soils and poorly established incentive measures for sustainable land management is a major problem. In general, soils with the highest agricultural potential are found in the southern part of the central highlands and south-western lowlands of the country. However, shallowness, which is the result of continuous cultivation and soil degradation, is the major constraint to productivity in agriculture.

Trends of Forestry/Agricultural Development

Intervention to Improve status of Forest Resources

The Government of Eritrea is extremely concerned about the trend toward deforestation and its effects on the environment and society. Accordingly, it has recommitted to work with renewed effort to halt this decline and to restore Eritrea's forests. This commitment is shown by the fact that the Government imposed a total ban on cutting live forests and introduced reforestation measures right away after the liberation of the country. The country has established permanent and temporary closures in degraded forest and woodland areas to enhance natural regeneration. It has also developed forest plantations and strengthened environmental education programs, among other initiatives. Overall, since independence, there has been a strong emphasis on promoting activities related to afforestation and forest conservation.

Land Degradation

Land degradation is a major problem in Eritrea. Land degradation is evinced by loss of soil fertility and erosion. Further, land degradation is driven by unsustainable agriculture, livestock and forestry practices. Land degradation negatively impacts ecosystem services, food security and economic well-being.

During the Land Degradation Neutrality (LDN) target setting program for Eritrea, United Nations Convention to Combat Desertification (UNCCD) found that land productivity is declining across 8% of the Eritrean land mass and nearly 16% of Eritrea shows early signs of productivity decline. Only 12% of all land cover is stable but remains stressed. Land degradation is particularly pronounced in the temperate and relatively crowded highlands due to unsustainable agriculture and forestry practices.

The annual rate of soil loss from crop land is estimated at 12–17 tons/ha. Meanwhile, crop yield is declining at a rate of 0.5% per annum due to soil erosion. Communities have very low adaptive capacities and face a high degree of risk exposure. This includes limited and insufficient access to innovative Sustainable Land Management (SLM) and climate resilient practices.

Livestock is a major driver of land degradation with stocking rates generally exceeding carrying capacity. Poor herd health and increased livestock numbers often combine to intensify land degradation. There is very little data available regarding overall herd fitness. However, anecdotal data from project preparation phase (PPG) field visits and discussions point to very low herd health. Issues such as parasite loads often result in livestock increasing grazing requirements while reducing weight gain. As domestic herds increase, grazing territories and periods expand and climate-related impacts continues to weaken an already vulnerable system. This includes increased competition for water and grazing between wild and domestic animals. This also limits the ability of grasslands and forests to regenerate, further increasing vulnerabilities.

Status of Forest Resources

Eritrea's forest resources and vegetation cover are under serious threat and declining at an alarming rate both in terms of area and quality. Its total forest cover has been dwindling progressively over the last century. About one third of the total area of Eritrea was under forest cover but it dwindled to about 2.0% in 1986. At present forest land is less than 1% of the total area and about 13.7% if sparse woodlands are included. The main causes for this destruction are cutting of trees for fuel and construction, land clearing for agricultural, overgrazing and drought. For example, land concessions were given out to Italian nationals in the range of 90 hectares. This Italian colonial policy had impact on the environment. Therefore, during the Italian colonial rule (1890s-1941) about 300,000 hectares of forestland were converted into agricultural land (Alexander, 1998). Granting agricultural concessions on forestland had also continued during the British protectorate following the Italians. These gave the green light to clear-fell forests for the purpose of converting them to productive agricultural land with its true motive was cash returns from the sale of trees rather than the output as cash crops. Apart from this, granting concessions for saw millers was common in the late 1930's. Up to 1947,

for instance, it was reported that about 55 wood processing factories and sawmills were installed in the country that definitely contributed to forest destruction (Aldo, 1947, cited in MOA, 1994). The degree of devastation by all colonisers was tremendous and deforestation continued up dramatically until the liberation of the country. Even right after independence for a short time somehow tens of thousands of hectares of woodlands were issued to private investors or granted for concessions.

Extent and Distribution of the Natural Forests

Eritrean forest resources are known to be rare, degraded and placed under an increasing human and livestock pressures for divers needs such as firewood, construction materials, agriculture and grazing. However, Eritrea is still endowed in many of its parts of a sizeable forest cover that plays an important social and economic role in the nation.

The three major forest/woodland types in Eritrea are highland forests, Acacia woodlands and Reverie forests. The forest/woodland formations include the highland forests, which cover about 0.8%, mixed woodlands of Acacia and associated species, riverine forests and mangrove vegetation. The total area of this formation constitutes 13.7% of the total surface area of the country. The natural forests of Eritrea can be classified into six main categories namely:

- **Highland Forests:** These are composed of a mixture of coniferous species (*Juniperus procera*) and broad-leaved species (*Olea africana*) and other associated species (e.g. *Acacia abyssinica*). Originally *Juniper-Olea* forest once covered the greater part of the plateau, but have now been largely destroyed or degraded mainly by clearing of land for cultivation and timber; except for a few well-conserved sites.
- **Mixed woodlands of Acacia and associated species:** They occur mainly in the South Western Lowlands, but also in restricted areas elsewhere in the country.
- **Bush or Shrub vegetation:** Which is dominant cover in Eritrea.
- **Grassland to Wooded Grassland:** Which occurs in many parts of the country.
- **Riverine Forests:** Composed of salt cedar (*Tamarix aphylla*), tamarind (*Tamarindus indica*) and doum palm (*Hyphaene thebaica*) which are common on open flood plains and on riverbanks in most lowlands parts of Eritrea. The forests are under heavy threat as they occupy fertile, well-watered and level sites suited to commercial agriculture development; and
- **Mangroves:** Occurs in many spots along the coast with main species being *Avicennia marina*

Area and percentage coverage for various vegetation types is indicated in Table 7.4.

Table 7.4: Forest/woodland vegetation areas of the state of Eritrea.

Vegetation types	Area (Km ²)	Share of total area %
Forest	1,001	0.8
Closed to medium Forest	591	
Open Forest	410	
Wood land	14,074	11.3
Closed to medium closed	4,533	
Open	9,541	
Bushland and Grassland	79,401	63.8
Grassland/Wooded Grassland	25,577	
Bushland	53,824	
Riparian Forest	1,929	1.6
- Riverine Forest	1,865	
- Mangroves	64	

Source: FAO, 1997.

Current Programmes/Projects to Address Climate Change

Climate change is a global challenge, and due to the country's geographical location and low adaptive capacity, Eritrea is among the countries most severely affected by the impacts of climate change. It is highly susceptible to climate variability, manifested in the form of recurrent droughts, water shortage, and spatial and temporal rainfall variability. In 2021, Eritrea submitted its Third National Communication (TNC), which provides comprehensive information on the country's climate and climate change background. In 2006, 2010 and 2015 National Green House Gas (GHG) inventory carried out and revealed Eritrea's GHG emission contribution is negligible and accounts to only 0.013% of the global GHG emission. However, the climate vulnerability assessment indicates that agriculture, water and forestry are the most severely affected sectors which require intensive climate smart adaption interventions. Eritrea expresses its commitment to the achievement of the ultimate objectives of the Convention and the Paris Agreement. Some of the initiatives, programmes and / or projects on climate resilient adaptations and mitigations activities, landscape restoration and forestry development include:

1. Drought Resilience and Sustainable Livelihoods Program in the Horn of Africa Project II DRSLPII (AfDB)
 - Improve drought resilience of the pastoral and agro-pastoral nationally.
 - Rebuild existing livelihoods through investment in integrated management and agricultural and water infrastructure.

2. Drought Resilience and Sustainable Livelihoods Program V (DRSLP-V) (AfDB – 2019 –2025)
 - Support implementation of National Indicative Development Plan (NIDP) to: accelerate economic growth, reduce rural poverty, improve food and nutrition security and increase exports and decrease imports.
 - Promote rainwater harvesting through construction of masonry dams and make the sector more dynamic through active participation in agribusiness for job creation.
 - Address problems of food and nutrition insecurity, postharvest losses, high rate of unemployment and inadequate Micro, Small and Medium Enterprises (MSMEs) in the agricultural sector.
3. The National Agricultural Program (NAP) (IFAD)
 - Contribute to rural household and national food security and poverty alleviation.
 - * Raise agricultural production and productivity through Agricultural Water Resources and Infrastructure Development.
 - * Integrated Agricultural Production; and
 - * Programme Support Services.
4. Sustainable Job Creation and Growth for Increased Food Security and Resilience in Eritrea (UNDP –2020 –2024 EU/EDF)
 - Support sustainable jobs and promote inclusive green growth in agriculture and agri-business in Eritrea
 - * Enhance food security and resilience of rural communities, with a special focus on youth and women.
 - * Contribute to the extension of irrigation infrastructure and facilities to the end users, development of the land for irrigation as well as soil and water conservation upstream.
 - * Provide seeds and fertilizers, agricultural machinery and farm tools, are expected to contribute to increasing crop and livestock production.
 - * Access to credit to support young and women entrepreneurs to start up and/or expand small and medium agri-businesses and strengthen linkages to markets.
5. Climate Change Adaptation Programme in Water and Agriculture (UNDP – Adaptation Fund)
 - Increase food security through ecologically sustainable and climate-resilient improvements in agricultural production.
 - Increase community resilience and adaptive capacity to climate change through an integrated water management and agricultural development approach in the sub-Zobas of Hamelmalo and Habero in the Anseba Region.

- Floodwater harvesting and groundwater recharge; promote a range of climate-resilient technologies for enhanced agricultural and livestock production; climate risk information through a community-based early warning system.
6. Strengthening Climate Information Systems for Climate Change Adaptation in the Greater Horn of Africa through regional cooperation [Green Climate Fund (GCF) regional program – (IGAD)]
 - Establish improved early warning and climate information dissemination systems at the regional level and integrate within existing national climate information systems.
 7. Improving Grain Post- Harvest Handling and Storage for Smallholder Farmers in Eritrea (FAO: 2019 –2021)
 - Contribute to improved food security and livelihood of vulnerable populations affected by successive drought.
 - Provide inputs and strengthen extension services to reduce the vulnerability of agro-pastoralist communities affected by below-average rains, which have negatively affected crop production in marginal agricultural areas on the highlands of the coastal Northern Red Sea Region and where drought conditions have resulted in widespread failure of staple crops and critical feed shortages.
 8. Early Warning Tools for Increased Resilience of Livelihoods in IGAD Region (FAO: 2020 –2021)
 - Contribute to saving lives through saving livelihoods, alleviating human suffering (without adding burden to either men or women) and paving the way for evidence-based humanitarian early and long - term development actions in the East Africa region.
 - Improve availability of animal feed-related data through the development, implementation, and institutionalization of three feed security assessment tools/ methodologies.
 9. Improving food and nutrition security of vulnerable women through net making and traditional small fishing activities in Eritrea (FAO: 2019 –2021)
 - Assist vulnerable women and women headed households to introduce production assets and scaling up of knowledge to empower the job creation and income generating activities and possibly linking women participation in programme activities and market
 10. Boosting Restoration, Income, Development, Generating Ecosystem Services (BRIDGES) project: Eritrea, Mauritania and Sudan (FAO: 2018 –2022)
 - Provide village communities within the Great Green Wall core areas with restored productive lands for resilient small-scale farming, generating income and ecosystem services for their sustainable livelihoods.

The ministry of agriculture has launched a National Greening Campaign Program in the country. Committees have been established in facilitating the National Program in all the

regional administrative and village areas. In line with this, farmers have been allocated with their respective areas for planting seedlings.

The tree planting is categorised as follows:

Farm Planting

Though not in a large extent, there is tree planting on or around farmland. However, the government development policy now emphasises food security that encourages to any farmer who wants to produce tree products on his or her land. There are some examples of farm planting left over from the era prior to independence. These were established on better soils and demonstrate the growth potential of site and responsible maintenance.

Homestead Planting

Many families plant trees for their immediate needs, most often poles and shade around their compounds.

School Planting

The school woodlots established by direct involvement of school children who are responsible for planting and post planting care, which is a clear indication of highest degree of their motivation and commitment the plantations are very successful. These trees are planted for fuel in addition to shade, reduction of wind speed, settle dust and provide a source of nectar for honey.

Village Planting

Species planted are *Eucalyptus*, ornamental and multipurpose trees. There is great interest towards fruit species growing around homes and more extension work should be done to promote them. Besides mango and citrus, other species requested are *Prunus persica* and *Casimiro aedulis* and *Rhamnus prinoides* whose leaves are utilized to flavour the local beer.

Municipal and Roadside Planting

With the participation of the communities, trees are planted in different areas for amenity. The sites include; roadside planting, especially on major roads radiating from Asmara, the capital city of Eritrea for national memorial and shade as well as municipal planting for shade and urban beautification. As interest revived in such amenity tree plantings, street trees have successfully been established.

Peri-urban Plantations

Fuelwood is one of the most important forest products as source of household energy in the country. According to the study conducted by the MoLWE Department of Energy in 2003, the total annual fuel wood consumption at national level estimated to be about 1.1 million metric tonnes. This study showed that shortage of fuelwood has pushed many households to use animal dung and crop residue. Fuel wood consumption is one of the

most serious detrimental demands on the Eritrean eco-systems. To address shortage of fuelwood and construction poles in the main urban centres, proposals have been forwarded for the development of peri-urban plantations.

Non -Wood Forest Products

The most significant non-wood forest products in Eritrea are; gum Arabic, gum olibanum, doum palm leaves and cactus fruits. Both gum arabic and gum olibanum (frankincense) are traditional non-wood products of Eritrea found in the Western Lowlands Zone. The most important is the existence of a preference in market for the natural products rather than synthetic substitutes. Incomers (gum olibanum by Somali people in 1925; and gum Arabic by Sudanese in the early 1950s) started tapping and collecting gum and eventually this knowledge transferred to the local people. However, the local people were deriving relatively little income. Thus, efforts are being made to involve the local people in the harvesting work. To upgrade the technical expertise of tapping and collecting gum, on the job training conducted at least annually as an integral part of the overall human resources development programme of the Ministry of Agriculture. The gum production in 1996 -2001 under MoA license is as shown in Table 7.5. However, there is a speculation that more of the products are produced and sold illegally.

Table 7.5: Gum Production (1996-2001)

Year	Gum Arabic(tonnes)	Gum Ollibanum (tonnes)
1996	117	463
1997	49	543
1998	393.5	1,382
1999	101.1	451.4
2000	19	971.2
2001	319.5	21.8

Source: Ministry of Agriculture Annual Reports

Over the years, the resource has apparently dwindled due to unsustainable exploitation (destructive tapping, indiscriminate cutting and excessive trimming for feeding livestock) and drought. Thus, there has been some limited replanting of both. *Acacia senegal* and *Boswellia papyrifera*. For instance, more than 1.4 million *Acacia senegal* seedlings have been planted at sites in Mereb, Berakit, Barentu, Omhajer and Asmat since 1994 with a very good (70 – 80%) survival rate. Efforts will continue to plant these species on a large scale. There is a project proposed based on the sustainable management of gum Arabic and incense for productive purposes, which will consolidate research into the species, expand the resource through enrichment and /or plantations, and support the development of locally based cooperatives (FAO, 1997).

- a) On the integration of trees / shrubs in farming systems, thereby improving soil fertility, crop yield, fuel-wood and fodder yields on farms;
- b) In staff, development has been given priority and some staff trained in short- and long-term training.

Forest Management Guidelines, which have been framed to incorporate both protective and potential productive functions, have been formulated for both permanent and temporary closures.

Encouraging production and Substitutions of Fuel and Construction Woods

Like in most underdeveloped countries, biomass is the major household energy source in the Eritrean society. Though a government legislation banning the cutting of live trees is in effect since 1994, the pressure from livestock and some people venturing into the protected areas may continue until an alternative animal feed and energy sources are available to meet the high demand of feed and fuel wood by the population. Similarly, until the millions of trees that have been planted are mature and ready for use. In order to minimize or if possible, eliminate this problem, it is proposed to develop programmes/ actions that include:

Increasing Wood Production

Enhance gathering wood from plantations such as; trees grown along farm boundaries, in home compounds, for shade and as windbreaks or farm woodlots) and not from natural forests. This includes activities such as:

- Raising awareness on tree planting for wood supply.
- Increasing the availability of quality tree seeds.
- Establishment of on-farm tree nurseries to meet the demand.

Most plantations planted at hillside closure catchments planting campaign, there also exist some community, farm and homestead plantations. This also includes the municipal and roadside planting. Before independence, some afforestation programme was carried out most under Food for Work (FFW) primarily for soil and water conservation. Through these actions, more than 10,000 hectares of plantation were established consisting mainly of *Eucalyptus cladocalyx*. Tree planting was combined with physical terracing operations. After independence in 1991, the Government of Eritrea (GoE) continued this planting programme accompanied with extensive land works mainly of contour terracing and some micro-basin construction. Since then, the government/MoA has made an effort to maintain proper records of afforestation activities.

Increase Fuelwood Efficiency: Reducing wood Demand

- Develop and use alternative energy sources such as improved traditional stove (mogogo).
- Gas-based or kerosene-based stoves, solar energy, wind energy and other energy conservation techniques like covering food when cooking, soaking dry grains overnight, chopping food into small pieces before cooking, preparing food before

lighting the fire.

- Promote substitutes for construction wood, such as iron or concrete beams for pillars and rafters and corrugated iron sheet for roofing.

In Eritrea, research is purely to solve existing problems, which is one of the pre-requisites for sustainable social, economic and environmental development of a country. It is a vehicle for implementation of the government's development programmes.

Major Achievements, Challenges and Opportunities

Major achievements on Climate Change mitigation and adaptation, and landscape restoration initiatives off-farm, on-farm and water harvesting in Eritrea highlighted as follows;

Off-farm

- 129, 152 ha terraces constructed.
- 5,750,947 m³ check dams constructed.
- 151,348,147 tree seedlings planted.
- 399,330 ha of land enclosed.
- 173,000 improved stoves (Adhanet) constructed.

On-farm

- On about 276,204 ha of farm land different types of soil and water conservation infrastructures have been constructed.

Water Harvesting

- 840 dams and ponds constructed and irrigating in the downstream.
- About 32,000 ha of land irrigated.

The Eritrean Agricultural Research is dealing with different research activities to mitigate Climate change. The loss of forest cover and other types of woody vegetation will lead to increasing scarcity of forest products, environmental degradation, and loss of biodiversity. To achieve sustainable land use system, socio-economic problems contributing to deforestation will need to be addressed by the forestry sub-sector. To sustainably manage and rehabilitate forest resources of the country scientifically, input from forest research is indispensable. Hence, the government of Eritrea established Forestry Research unit in 1994 to undertake Research and Development in forestry and allied natural resources. The unit has the following Programmes:

- i) Tree Seed development and gene conservation.
- ii) Silviculture and natural forest management.
- iii) Agroforestry research demonstration.

The most significant early findings from the commendable start on forestry research are:

- a) The Forestry research unit has established 4 research centres in various agro ecological zones of Eritrea.
- b) The unit is screening over 25 multipurpose for site and species matching, water harvesting techniques for improved tree survival and growth in dry areas.
- c) Early results indicate that the various species included in the field trials at the few locations show differential adaptation to and growth performance in the contrasting climatic and soil conditions at the trial sites.
- d) That there exist great opportunities to introduce other species (and their provenance) with superior growth performance over and above indigenous species and local land races; and
- e) Trials of Bamboo growth for restoring the land.
- f) Spacing trials of *Cordia Africana*.
- g) Established and domesticating different indigenous fruit trees.
- h) Trials on spacing and growth of *Cordia africana* and management straight and by pruning the tip of the trees.

Crop Improvement to Mitigate Climate Change

Crop improvement division is engaged to mitigate climate change impact on crop production. National Agricultural Research Institute practices and use strategies that can help to achieve food and nutrition security of the country. The strategies and practices adapted by National Agricultural Research Institute are:

- Utilization of early maturing varieties.
- Introducing and development of drought tolerant varieties.
- Using moisture conserving techniques such as tie ridge.
- Utilization of disease and pest resistant varieties.

Challenges

The challenges encountered include:

- Land tenure system.
- Limited financial resources.
- Shortage of skill manpower.
- Lack of effective soil and water conservation legislation.
- Lack of motivation by farmers as land and tree ownership rights are not absolute.
- Intensification of livestock production.
- Investment on the land.
- Free grazing system discouraging planting trees on farm / modern agroforestry practices.

- Insufficient introduction of alternative energy sources accelerating degree of deforestation.
- Lack of awareness of climate change mitigation.

Opportunities

The opportunities include:

- Good will of the Government of Eritrea.
- Community participation, National Services, and Students Summer Campaigns.
- Policies of the Government on Climate change, Agriculture, and Forestry.
- Five-year Strategic Development Plan / Action Plan to come up with project proposals and look for internal and external resource mobilization in food and nutrition security; climate Change mitigation and adaptation, landscape restoration and forestry development.
- Existence of Agricultural Departments such as Research, Extension and Regulatory Services.

Policy, Legislation, Strategies and Guidelines

National Forestry Policy and Strategies

The government replaced the pre-existing policy known as *Forest and Wildlife Conservation and Development No. 192/1980*, and associated rules and regulations that being used during war of liberation (1961-1991), by a new Forest and Wildlife Conservation and Development Proclamation No.155/2006 and the *Regulation NO.111/2006*. In addition to this Forestry and Wildlife Management Policy” drafted in 2005. This policy defines the following sub-sector objectives:

- Produce fuel wood and construction poles.
- Promote soil conservation through reforestation.
- Restore the ecosystem through natural regeneration.
- Promote the development of non - wood forest products.
- Protect the existing known populations of endangered wildlife while undertaking.
- A national reconnaissance of remnant habitats and associated communities.

This has been shaped by its ratification of international agreements for trade in endangered species (CITES, 1974), and the Convention on Biological Diversity (COB, 1992).

The policies should focus at ecosystem enhancement by promoting soil and water conservation structure, afforestation and reforestation, drought resistant crop varieties, integrated pest management and disease control. Policies should also be tailored toward coastal area management to prevent coastal erosion. The major legislative frameworks and policies in place support the promotion of climate change mitigation and adaptation measures.

Landscape restoration and forestry development in Eritrea documented includes the National Economic Policy Framework and Program (1998-2000), Food Security Strategy, The Interim Poverty Reduction Strategy Paper, (IPRSP2004), National Adaptation Plan of Action (NAPA,2007)National Biodiversity Strategy and Action Plan for Eritrea, (NBSAP-2015), National Environmental Assessment Procedures and Guidelines (NEAPG,1999),National Action Program (NAP) to Combat Desertification, Environmental Management Plan for Eritrea (NEMP-E,1995), Water Policy and Proclamations, (2010), Health Policy, Coastal Areas Policy and Marine Protected Areas (MPA) and Land use policy are fully specified to show that the policy reflects the adaptation activities to be implemented.

Strategies

The strategies in pursuance of these objectives have been put forward are:

- Implementing the Land Reform Proclamation No. 58/1994.
- Implement the international agreements relating to forestry and wildlife.
- Establish national parks and other areas for the conservation and management of wildlife.
- Conserve, protect and establish a system for sustainable use of the forests and wildlife of Eritrea.
- Develop plans to protect current endangered wildlife and habitats in consultation with the community.
- Developing community-based local land management plans.
- Encouraging private fuel and construction wood plantations and in improving fodder production.
- Protect catchments by permanent and temporary closure, augmented where necessary by reforestation.
- Promote the use of multiple purpose tree species and the development of social forestry.
- Encourage the introduction and adoption of alternative energy sources and fuel-efficient stoves.
- Promote participatory approaches for the protection and restoration of the environment.
- Ensure the sustainable exploitation of wood and non-wood forest products.
- Make tree seedling production financially self- sustaining through charging for seedlings; and raising public awareness.
- Expanding research, education, and training in appropriate technologies.
- Empowering civil society, NGOs, and community-based organisations to be active partners of Government in forestry programmes.
- Relevant policies, strategies and legal framework are indicated in Table 7.6.

Table 7.6: List of national policies, strategies and legal framework

National Policy Documents	Year
The Five-Year Indicative Development Plan (FYIDP), GOE	2009
Ten Year Long-Term Indicative Perspective Development Plan (TYIPDP), GOE	2009
Interim-Poverty Reduction Strategy Paper(I-PRSP), GOE	2003
National Economic Policy Framework and Program (NEPFP), GOE	1998-2000
National Constitution, GOE	1997
Macro Policy, GOE	1994
Cross-cutting	
Eritrean Environmental, Protection Management, and Rehabilitation Framework 179/20017	2017
Environmental Protection and Management Regulations, Legal Notice 127/20017	2017
National Environmental Management Plan	1995
Water Law, Proclamation No. 162,	2010
National Health Policy	2010
Integrated Water Resource Management Action Plan	2009
Land Use Policy	2007
Water Policy	2007
Rural Sanitation Policy	2007
Fishery Proclamation 195/2007	2007
Agriculture Sector Policy	2006
Forest and Wildlife Policy	2005
National Environmental Assessment Procedures & Guidelines	1999
Environmental Health Policy	1998
Fisheries Product Proclamation	1998
National Agricultural Development Strategy and Policy	1994/2005
Biodiversity	

National Policy Documents	Year
National Biodiversity Strategy and Action Plan (NBSAP)	1996, 2000, 2014
Proclamation on Conservation of Biodiversity	1998
Forestand Wildlife Conservationand Development Proclamation No.155/2006	2006
Climate Change and Energy	
Second National Communication (SNC)	2012
National Adaptation Program of Action	2007
Renewable Energy Sub-Sector Policy	1997
Land Degradation	
Five Year Action Plan for The Great Green Wall Initiative (Draft)	2011-2015
National Action Program	2002
Land Use Planning Regulatory Framework	1999
LandProclamationNo.58	1994

Opportunities and Challenges to Capacity Building

Opportunities

The opportunities for capacity building are:

- Enough human power to be trained.
- Availability of short courses (local and abroad).
- Awareness through mass-media and other information materials that include; brochures, manuals, and guidelines.
- Exposure through scientific visits and exchange of experiences, especially in neighbouring countries.

Challenges

The challenges encountered in capacity building include

- Lack of department of Forestry in Hamelmalo Agricultural College.
- Financial limitation.
- Only few chances for higher education.

Areas of Particular Training Needs

The identified areas of capacity building include:

- Sustainable land management.
- Sustainable Forestry Management (SFM).
- Agroforestry.
- Integrated Watershed Management.
- Sustainable and Effective Water Management.
- Climate Change; Climate Smart Agriculture, Forestry and Agroforestry.

7.3 Promoting Climate Change Resilient Forestry in Ethiopia

Miheret Semere Negash

Central Ethiopia Forestry Development Center (CEFDC)

Introduction

Ethiopia, situated in the Horn of Africa, is one of the oldest nations with a well-known ancient civilization and diverse geography and culture. It is the 10th largest country in Africa, covering an area of 1.1 million km². The climate varies from arid and semi-arid lowlands to cool, wet highlands. Ethiopia includes the world's lowest altitude (125 meters below sea level) called the Danakil Depression and the highest altitude (4,550 meters above sea level) at Mount Ras Dashen in the Simien Mountains, the highest point. Ethiopia experiences seasonal bimodal and unimodal rainfall patterns. Annual precipitation ranges from less than 300 mm in the east to over 2,000 mm in the southwest (Njoya *et al.*, 2024). The dominant landscapes are the Highlands, Rift Valley, dry lowlands, and major river basins (e.g., Awash, Blue Nile). The total population is estimated at 126 million (2023). Although agriculture accounts for 33% of the GDP, rural populations are highly dependent on subsistence farming (World Bank, 2023).

Ethiopian forests have been considered one of the world's biodiversity hotspots (Eastern Afromontane), but deforestation due to human-induced factors has been an alarming trend. (Njoya *et al.*, 2024). Various efforts are underway to restore Ethiopian forests through Forest Landscape Restoration (FLR), Sustainable Land Management (SLM) practices, and tree-planting campaigns (e.g., Green Legacy Initiative), which are becoming increasingly effective. However, regeneration remains uneven. The country's major GDP is supported by agriculture, which is mostly composed of smallholders farmers. However, there is ongoing intensification, irrigation expansion in the Rift Valley, and increased commercial agriculture in lowlands. Despite these efforts, efficiency remains limited due to natural and human-induced causes. As a result of different negative factors, nearly 27% of the land has become degraded, losing approximately 1.5 billion tons of soil annually (Hurni *et al.*, 2016). The main drivers of land degradation are identified as deforestation, population pressure, climate change, and overgrazing, all of which impact the overall productivity of crops and livestock by increasing vulnerability to drought. The government has implemented various response mechanisms, including soil and water conservation measures (such as terraces and check dams), watershed management, and afforestation programs. However, these programs should be inclusive and participatory to effectively mitigate the impacts that have already occurred.

Farm lands and urban settlement expansion are becoming characteristic of forest and rangelands. From 2000 to 2020, the expansion of cropland increased by 20%, which is very alarming and indicates the dependency of rural areas on farming. Croplands grew by approximately 20% at the expense of forests (Njoya *et al.*, 2024). The forest cover also declined from 40% to between 12% and 15% in the early 20th century (FAO FRA, 2020). Acacia-Commiphora woodlands are the most common woodlands, mainly in the lowland parts of the country, and they are the primary source of fuelwood, charcoal, gum, and fodder, in addition to their ecological benefits in regulating the environment.

Programs/Projects being Undertaken by Different Actors to Address Climate Change

Ethiopia has been designing and implementing various programs to address the negative impact of climate change. Some of the major initiatives designed by different actors in the country to combat climate change, basically in climate change mitigation and adaptation include the following;

Ethiopia's Climate Resilient Green Economy (CRGE) Strategy

This strategy has been implemented, aiming to achieve the country's goal of meeting a carbon-neutral middle-income status by 2030 by implementing afforestation, reforestation, and forest conservation actions. The program also considers climate-smart agriculture as one of the most important strategies in agriculture (FDRE, 2021). This program is not only applied in agricultural sectors but also implemented in different sectors to facilitate the afforestation effort.

National REDD+ Program

Emission reduction from deforestation and degradation is the most pressing factors for climate change are forest degradation. This program generally aims to reduce emissions from deforestation and forest degradation in doing so, promoting people's livelihoods is basic concern at the same time. while improving livelihoods. This program, largely supported by the World Bank and UNDP (Kassa *et al.*, 2019), has been and also currently being implemented in different regions of the country.

Climate-Smart Agriculture and Agroforestry Integration

Considering agroforestry systems as one of the promising land use systems in climate change mitigation (Sequestering a significant amount of carbon from the atmosphere) and maintaining household livelihood at the same time. (Mekonnen *et al.*, 2022).

Green Legacy Initiative

This very popular and leading initiative has been implemented effectively since 2019 to present this tree-planting program has successfully over 25 billion seedlings planted between 2019–2023, aiming to restore 20 million ha of degraded land and enhance national food security (Gebreselassie *et al.*, 2023). Ethiopian Forestry Development is committed to supporting this effort by engaging in plantation programs, tree seed provision, and facilitating planting campaigns. About 7.5 billion seedlings were planted in 2025. Participatory Forest Management (PFM) and other community-based models restoring forest landscapes also work in line with the above-mentioned measures towards saving the landscape from degradation, while ensuring livelihood benefits (Ameha *et al.*, 2020). National Forestry Sector Development Programs (NFSDP, 2018–2028) involves a 10-year plan of transforming/involving forestry into one of the country's green economy sources. Besides biodiversity conservation, forest enterprise, industrial/commercial plantations, and wood supply are among the major projects that have been implemented so far. Some of the active programs involved in forest sectors (MEFCC, 2018) include forest coffee conservation, UN-REDD & FAO-supported Forestry Capacity Building and Sustainable Land Management Program (SLMP) combines conserving unique

Ethiopian wild coffee (Arabica coffee), monitoring, reporting, and verification (MRV) systems for Ethiopian forest carbon accounting and soil conservation and reforestation in agricultural landscapes, supported by GIZ and World Bank (Nigussie *et al.*, 2021).

Major Achievements, Challenges and Opportunities

The Climate Resilient Green Economy (CRGE) strategy (2011) was one of the best initiatives given the concern by the government and forestry sector towards aiming for carbon-neutral growth by 2030. The country has also made significant progress in expanding its renewable energy sources, particularly in hydropower, wind, and solar energy, along with various forest restoration programs like, Green Legacy Initiative, engaged in planting tree seedlings in a shorter period. mobilized millions to plant billions of trees. In doing so, the country has achieved in attracting climate funds from GCF, GEF, and REDD+, mainly allocated for forest conservation and climate change.

Nevertheless, considerable measures have been applied against climate change and threats against forests, but institutional capacities fail to fulfil the overall mission of the initiatives. This could be due to policy implementation gaps, limited technology and skilled manpower, rising climate-related crisis and their high demand to rehabilitate the impact, and most importantly, adequate financing to run all the measures are the challenges faced while implementing the measures. Growing concern of international parties to support climate change efforts like carbon financing has been one of the outstanding opportunities to implement the measures.

Policy, Legislation, Strategies, and Guidelines

Ethiopia's climate response is anchored in the Constitution of 1995, which enshrines the rights of citizens to a clean and healthy environment as one of the baseline policies towards climate and environmental protection. The 1997 Environmental Policy of Ethiopia (1997) put the basic groundwork for sustainable natural resource use and conservation. In 2002, the Environmental Impact Assessment Proclamation (2002) obligated to monitoring and evaluation of projects that are designed to protect the overall environment. With participatory forest management the Forest Development, Conservation and Utilization Proclamation make forest conservation perceptible, which was designed in 2007 and revised in 2018. The milestone Climate Resilient Green Economy (CRGE) Strategy (2011), was to put the country for international opportunities towards carbon financing. The National Adaptation Plan (2019), designed to strengthen the adaptation scale towards climate impacts and build resilience in various sectors. Most importantly, the Nationally Determined Contribution (NDC, updated 2021) plays a significant role in empowering Ethiopia's climate pledges under the Paris Agreement.

Opportunities and Challenges to Capacity Building

All policy frameworks discussed in the above section has been creating a promising prospect for institutional capacity building including universities and research centres. International partners who have been financing the forest restoration and climate change efforts has also provide access to expertise. Participatory forest conservation measures enhance awareness and ownership towards the efforts. The assessment towards the

efforts were also digitized and modernized which improves the monitoring and evaluating determination. Yet, failure to integration among institutional and weak synchronization persist as major drawbacks. Limited technical expertise, financial constraints shortage of skilled human power hinders the effort towards capacity building. Innovation, education and sustainable investment can be opportunities.

Areas of Particular Training Needs

- Climate finance and resource mobilization: enabling how to acquire and manage funds, writing bankable proposal and be competent. (e.g., GCF, REDD+).
- Climate policy and governance: to enable the expertise how to understand and execute forest and climate-related legislation this also include Monitoring, reporting, and verification (MRV) skills.
- Disaster risk management – solidification of the community, particularly in drought prone and vulnerable areas to respond to climate impacts. This also include allowing local groups to sustain interventions.
- Research and innovation – enhancing universities and institutes’ role in applied climate and forestry research.
- Cross-sectoral organization and management: – training institutions to work together across various sectors.

Additional information

This training is expected to implement significant change in forest use and management among communities. It will strengthen cross-national and sectoral collaboration between various actors for integrated land scape restoration and climate change mitigation and adaptation. Such kind of trainings also could maintain the accountability and sustainability local governance structures towards such efforts. Being Inclusive and participatory (youth gender) in trainings also improve climate-resilient livelihood opportunities. Generally, this enhances the capacity to implement policies and strategies in the way they can answer all climate related impacts.

7.4 Promoting Climate Change Resilient Forestry in the Kingdom of Eswatini

Mbalenhle Primrose Baxter

Ministry of Tourism and Environmental Affairs – Department of Forestry

Introduction

The Kingdom of Eswatini covers approximately 17,363 Km². It is a small, landlocked country in Southern Africa, bordered by South Africa to the west, north and south and Mozambique to the east. The country experiences drought and occasional floods linked to EL Nino and La Nina cycles. It is subtropical, with a clear seasonal pattern such as wet, hot summers (October to March) and cold and dry winters (April to September). There are 4 ecological regions defined by elevation, climate, soil and vegetation as indicated in Table 7.7.

Table 7.7: Ecological regions of the Kingdom of Eswatini

Region	Rainfall (mm/year)	Temperature	Vegetation /Ecosystem
Highveld (mountainous) western	1,000 - 1,500 (upto 2,000)	Mild/temperate; frost in winter	Montana grasslands, forests
Middle veld	700 - 1,000	Warm/ occasionally 40°C	Mixed farms, woodlands, savannas
Lubombo Plateau	700 - 1,000	Warm/ subtropical	Forest mosaic, riverine habitats
Lowveld / eastern	500-900 (sometimes <500)	Hot (Around 29- 30°C	Savannah, thorn bush, sugarcane fields

Eswatini’s human population is relatively small but growing slowly with an estimated total population at about 1.24–1.26 million people. The 2025 population projections estimates around 1.25 million inhabitants, reflecting a +1.07% annual growth rate, About 68.7% of the population live in rural areas, while 31.3% of the population live in urban areas. Population density is highest in the Middleveld, where the climate and soils are most favourable for agriculture and settlement. Although urban centres such as Mbabane and Manzini are expanding, about three-quarters of the population still live in rural areas and depend heavily on subsistence farming, livestock and natural resources for their livelihood.

A largely rural country is undergoing shifts in land use, including agricultural expansion and habitant change. Forest land compromised of 46% of the national area (24% is plantation/wattle/woodlots, and the balance is natural forests. Grassland 24%, cropland

23%, settlement 4%, wetlands 2% and others 1% in 2020. Historical deforestation rate is about 811.6 ha/year, or 0.1% per year (2000- 2020) (*Worldometer 2025, redd.unfccc.int*).

Forestry consisting mainly of plantation of pine, eucalyptus, wattle, contributes significantly- about 15% of GDP and employs about 8000 people (approx. 8% of the formal employment. Agriculture is also key, with cropland covering 23% of the country by 2020. Sugarcane dominated 74% of the agricultural outputs in 2015, contributing 13% of GDP.

Status of Forestry and Forest Resources, Woodlands and Allied Natural Resources in The Kingdom of Eswatini

Forests in Eswatini includes indigenous forests and woodlands as well as timber plantations. Forest cover remains substantial with 46% plantations pine and eucalyptus being high-managed, but wattle have spread uncontrolled around the Highveld and middleveld. The forestry industry is privatized, led by companies such as Montigny Investment (used to be Sappi- Usuthu) and TWK Peak Timber (used to be Mondi Forestry) and Shiselweni Forestry Company. The companies manage approximately 130,000 ha of plantations, approximately 25,000 ha of that is unplanted for infrastructure and biodiversity.

Trends of Forestry/Agricultural Development in Eswatini

Forestry and agricultural development in Eswatini have evolved significantly over the past decades, driven by commercial expansion, land-use change, and increasing pressure on natural ecosystems. Since 1949, commercial forestry has grown steadily, with plantations particularly of exotic species expanding across suitable zones of the country. While this growth has strengthened the sector's contribution to national economic development, it has also been accompanied by a gradual decline in the management quality of older wattle forests, where inadequate maintenance and aging stands have reduced productivity and ecological value.

At the same time, agricultural expansion remains one of the most prominent land-use trends, with sugar-cane cultivation in the Middleveld and Lowveld intensifying competition for land. The profitability of sugar-cane farming has encouraged its continuous spread, often replacing natural vegetation and marginal forested areas. These combined shifts have accelerated habitat loss, resulting in noticeable declines in natural landscapes across Eswatini. Grasslands have diminished by approximately 34%, while savannah ecosystems have reduced by around 7%. Such transformations highlight the growing pressure on the country's biodiversity and the need for improved land-use planning, sustainable forest management, and restoration initiatives to balance economic growth with ecological integrity.

Current Situation on Land Degradation

Land degradation and soil erosion are widespread in Eswatini, driven by expanding urban areas, agricultural encroachment, unsustainable firewood harvesting, invasive species, and the drying of wetlands. These pressures have accelerated the loss of productive land, particularly in degraded grasslands and key catchment zones. Wildfires remain a major

concern especially in the Upper Middleveld where they have repeatedly been reported as disasters in successive State of Environment Reports (SOER), further intensifying landscape degradation and undermining ecosystem resilience.

Recent and/or Current programmes/Projects being Undertaken in Eswatini to Address Climate Change Mitigation and Adaptation

Eswatini has made notable progress in advancing climate change mitigation and adaptation, particularly within the forestry and land-use sectors. In January 2024, the country submitted its first Forest Reference Level (FRL) to the United Nations, covering land-use data from 2000 to 2022. This establishes a national baseline for REDD+ activities focused on reducing deforestation, enhancing carbon stocks, and promoting sustainable forest management positioning Eswatini as a potential net carbon sink in the forestry sector.

Policy efforts continue to guide climate action. The National Climate Change Policy (2016) outlines the country's strategic framework for mitigation and adaptation, complementing the National Development Strategy (1997/2014), the National Land Policy (2020–2030), the Flora Protection Act (2001), and the National Forestry Policy (2002). Together, these instruments strengthen governance, conservation, and sustainable land use.

Institutional reforms are also underway. The Ministry of Tourism and Environmental Affairs, through the Department of Forestry, is currently amending the Forest Bill of 2021 to better align legislation with emerging climate priorities, sustainable forest management objectives, and evolving global frameworks.

Landscape Eestoration Programmes for Forest and/or Agricultural Landscapes Rehabilitation

Eswatini is implementing several large-scale landscape restoration initiatives aimed at rehabilitating degraded forest and agricultural areas while strengthening ecosystem services. The Mbuluzi River Ecosystem Restoration Project, supported by the Global Environment Facility (GEF), focuses on restoring degraded landscapes within the Mbuluzi catchment and adjacent protected areas. It seeks to rebuild ecological integrity, enhance habitat quality, and improve the delivery of water and land-based ecosystem services.

Under the AFR100 initiative, Eswatini has committed to restoring 500,000 hectares of degraded land by 2030. This national pledge is aligned with the country's goal of achieving land degradation neutrality and increasing forest cover by 5%. As part of this effort, Eswatini plans to plant 10 million trees by 2030, with approximately 8.5 million trees already planted, demonstrating strong progress toward its targets.

Complementing these efforts, the Eswatini Environmental Fund (EEF) is supporting community-driven wetland and biodiversity restoration projects. These initiatives focus on rehabilitating wetlands, enhancing groundwater recharge, strengthening climate resilience, and improving local livelihoods through nature-based solutions.

Forestry Development

Forestry development in Eswatini continues to advance through both commercial and community-oriented initiatives. Commercial plantation forestry remains a major focus, with ongoing expansion of pine and eucalyptus plantations. Current policies such as the National Forest Policy and the Flora Protection Act emphasize improving plantation management, diversifying species, and strengthening sustainable forest practices.

Alongside commercial forestry, the country is implementing projects that integrate ecosystem-based adaptation with forest and biodiversity conservation. These initiatives, supported through national policy frameworks and the Eswatini Environmental Fund (EEF), aim to enhance ecosystem resilience while promoting sustainable land management.

Efforts to formalize and strengthen smallholder participation in the forestry sector are also growing. The registration of small-scale farmers for Forest Stewardship Council (FSC) certification reflects a move toward improved market access, better management standards, and increased incentives for sustainable forestry across rural landscapes.

Major Achievements, Challenges and Opportunities

Achievements

Eswatini has taken significant steps in strengthening its climate mitigation framework, marked most notably by the submission of its first Forest Reference Level (FRL). This achievement reflects the country's growing technical capacity in forest monitoring and establishes a solid foundation for implementing REDD+ activities. It also signals a more coordinated and data-driven approach to national climate strategy.

The country's commitment to restore 500,000 hectares under the AFR100 initiative further demonstrates strong alignment with international restoration goals. This pledge positions Eswatini as an active regional contributor to Africa's broader landscape restoration agenda and reinforces its national ambition to achieve land degradation neutrality and expand forest cover through large-scale tree planting.

At the community level, Eswatini Environmental Fund (EEF) supported wetland restoration projects have delivered meaningful ecological and socio-economic benefits. These include improved water security, enhanced carbon sequestration, biodiversity recovery, and livelihood support through handcraft materials and income-generating opportunities. The success of these initiatives highlights the value of community-driven restoration in building resilience and restoring degraded ecosystems.

Challenges

Despite notable progress, Eswatini continues to face significant data and capacity constraints that affect effective climate and forest-sector reporting. Persistent gaps in emission factors, limited national capacity for monitoring, reporting and verification (MRV), and weak inter-agency coordination undermine the quality, completeness, and consistency of national climate information. These limitations slow down decision-making and complicate the implementation of advanced frameworks such as REDD+.

There are also ecological risks associated with large-scale restoration commitments. While AFR100 offers substantial opportunities, poorly planned interventions risk compromising natural ecosystems particularly grasslands and savannas. Experts warn that afforestation efforts, if not ecosystem-sensitive, could degrade these naturally treeless systems. Inappropriate tree planting in savannas may reduce biodiversity, alter fire regimes, and diminish ecosystem functions, highlighting the need for careful landscape-level planning.

Opportunities

Eswatini has significant potential to expand its restoration and climate adaptation efforts by scaling up successful community-based initiatives. The positive results from Eswatini Environmental Fund (EEF) projects particularly in wetland rehabilitation and livelihood enhancement provide practical models that can be replicated across other landscapes to strengthen resilience and improve ecosystem services.

The country can also harness the momentum created by its AFR100 commitment to attract additional climate finance and technical support. This creates an opportunity to implement ecosystem-appropriate restoration that respects the ecological integrity of grasslands, savannas, and forest systems, ensuring that restoration aligns with biodiversity conservation and avoids unintended ecosystem trade-offs.

Additionally, Eswatini can further enhance its Forest Reference Level (FRL) and national monitoring, reporting, and verification (MRV) systems by adopting updated methodologies, new datasets, and improved inter-agency coordination. Strengthening these systems will increase the country's readiness for future REDD+ financing and bolster its capacity to meet long-term climate and restoration objectives.

Policy, Legislation, Strategies and Guidelines

The major legislative frameworks enabling promotion of climate change mitigation and adaptation measures, landscape restoration and forestry development include;

- Environmental Management Act (2002) and mandate of the Eswatini Environment Authority for the environmental oversight and SOER preparation.
- National Climate Change & national biodiversity plans detail ecosystem-based adaptation, forest-smart agriculture and restoration targets (e.g. restoring 15% of degraded ecosystems).
- Alignment with AFR100 and REDD+ policies, following Bonn Challenge restoration commitments and REDD+ frameworks.

Opportunities and Challenges to Capacity Building

Opportunities to Capacities

Eswatini has strong opportunities to enhance capacity through locally driven, EF-supported projects that have already helped communities and institutions develop practical skills in adaptation, restoration, and sustainable land management. These initiatives provide hands-on learning environments where local actors can strengthen

technical competencies while applying restoration methods directly within their landscapes.

At the national and international levels, frameworks such as REDD+, AFR100 and UNDP-supported State of Environment Report (SOER) updates offer valuable platforms for training, knowledge exchange, and improved technical methodologies. These mechanisms open opportunities for continuous learning, access to global best practices, and stronger institutional capacity to implement climate and restoration programmes effectively.

Challenges to Capacity Building

Despite progress, significant institutional gaps persist across key ministries and agencies responsible for climate, forestry and environmental management. Fragmented coordination, overlapping mandates, and limited information-sharing continue to undermine cohesive planning and hinder the effective delivery of capacity-building initiatives. These structural weaknesses slow implementation and reduce the efficiency of national climate and restoration programmes.

Technical limitations also present major challenges. There are notable gaps in Geographic Information System (GIS) expertise, Measurement, Reporting and Verification (MRV) systems, and the development of ecosystem-specific emission factors. Additionally, inadequate capacity for sustainable ecosystem planning particularly distinguishing appropriate interventions for forests, grasslands, and savannas limits the precision and impact of restoration efforts. Together, these constraints weaken national readiness for advanced climate finance mechanisms and long-term restoration commitments.

Areas of Particular Training Needs

Enlist of other training needs that may not have been covered by this programme as indicated in the training objectives:

- Measurement, Reporting and Verification (MRV) and Greenhouse Gas (GHG) inventory method (for forestry/land use).
- Ecosystem - contextual restoration planning, with attention to grassland savanna dynamics.
- GIS and remote sensing for land use tracking and carbon monitoring.
- Inter-agency coordination and stakeholder engagement frameworks.
- Proposal development for climate finance (e.g. REDD+, adaptation fund, AFR100 technical support).

Additional Information

- Dryland context: Eswatini's inclusion in the dryland restoration is important these ecosystems are vital for livelihoods, biodiversity, and resilience. AFR100 represents a key to address dryland degradation.
- SOER's strategic role; Biennial environmental tracking informs policy, foster stakeholder alignment, and aligns ecosystem restoration with climate resilience goals.

7.5 Promoting Climate Change Resilient Forestry in Kenya

Penina Ngugi¹, Elizabeth Muthoni Kariuki² and Wato Gregory Godana³

1. Keya forestry Research Institute (KEFRI)
2. Kenya Forest Service (KFS)
3. Ministry of Environment, Climate Change and Forestry (MECC&F)

Introduction

Kenya is located in East Africa, spans approximately 580,367 km² and is characterized by diverse landscapes including tropical coastal plains, highlands, the Great Rift Valley, and arid and semi-arid lands. The country exhibits a variety of climatic zones ranging from tropical, temperate, to semi-arid conditions. Rainfall patterns are largely bimodal with long rains occurring between March and May and short rains between October and December. The variability of rainfall, coupled with prolonged droughts and temperature rise, has significantly impacted agriculture, forestry, and livelihoods. Kenya's population exceeds 55 million, with rapid urbanization and youth dominance, driving increased demand for land, jobs, and services. Agriculture remains the backbone of the economy, employing about 75% of the workforce. Key crops include maize, tea, coffee, and horticultural products. Forestry, tourism, hydropower, and natural resources also contribute significantly to national income.

Status of Forestry and Natural Resources

Kenya's forest cover stands at approximately 8.8% (5.2 million hectares), while tree cover including agroforestry and urban trees is about 12.13% (7.1 million hectares). Forests are distributed across diverse ecosystems, including indigenous forests such as Mau, Arabuko Sokoke, Mt. Kenya, and Kakamega, as well as mangroves, savannah woodlands, and coastal forests. Forest ecosystems provide vital services such as watershed protection, biodiversity conservation, carbon sequestration, and livelihood support through fuelwood, medicinal plants, and construction materials. However, forest degradation and deforestation continue to threaten these ecosystems. Major drivers include agricultural expansion, illegal logging, charcoal production, urbanization, and forest fires. Approximately 241,000 ha of forest were lost between 1990 and 2010, translating to an annual loss of over 12,000 ha. Deforestation has also resulted in loss of biodiversity, soil erosion, and disruption of hydrological cycles.

Current Situation on Land Degradation

Over 90% of Kenya's land experiences some form of degradation, with 27% classified as severely degraded. Key drivers of degradation include; deforestation, unsustainable agricultural practices, overgrazing, and unplanned urbanization. Degradation is particularly pronounced in arid and semi-arid lands (ASALs), where vegetation loss, soil erosion, and desertification threaten livelihoods and biodiversity. Government and partner responses include the National Landscape and Ecosystem Restoration Strategy, the 15 Billion Tree Growing Initiative, and community-based restoration projects such as grass seed banks and gully rehabilitation in counties like Laikipia and Kitui. These interventions promote sustainable land management, increase vegetation cover, and enhance ecosystem resilience.

Climate Change, Mitigation and Adaptation Programmes in Kenya

National Tree Growing and Restoration Programme (2023–2032), will guide Kenya’s 15 Billion Tree Goal: This programme is Kenya’s biggest national climate and restoration initiative and aims to reverse forest loss, increase tree cover, and restore degraded ecosystems in all 47 counties. The programme prioritizes indigenous species, water tower rehabilitation, riparian protection, and dryland restoration. Nationally, this programme enhances carbon sinks, strengthens watershed protection, and contributes directly to mitigation through increased biomass and reduced land degradation. It also supports adaptation by improving microclimates, reducing soil erosion, and enhancing local water security.

Kenya has developed a robust climate governance framework anchored in the Climate Change Act (2016, amended 2023), the National Climate Change Action Plan (NCCAP 2023–2027), and the National Adaptation Plan (NAP 2015–2030). Together, these instruments guide national and county-level efforts in low-carbon development, climate-resilient ecosystems, and sustainable livelihoods. Priority actions focus on renewable energy, forestry, water resource management, climate-smart agriculture, and nature-based solutions, forming the backbone of Kenya’s national climate agenda.

A major driver of Kenya’s climate and restoration efforts is the project for Strengthening Forestry Sector Development and Community Resilience to Climate Change (SFS-CORECC) Project (2022–2027), jointly implemented by KEFRI, KFS, and JICA. The programme enhances sustainable forest management, supports forest landscape restoration, strengthens tree seed systems, and builds regional capacity on climate-resilient forestry technologies. It also advances research on drought-tolerant tree species, carbon monitoring, and forest health, while promoting community-based climate adaptation interventions.

Kenya is also implementing the Regreening for the Future Initiative (2025–ongoing), led by KEFRI, World Vision Kenya, and CIFOR–ICRAF, which aims to restore 10.6 million hectares of degraded land using FMNR, agroforestry, on-farm tree planting, and livelihood-based restoration models. The initiative directly supports Kenya’s commitment to plant 15 billion trees by 2032 and to achieve its AFR100 and Bonn Challenge restoration targets.

The Kenya Climate Change Adaptation Programme (KCCAP) enhances resilience in climate-vulnerable regions by restoring mangroves and coral reefs, promoting rainwater harvesting, protecting shorelines, and supporting community-based management of fisheries and marine ecosystems. These interventions strengthen coastal resilience and improve blue-economy livelihoods.

The Kenya Landscape and Ecosystem Restoration Programme (KLERP) – 2021–2030 is a flagship national initiative coordinated by the Ministry of Environment, Climate Change and Forestry, with technical support from KEFRI, KFS, NEMA, and county governments. The programme focuses on accelerating climate change mitigation and adaptation through large-scale forest and rangeland restoration across priority ecosystems including the Mau, Cherangany Hills, Mount Kenya, Tsavo, West Pokot drylands, and the coastal belt.

Major Achievements, Challenges, and Opportunities

Achievements

Strengthened Policy and Legal Framework

- Adoption of progressive frameworks such as the Forest Conservation and Management Act (2016), National Forest Policy (2020), and Climate Change Act (2016/2023).
- Development of strategic instruments including the National Landscape and Ecosystem Restoration Strategy (2021–2032) and the 15 Billion Tree Growing Strategy (2022–2032).

Expansion of Tree Cover and Restoration Efforts

- Significant national momentum toward tree growing across landscapes (farmlands, water towers, drylands).
- Large-scale restoration projects contributing to increased carbon sequestration and improved watershed and ecosystem health.

Community Participation and PFM Success

- Strengthening of Community Forest Associations (CFAs).
- Community contributions to forest monitoring, rehabilitation, sustainable harvesting, and nature-based enterprises such as beekeeping, eco-tourism, and bamboo production.

Improved Forest Monitoring and Climate Alignment

- Advancements in forest mapping, carbon stock assessment, and Monitoring Reporting and Verifying (MRV) systems.
- Alignment of national forestry actions with global climate commitments (Paris Agreement, AFR100, Bonn Challenge).

Challenges

Challenges in Kenya's Forestry Sector are:

Persistent Deforestation and Degradation Pressures

- Agricultural expansion, infrastructure development, charcoal production, and illegal logging.
- Continued decline of natural forests and pressure on water tower ecosystems.

Climate Change Impacts

- Increased frequency of droughts, forest fires, and pest/disease outbreaks.
- Vulnerability of dryland forests and plantations to extreme weather conditions.

Limited Financing and Weak Benefit-Sharing

- Insufficient resources for forest restoration, monitoring, and enforcement.
- Inadequate or unclear benefit-sharing arrangements discouraging community engagement.

Capacity and Governance Gaps

- Limited technical capacity at county/community levels (MRV, forest management, restoration skills).
- Weak or fragmented coordination among agencies, counties, and community groups.

Land Tenure and Wood Fuel Dependence

- Land-use conflicts, insecure tenure, and high dependence on wood fuel.
- Demand for biomass energy outpaces regeneration rates.

Inadequate funding

- Restoration activities such as seed production, nursery development, forest patrols, and post-planting care require sustained investment, yet government and county budgets are often insufficient. As a result, forest programmes rely heavily on short-term donor funding, which limits long-term continuity and impact. Limited access to climate finance, weak benefit-sharing mechanisms, and high costs of implementing REDD+ and MRV systems further widen the financing gap. This underfunding slows restoration progress, weakens enforcement, and reduces the sector's ability to effectively address deforestation, degradation, and climate change.

Opportunities

The opportunities that are available are:

Large-Scale Restoration Commitments

- The 15 Billion Tree Growing Initiative offers opportunities for ecosystem restoration, job creation, and biodiversity enhancement.
- Potential to upscale restoration in ASALs, water towers, wetlands, and riparian zones.

Growth of Farm and Private Forestry

- Expanding commercial timber, poles, and biomass markets.
- Opportunities for farmers to engage in carbon farming, agroforestry, and tree-based value chains.

Climate Finance and Carbon Markets

- Emerging opportunities through REDD+, voluntary carbon markets, and blended financing.
- Increased global demand for nature-based solutions (NbS).

Digital Forest Monitoring and Research

- Advances in GIS, remote sensing, forest inventories, and MRV systems.
- Growing research on indigenous species, dryland forestry, and climate-resilient restoration.

Strengthened Multi-Stakeholder Collaboration

- Opportunities for national governments, county governments, communities, NGOs, and private sector partnerships.
- Increased regional collaboration through AFR100 and the UN Decade on Ecosystem Restoration.

Achievements include the successful implementation of national tree-growing campaigns, development of tools such as the KEFRI App and Jaza Miti for digital monitoring of tree growing, and introduction of drought-tolerant tree species. Policy reforms that include; Forest Conservation and Management Act (2016) and Climate Change Amendment Act (2023) have enhanced governance and accountability in forest management.

Challenges include inadequate funding, weak monitoring and evaluation systems, fragmented land use planning, and increasing ecological pressures from invasive species and climate variability. However, opportunities exist in digital innovation, community-based restoration, and access to global climate finance through mechanisms such as the Green Climate Fund.

Policy, Legislative and Strategic Frameworks

Kenya is a signatory to key global agreements that shape national climate and forest governance. Some of the agreement include the following:

- Paris Agreement (2015): Kenya ratified the Paris Agreement, committing to reduce greenhouse gas emissions, strengthen climate adaptation, and enhance climate-resilient development. This global framework guides Kenya's NDCs, climate legislation, and sectoral mitigation measures.
- Rio Conventions: Kenya is a signatory to all three foundational global conventions adopted at the 1992 Earth Summit: UN Convention on Biological Diversity (CBD); UN Convention to Combat Desertification (UNCCD) and UN Framework Convention on Climate Change (UNFCCC). These commitments underpin national efforts in biodiversity conservation, land degradation neutrality, and climate action.
- Bonn Challenge (2011): Kenya subscribes to the global goal of restoring degraded landscapes, contributing to global carbon sequestration, biodiversity recovery, and sustainable livelihoods.
- Kunming–Montreal Global Biodiversity Framework (2022): As a CBD signatory, Kenya aligns national biodiversity targets and conservation actions with this new global roadmap for restoring nature by 2030 and 2050.

Further Kenya also aligns with (regional framework) Africa-wide Forest and climate commitments that help translate global goals into regional action which include:

- African Forest Landscape Restoration Initiative (AFR100): Kenya is a committed member, pledging to restore 5.1 million hectares of degraded landscapes by 2030. AFR100 mobilizes technical, financial, and capacity support across the continent for restoration and climate-resilient land management.
- African Union Climate Change Strategy and Agenda 2063: These frameworks reinforce Kenya's commitment to climate-smart development, resilient ecosystems, and sustainable land use across the African continent.

Building on its international and regional commitments, Kenya has developed strong national frameworks guiding forest governance, climate action, and ecosystem restoration.

- Kenya National Forest Policy (2023): Provides guidance for sustainable forest management, participatory governance, biodiversity conservation, and expansion of tree cover across landscapes. It aligns Kenya's forest sector with global restoration and climate objectives.
- Forest Conservation and Management Act (2016): Kenya's principal forestry legislation. It establishes the legal mechanisms for forest protection, regulates forest utilization, recognizes Community Forest Associations (CFAs), and promotes sustainable forest use and restoration.
- Climate Change Act (2016, amended 2023): Anchors Kenya's climate governance structure. It mandates mainstreaming climate change in national and county planning, establishes the National Climate Change Council, strengthens climate finance mechanisms, and operationalizes Kenya's Nationally Determined Contributions (NDCs).
- National Climate Change Action Plan (NCCAP 2023–2027): Kenya's most recent climate action plan. It outlines priority mitigation and adaptation measures across energy, water, forests, agriculture, waste, blue economy, and disaster risk management.
- National Adaptation Plan (NAP 2015–2030): A long-term strategy that enhances resilience of vulnerable communities and ecosystems. It ensures that climate risks are integrated into national development planning and county planning processes.
- National Landscape and Ecosystem Restoration Strategy (2021–2032): Provides Kenya's roadmap for restoring degraded landscapes, water towers, forests, rangelands, and wetlands. It aligns national restoration targets to global commitments such as AFR100 and the Bonn Challenge.
- 15 Billion Tree Growing Strategy (2022–2032): A national strategy to increase tree cover, rehabilitate degraded ecosystems, enhance biodiversity, and expand carbon sinks. It operationalizes Kenya's ambition to plant 15 billion trees within 10 years in order to mitigate climate change and improve ecosystem services.

Opportunities and Challenges to Capacity Building

Opportunities to Capacity building

Kenya has strong opportunities to strengthen capacity across the forestry and climate sectors. Some of the opportunities include:

- Community-based restoration projects provide practical platforms for hands-on learning and skill development.
- Participation in international initiatives (e.g., Paris Agreement, AFR100, REDD+, UN Decade on Ecosystem Restoration) offers access to training, technology transfer, and expert support.
- Growing use of digital tools (GIS, remote sensing, MRV systems) opens opportunities for modern technical capacity building.
- Increasing collaboration among government, counties, NGOs, and research institutions enhances joint training, knowledge exchange, and professional development.
- Expansion of national restoration programmes (15 Billion Trees, landscape restoration strategies) creates demand for and investment in technical skills.

Challenges

Despite these opportunities, several challenges limit effective capacity building. The challenges are as:

- Fragmented institutional mandates and weak coordination hinder effective and consistent capacity-building efforts.
- Shortages of skilled personnel in GIS, MRV, forest restoration planning, carbon accounting, and ecosystem-specific management especially at county and community levels.
- Limited and unpredictable funding constrains long-term training programmes.
- Complex procedures for accessing climate finance reduce opportunities for skill development in proposal writing and financial management.
- Inadequate technical infrastructure and insufficient data systems limit the effectiveness of advanced training and knowledge application.

Additional Information

Kenya has made substantial progress in promoting climate change resilient forestry through robust policies, technological innovation, and strong community participation. While challenges such as land degradation and limited funding persist, strategic investments in research, governance, and community empowerment can accelerate progress towards achieving sustainable forest management and climate resilience.

7.6 Promoting Climate Change Resilient Forestry in Lesotho

Rethabile Mathola

Lesotho Agricultural College

Introduction

Lesotho is a landlocked country located in Southern Africa, entirely surrounded by South Africa with nine official borders. It covers a total land area of approximately 30,355 km², whereby over 80% of the country situated above 1,800 meters above sea level. The climate is predominantly temperate and semi-arid, with hot, wet summers and cold, dry winters, including frequent frost and occasional snowfall in the highlands mostly in winter season. The ecological zones include the lowlands, foothills, Senqu River Valley, and highlands, each characterized by distinct vegetation and land use patterns. Agriculture, livestock rearing, small-scale industry, and remittances are the backbone of Lesotho's economy. Crop farming (mainly maize, sorghum, and wheat) is concentrated in the lowlands, while livestock production (cattle, sheep, and goats) dominates the highlands.

The population is estimated at 2.3 million in 2023, with high rural density and dependence on subsistence farming that goes with livestock production where wool and mohair has become very successful. The land use is shifting due to population pressure, urbanization, and expansion of settlements, leading to significant pressure on natural resources that lead to increase in carbon emissions.

Forestry and Forest Resources Current Status

Lesotho has limited forest cover, estimated at less than 1% of total land area, mainly consisting of planted woodlots, gum and pine plantations, and community-managed forests. Lesotho had 372 ha of natural forest, extending over 12% of its land area. In 2024, the country lost 7 ha of natural forest, equivalent to 1.25 kilotons of CO₂. Major forests consist mainly of planted woodlots, gum and pine plantations, and community-managed forests. Indigenous forests are scarce, with small patches of natural woodlands and shrubs found in the highlands and along river valleys and in conserved areas like national parks such as Tsehlenyane Nature Park. Wood fuel remains the dominant source of household energy, placing heavy impact on forest resources and shrub lands. Uncontrolled burning has also increased the pressure on trees and rangelands in the country.

Trends in Forestry and Agriculture

Agricultural productivity has been declining due to soil loss of fertility as a result of high erosion, land degradation, and climate variability. Forestry development has focused on afforestation programmes, community woodlot development, and catchment management. Integrated approaches are increasingly being adopted to promote climate-smart agriculture, watershed management, and sustainable land use practices. There are however mitigation developments through intervention of projects such as Renoka, Roll and SADP.

Land Degradation

Land degradation is among Lesotho's most pressing environmental challenges. Overgrazing, deforestation, urbanization, soil erosion, and unsustainable farming practices have led to severe loss of arable land and declining crop yields. Approximately 40% of the country's land is classified as degraded, threatening food security, biodiversity, and rural livelihoods.

Recent and Current Programmes/Projects in Lesotho

Climate Change Mitigation and Adaptation

- Implementation of the National Climate Change Policy (2017) and Nationally Determined Contributions (NDCs) under the Paris Agreement.
- Promotion of renewable energy (solar, wind, and small-scale hydro) to reduce reliance on biomass.
- Capacity-building initiatives for farmers on climate-smart agriculture and drought-resilient practices.

Landscape Restoration

- The Lesotho Sustainable Land Management Project (SLMP), supported by the Global Environment Facility (GEF) and World Bank, focusing on watershed rehabilitation and soil erosion control.
- Integrated Catchment Management Programmes aimed at restoring degraded landscapes, wetlands, forestry, improving water security, and enhancing rangeland management are implanted under projects that collaborate with the ministry of Environment Forestry and Range Management.

Forestry Development

- Community-based afforestation programmes, including establishment of village woodlots.
- Expansion of government and private sector plantations for timber and fuelwood.
- Awareness campaigns on sustainable forest management and alternative energy sources in schools and communities.

Major Achievements, Challenges, and Opportunities

Achievements

Lesotho has made notable progress in strengthening its environmental management, climate resilience, and sustainable land-use practices. Through a combination of policy reforms, community-driven initiatives, and institutional capacity building, the country has advanced efforts to restore degraded landscapes, enhance agricultural productivity, and integrate climate change considerations into national planning. Key achievements include:

- Establishment of community woodlots and afforestation projects.

- Mainstreaming of climate change in national development planning.
- Adoption of climate-smart agricultural technologies in selected communities.
- Establishment of National Parks.
- Development of Integrated Catchment Management Curriculum in academic institutions.

Challenges

Lesotho continues to face several structural and environmental challenges that hinder effective forest management, sustainable land use, and climate-resilient development. Despite progress made in restoration and policy reforms, gaps in capacity, resource availability, and ecosystem stability continue to limit the country's ability to fully implement large-scale interventions. Key challenges include:

- Limited forest cover and high demand for fuel wood.
- Law enforcement and Policy adaptation.
- Persistent land degradation, soil erosion, and declining agricultural productivity.
- Limited financial and technical capacity to implement large-scale programmes.

Opportunities

The country has significant opportunities to strengthen its forestry sector, enhance climate resilience, and improve sustainable land management. With growing regional cooperation, emerging technologies, and community-driven initiatives, the country can leverage several pathways to accelerate restoration and reduce pressure on natural ecosystems. Key opportunities include:

- Expansion of renewable energy as an alternative to biomass.
- Regional collaboration within SADC on climate resilience and forestry.
- Potential for scaling up community-driven land restoration and afforestation.

Strategies Applied

The country has adopted several practical strategies to address land degradation, improve ecosystem resilience, and promote sustainable natural resource management. These approaches focus on strengthening community participation, enhancing land productivity, and encouraging the adoption of climate-smart practices. Key strategies applied include:

- Promotion of conservation agriculture and rangeland rehabilitation.
- Use of incentives to encourage adoption of sustainable land management practices.
- Engagement of local communities in participatory forest management.

Policy, Legislation, Strategies, and Guidelines

Lesotho's environmental management, forestry development, and climate resilience

efforts are guided by a comprehensive set of policies, legislation, and strategic frameworks that provide direction for sustainable land use and natural resource governance. Key legislative and strategic frameworks include:

- At the international level, Lesotho is a signatory to key global agreements, including the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD), and the United Nations Convention to Combat Desertification (UNCCD). These global frameworks guide the country's actions in climate mitigation and adaptation, biodiversity conservation, sustainable land management, and restoration of degraded landscapes.
- Lesotho aligns its environmental policies with Southern African Development Community (SADC) frameworks that promote climate resilience, transboundary resource management, and harmonized environmental governance. SADC's emphasis on sustainable land management, rangeland conservation, and integrated watershed management reinforces Lesotho's national priorities, especially given its ecological significance as a major water catchment for Southern Africa.
- At national level, Lesotho has developed a strong suite of policies, legislation, and strategic plans to guide sustainable development and natural resource management which include:
 - * National Climate Change Policy (2017) – Provides direction on climate adaptation, mitigation, and resilient development.
 - * Lesotho National Forestry Policy – Guides sustainable forest management, afforestation, and community participation.
 - * Lesotho Environment Act (2008) – Establishes the legal basis for environmental protection, regulation, and compliance.
 - * Lesotho Water and Sanitation Policy – Strengthens governance of water resources and supports integrated watershed management.
 - * Vision 2020 – Sets long-term national development goals, including environmental sustainability.
 - * National Strategic Development Plan (NSDP II) – Integrates climate resilience, sustainable land management, and natural resource conservation into national development priorities.

Opportunities and Challenges to Capacity Building

Opportunities to Capacity Building

Lesotho has several promising opportunities to strengthen capacity in the forestry and climate resilience sectors. With growing regional cooperation, expanding donor engagement, and strong community structures already in place, the country can build on these foundations to enhance technical skills, improve resource management, and support effective implementation of environmental programmes. Key opportunities include:

- Strong regional and international partnerships for training and knowledge sharing.
- Increasing donor support for climate resilience and forestry initiatives.
- Existing community structures that can be leveraged for capacity building.

Challenges

Lesotho continues to face several constraints that limit effective capacity building within the forestry, environmental, and climate resilience sectors. These challenges hinder the development of skilled personnel, weaken institutional performance, and reduce the country's ability to implement adaptation and restoration initiatives at scale. Key challenges include:

- Limited technical expertise in advanced forestry and climate modelling.
- Inadequate financial resources to support training and extension services.
- Shortage of skilled or techno professionals in environmental sciences.
- Non-Compliance to policy and law towards climate change adaptation measures.

Areas of Particular Training Needs

The country has several priority areas where targeted training is essential to strengthen environmental governance, improve climate resilience, and enhance sustainable natural resource management. Building capacity in these areas will enable institutions and communities to respond effectively to climate risks, restore degraded landscapes, and adopt modern conservation practices. Key areas of particular training need include:

- Geographic Information System on Natural conservation
- Advanced climate change modelling and scenario planning.
- Sustainable forest management techniques.
- ^a Soil conservation and rangeland restoration.
- Renewable energy technologies for rural communities.
- Community engagement and participatory resource management approaches.

Additional Information

Lesotho's vulnerability to climate change underscores the urgency of accelerating action in forestry, agriculture, and land management. With targeted investments, policy alignment, and capacity development, the country can significantly improve food security, livelihoods, and ecosystem resilience, while contributing to SADC's regional climate change agenda.

7.7 Promoting Climate Change Resilient Forestry in Sierra Leone

Alex Saffa Vandí

Ministry of the Environment and Climate Change (MoECC)

Introduction

Sierra Leone is located on the west coast of Africa, has a total land area of approximately 72,000 km². The country has a tropical climate characterized by two distinct seasons: a rainy season from May to October and a dry season from November to April. Forest in Sierra Leone include; lowland rainforests, mangroves, montane forests and savanna ecosystems. The major landscapes include coastal plains, interior lowlands, forested hills and the Loma Mountains.

The population is estimated at over 8 million people, with the majority relying on natural resources for subsistence farming, fishing and small-scale mining. Agriculture remains the backbone of the economy, engaging about 60% of the labour force. Rapid population growth and urban expansion have placed significant pressure on land resources, contributing to notable land use changes such as deforestation, wetland conversion, and shifting cultivation.

The main challenges of forestry sector in Sierra Leone include; illegal logging, slash-and-burn agriculture, fuelwood harvesting, and mining. Forests, which once covered 70% of the country, now account for less than 35%, with protected areas being some of the last remaining forest blocks. The woodlands, mangroves and natural forests continue to decline, negatively impacting biodiversity and carbon sequestration. Forestry and agriculture have evolved, with recent efforts focused on sustainable land management and forest rehabilitation. However, land degradation, especially in upland and inland valley swamps, continues to threaten food security and climate resilience.

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

Sierra Leone is undertaking several initiatives to mitigate and adapt to climate change, restore degraded landscapes, and promote sustainable forestry. The programmes are outlined as follows:

Climate Change Mitigation and Adaptation

- National Adaptation Plan (NAP) developed to integrate climate risks into national planning.
- Nationally Determined Contributions (NDCs) under the Paris Agreement, prioritizing energy, forestry, and agriculture.
- Green Climate Fund (GCF) readiness projects focusing on capacity building and ecosystem resilience.
- Promotion of climate-smart agriculture (CSA) and renewable energy in rural areas.
- Ongoing climate change legislation or laws process for enactment.

Landscape Restoration Programmes

- The African Forest Landscape Restoration Initiative (AFR100) – Sierra Leone committed to restoring 2 million hectares by 2030.
- EU-funded Agroforestry and Tree Planting Projects in Northern and Eastern regions.
- Community-based reforestation in degraded areas including Bombali, Bo and Kenema.
- National Tree Planting project funded by the government of Sierra Leone

Forestry Development

- REDD+ Readiness Projects in collaboration with UNDP and FAO.
- Reforestation and Afforestation Campaigns by the Ministry of Environment and Climate Change.
- Pilot initiatives promoting private sector involvement in sustainable timber and non-timber forest products (NTFPs).
- Sustainable Forest Management Project eg the ongoing National Forest Inventory.

Major Achievements, Challenges, and Opportunities

Achievements

The major achievements are:

- Establishment of over 150 community forests and forest edge buffer plantations.
- Formulation of the National Climate Change Policy (2020) and review of the Forestry Act.
- Active participation in international climate platforms (UNFCCC, AFR100, GCF).
- Improved inter-agency collaboration on forest governance.
- National forest inventory ongoing under the sustainable forest management project funded by the EU.
- The national tree planting targeting 5 million trees, founded by the government of Sierra Leone.
- Sierra Leone forest qualifies as a World Heritage site (Gola–Tiwa complex) in 2025.
- Ongoing legal review of the Forestry Act of 1988 and the Wildlife Act of 1972.

Challenges

The challenge experienced include:

- Weak enforcement of forest and land laws.
- Insufficient funding for climate and forestry initiatives.
- Limited access to climate-smart technologies.
- Inadequate community incentives for forest conservation.

- Poor management of plastic waste for example 10,000mt of plastic waste is found in the ocean every year, threatening human health and marine ecosystems Ref. SPACES 30*30 Sierra Leone.

Opportunities

The available opportunities are:

- Expanding carbon financing through REDD+ and voluntary carbon markets.
- Strong traditional knowledge systems on resource management.
- Youth engagement in green jobs and forestry entrepreneurship.
- Partnerships with NGOs, international donors, and private investors.

Adopted Strategies

Outlined are the strategies that can be adopted:

- Participatory forest management and community empowerment.
- Mainstreaming climate change into district development plans.
- Introducing fast-growing, drought-resistant species for reforestation.
- Promoting integrated agroforestry and soil conservation methods.

Policy, Legislation, Strategies and Guidelines

Key policy and legal instruments guiding climate-resilient forestry in Sierra Leone include:

- Forestry Act (1988) and Wildlife Act (1972): Currently under review to integrate emerging climate priorities and strengthen forest governance.
- National Environmental Protection Act (2008): Provides the legal framework for environmental management, regulation, and enforcement.
- National Climate Change Policy (2020): Outlines national strategies for climate adaptation and mitigation across key sectors, including forestry.
- National Biodiversity Strategy and Action Plan (NBSAP): Guides conservation, restoration, and sustainable use of biodiversity resources.
- National REDD+ Strategy: Supports reducing emissions from deforestation and forest degradation while enhancing carbon stocks.
- National Adaptation Plan (NAP) and Nationally Determined Contributions (NDCs): Prioritize climate-resilient landscapes, sustainable land management, and low-carbon development.
- National Land Policy (2015): Promotes sustainable land use, improved tenure security, and community participation in land governance.
- Institutional Framework: Key actors include the Environment Protection Agency (EPA), the Forestry Department, and the Ministry of Environment and Climate Change, which jointly oversee the implementation of climate-resilient forestry initiatives.

Opportunities and Challenges to Capacity Building

Opportunities to Capacity Building

Opportunities for capacity building in Sierra Leone's forestry and climate resilience sector are expanding, driven by increasing national commitment, active community involvement, and strong linkages with regional and international partners. These opportunities create a supportive environment for enhancing technical skills, strengthening institutions, and empowering communities to participate effectively in sustainable forest management. The opportunities to capacity building include:

- Existing networks of community forest management groups and CSOs that facilitate knowledge exchange and grassroots training.
- Regional training partnerships, including those supported by ECOWAS and the African Union, which enhance professional development and cross-country learning.
- Support from international agencies such as FAO, UNDP, GIZ, and the EU, offering technical assistance, funding, and specialized capacity-building programmes.
- Growing youth interest in environmental and climate-related careers, providing a strong foundation for future leadership in the forestry sector.

Challenges

Despite the growing focus on climate-resilient forestry in Sierra Leone, several capacity-related barriers continue to hinder effective implementation and long-term sustainability. These challenges cut across human resources, technical competencies, institutional coordination, and professional development, limiting the sector's ability to respond to emerging climate risks and management needs. The following are the challenges experienced in the country:

- Limited pool of trained forestry and climate professionals, resulting in significant capacity gaps within key institutions.
- Technical skill shortages in critical areas such as GIS, MRV (Monitoring, Reporting and Verification), forest inventory methods, and climate-data analysis.
- Weak knowledge-transfer systems between national, district, and community levels, leading to inconsistent implementation of policies and best practices.
- Inadequate continuous professional development for government staff, hindering their ability to adopt new tools, technologies, and climate-resilient approaches.

Areas of Particular Training Needs

To strengthen climate-resilient forestry and enhance institutional effectiveness in Sierra Leone, several targeted training areas are essential. These focus on improving technical competencies, enhancing community engagement, and equipping practitioners with the skills needed to implement modern and sustainable forest management practices:

- GIS and remote sensing for effective forest monitoring and decision-making.
- Climate-smart agroforestry and sustainable land management practices.

- Forest Landscape Restoration (FLR) planning, implementation, and monitoring.
- Carbon accounting and REDD+ mechanisms, including MRV systems.
- Legal and policy advocacy to strengthen forest governance and community rights.
- Community-based adaptation strategies for climate resilience.
- Financial planning and proposal writing for climate and forestry projects.
- Conflict management and resolution, especially in wildlife–human interactions.
- Agroforestry technologies relevant to both the agriculture and forestry sectors.

Additional Information

Sierra Leone’s government is committed to achieving Land Degradation Neutrality (LDN) by 2030 and increasing forest cover to 40% under its revised Forestry Development Strategy. Recent innovations, such as the use of mobile-based forest monitoring tools, are gaining traction. There is a strong need for regional coordination and funding.

7.8 Promoting Climate Change Resilient Forestry in Somaliland

Abdikani Yusuf Abdi

Somaliland Agriculture Society (SAS)

Introduction

Somaliland's Geographical Boundaries

Somaliland is a self-declared autonomous region in the northwestern part of the Horn of Africa, covering approximately 176,120 km². Although internationally recognised as part of Somalia, it has operated with de facto independence since 1991, governing its own administrative and security structures. Geographically, Somaliland borders Djibouti to the northwest, Ethiopia to the west and southwest, and Puntland to the east, with a long and strategically important coastline along the Gulf of Aden to the north. Its physical landscape ranges from coastal plains to interior plateaus and the elevated Golis Mountains. The region's climate is largely arid to semi-arid, shaped by high temperatures, low and erratic rainfall, and recurrent droughts. Rainfall is concentrated in short seasonal periods (Gu and Deyr rains), and long dry spells are common, influencing both vegetation patterns and livelihood systems.

The population of Somaliland is estimated at 4 to 5 million people, characterized by a combination of pastoral, agro-pastoral, and urban communities. Livestock herding especially camels, goats, and sheep remains the dominant livelihood and the primary contributor to exports. Fishing along the Gulf of Aden, small-scale farming in fertile pockets, petty trade, and remittances from the diaspora also support household economies. Urban centres such as Hargeisa, Berbera, and Burao are expanding rapidly, driven by trade, construction, and increasing private investment. Despite growing urbanization, a large portion of the population remains dependent on natural resources, with mobility and access to grazing land playing central roles in socio-economic stability.

Somaliland is endowed with a range of natural resources, including vast rangelands, dryland forests, coastal fisheries, and mineral deposits such as gypsum, limestone, and potential oil and gas reserves. Biodiversity includes drought-tolerant shrubs, acacia woodlands, and the iconic frankincense-producing *Boswellia* species found in the eastern highlands. The coastline supports rich marine life, offering significant potential for fisheries and blue economy development.

However, the region faces significant environmental challenges that threaten ecosystem stability and long-term development. Recurrent droughts, intensified by climate change, have led to severe water scarcity, livestock losses, and reduced pasture productivity. Land degradation is a major concern, driven by overgrazing, deforestation for charcoal production, erosion, and unregulated settlement expansion. Soil fertility declines and vegetation loss are common across much of the landscape. Coastal ecosystems face threats from overfishing, pollution, and inadequate management. Limited forest cover, combined with high demand for fuelwood and charcoal, continues to pressure remaining dryland forests. Additionally, the arid climate makes the region highly vulnerable to climate variability, with drought cycles becoming more frequent and severe.

In socio-economic terms, Somaliland's heavy reliance on natural resources makes it highly sensitive to environmental change. Weak infrastructure, limited investment in agriculture, and institutional constraints further affect development prospects. Despite these challenges, ongoing efforts in governance, peacebuilding, and resource management provide opportunities to strengthen climate resilience, improve sustainable land-use practices, and support economic diversification.

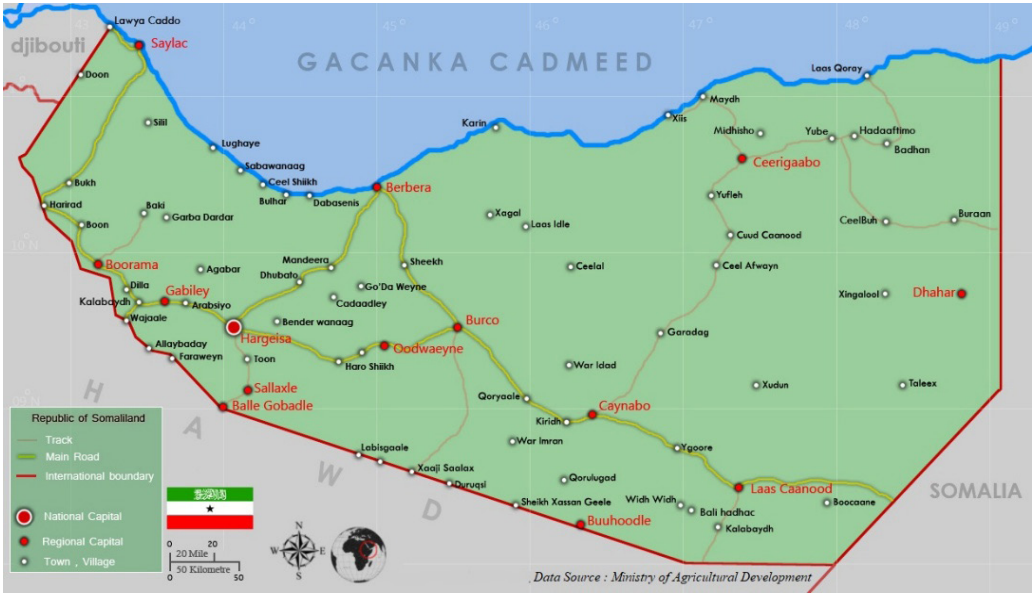


Figure 7.3: Republic of Somaliland

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

Somaliland is implementing a range of climate change adaptation and mitigation projects aimed at strengthening community resilience, restoring degraded landscapes, and promoting sustainable natural resource management. Community-led adaptation initiatives form an important part of these efforts, particularly through the use of fenced enclosures to rehabilitate degraded rangelands and large-scale tree planting campaigns to restore forest cover. These enclosures allow vegetation to regenerate naturally, improving soil stability and providing improved grazing areas over time. Complementing these actions, several forestry development projects are underway to reduce pressure on natural woodlands. These include the promotion of alternative energy sources to curb charcoal production, as well as training programmes that strengthen community-based forest management, enabling local groups to better protect, monitor, and sustainably utilize forest resources.

Under the **National Development Plan III (2023–2027)**, Somaliland has expanded its portfolio of climate resilience projects across various regions. National Climate Change Adaptation Programs focus on improving water security through water harvesting initiatives such as ponds and small reservoirs, while also promoting drought-resistant crops to help households withstand increasing climate variability. Recognizing the vital role of tree planting and ecosystem restoration, the government has significantly

invested in nursery development. Five new nurseries located in Debis, Geed-Deeble, El-Afweyn, Ainaba, and Shurko have been established, while existing nurseries in Borama, Hargeysa, Burco, Arigavo, and Berbera have been rehabilitated to support large-scale afforestation, reforestation, and landscape restoration activities.

Several additional projects have strengthened environmental resilience across Somaliland. Under the **Somaliland Development Fund (SDF) Phase I**, five community tree nurseries were established, contributing to the conservation of four major grazing reserves and supporting community-led reforestation efforts over approximately 1,900 hectares. The country also observes **Somaliland National Tree Day** every year on April 15th a nationwide initiative that, since 2018, has facilitated the distribution of more than three million tree seedlings to enhance environmental awareness, promote afforestation, and engage citizens in restoration activities. Furthermore, support from international partners has played a key role in scaling up land restoration. The **KfW German Sustainable Land Management Programme**, for example, has introduced targeted soil and water conservation interventions in the Bijji catchment, helping to rehabilitate degraded rangelands, strengthen watershed protection, and improve local livelihoods.

Supervision of Burning Charcoal Production from wetlands in Somaliland

Charcoal production activities in Somaliland's wetlands are supervised regularly typically three to four times per year to monitor forest conditions and enhance community awareness on sustainable resource management. During the first inspection, warnings are issued, and local communities, government offices, and community leaders are formally notified to take corrective measures. If the illegal charcoal burning continues, subsequent inspections result in penalties, including monetary fines or short-term imprisonment, as stipulated by local environmental regulations.

Forest Fire Fighting: Massive Wildfire Destroys Forestry Daallo Mountains area at Sanaag Region Somaliland

A massive wildfire recently swept through the Daallo Mountains in the Sanaag region of Somaliland, causing extensive destruction to one of the country's most ecologically valuable forest landscapes. The Daallo Mountain range, known for its rich biodiversity, endemic species, and rare montane forests, has long been recognized as a critical environmental and cultural asset. The wildfire burned rapidly across steep terrain, fuelled by high temperatures, dry winds, and extremely arid conditions that have intensified in recent years due to prolonged droughts and climate variability. As a result, large areas of woodland, shrubs, grasslands, and habitat used by wildlife were severely affected.

The fire's impact extends beyond vegetation loss. It threatens soil stability, water catchments, and grazing lands, which are vital for pastoral communities in Sanaag. The destruction of forest cover in Daallo also undermines local climate resilience, as these highland forests play a key role in regulating microclimates, conserving water sources, and preventing erosion. The incident highlights the growing vulnerability of Somaliland's fragile ecosystems to climate-related hazards and emphasizes the urgent need for improved wildfire management, early warning systems, and community-based forest protection measures.

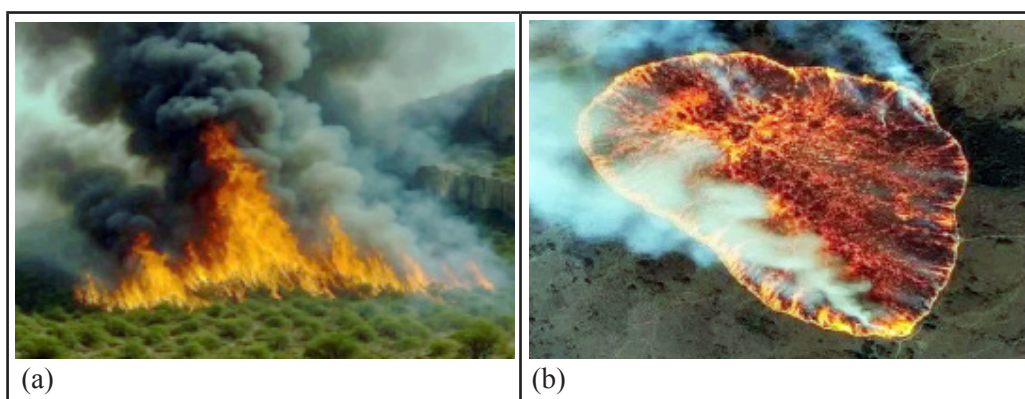


Figure 7.4: Massive forestry wildfire in Daallo Mountains area at Sanaag region - (a) side view, (b) aerial view

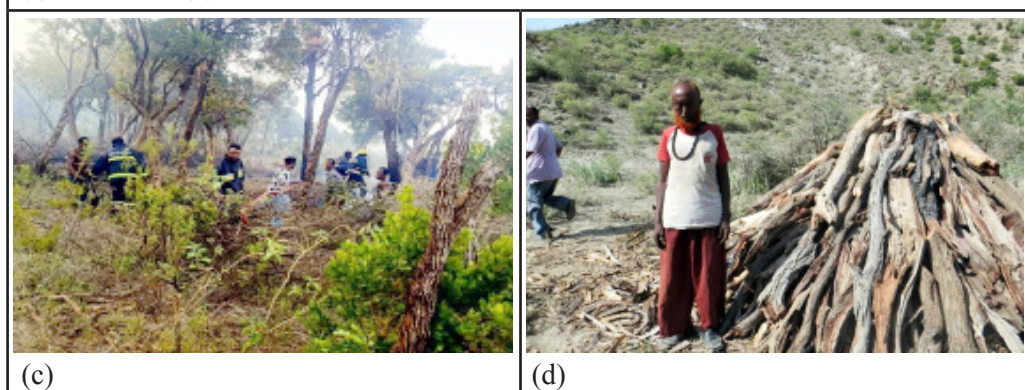


Figure 7.5: Community members engaged in forest fire suppression

Figure 7.6: Fuelwood harvested from the forest

Drivers of Land Degradation in Somaliland

Land degradation is one of the most pressing environmental challenges facing Somaliland, affecting its dryland ecosystems, rangelands, water catchments, and coastal zones. The largely arid and semi-arid climate, combined with recurrent droughts, makes the landscape highly vulnerable to disturbances. Over the past decades, degradation has intensified due to a combination of climatic stress and human pressure, leading to declining land productivity and reduced ecosystem resilience.

A major driver of land degradation in Somaliland is overgrazing, stemming from expanding livestock populations and reduced mobility of pastoral systems. Continuous grazing pressure especially around settlements, water points, and trade routes has led to loss of vegetation cover, soil compaction, and reduced regenerative capacity of rangelands.

Deforestation for charcoal production is another major contributor, particularly in eastern and central regions, where valuable tree species such as *Acacia* and *Boswellia* are increasingly depleted. This not only accelerates land degradation but also threatens the livelihoods of those dependent on forest resources.

Climate change exacerbates degradation, with prolonged droughts, erratic rainfall, and higher temperatures reducing vegetation recovery and soil moisture. Severe drought cycles occurring every two to three years have weakened ecological stability and made landscapes more prone to erosion and desertification. In several areas, soil erosion, both wind and water driven, removes fertile topsoil and leaves behind bare, unproductive land. In upland regions such as Sanaag and Togdheer, steep slopes combined with vegetation loss have worsened runoff and gully formation.

Human activities further aggravate the situation. Unplanned settlements, expansion of dryland farming, and weak land-use regulation have increased pressure on fragile ecosystems. Over-extraction of firewood, unsustainable farming on marginal land, and poor rangeland governance all contribute to declining land health. In riverine pockets and wadis, sedimentation and altered hydrology reduce water availability and affect downstream ecosystems.

The impacts of land degradation are far-reaching. They include loss of grazing capacity, reduced biodiversity, declining forest cover, diminished soil fertility, and increased vulnerability of pastoral and agro-pastoral communities. As land becomes less productive, households face heightened food insecurity, competition over resources, and pressure to migrate. Critical habitats such as the Daallo forests and eastern mountain zones are under increasing threat, reducing their ability to provide ecosystem services such as water regulation, carbon storage, and biodiversity conservation.

Despite these challenges, Somaliland has opportunities for restoration through sustainable rangeland management, community-led rehabilitation, water harvesting, tree planting, and ecosystem protection. Strengthening land governance and integrating indigenous knowledge with modern conservation approaches will also be essential in reversing degradation and safeguarding the region's natural resource base.

Figure 7.7 illustrates the categories of land degradation in Somaliland, represented by different colours: Strong Degradation-Red; Moderate Degradation-Green; Slight Degradation - Light Green and Non-Degradation -No colour

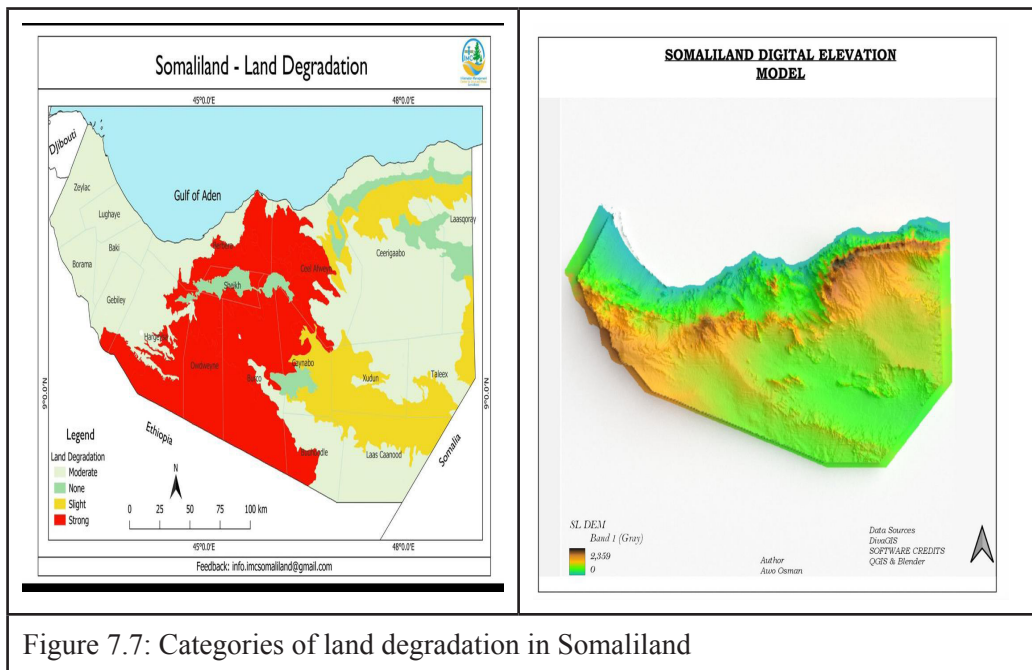


Figure 7.7: Categories of land degradation in Somaliland

Somaliland’s efforts to address environmental degradation and climate change have resulted in notable progress, yet the sector continues to face persistent constraints that limit long-term sustainability. At the same time, new opportunities are emerging driven by growing community engagement, policy development, and international support that can help strengthen environmental governance and resilience. The key achievements, challenges, and opportunities include:

Achievements

- Increased public awareness of environmental and climate issues.
- Successful establishment and operation of community-run tree nurseries.
- Development of key policy instruments, including the National Forestry Policy.

Challenges

- Limited funding and ongoing reliance on external donor support.
- Weak enforcement of environmental regulations and policies.
- Economic pressures that sustain the charcoal trade and accelerate deforestation.

Opportunities

- Strong international support for climate resilience and environmental initiatives.
- High potential for deeper community engagement in restoration and conservation.
- Investment opportunities in renewable energy particularly solar as an alternative to charcoal.

Policy and Legislation

Somaliland has developed a growing body of policies and legal frameworks aimed at strengthening environmental governance, promoting sustainable land use, and guiding national responses to climate change. These frameworks provide the foundation for coordinated action across sectors such as forestry, agriculture, water management, and climate resilience.

- **Environmental Management Law** – This law provides the overarching legal framework for the protection, conservation, and sustainable use of Somaliland’s natural resources. It outlines regulatory mechanisms for environmental impact assessments, biodiversity conservation, pollution control, and sustainable land management. The law plays a central role in safeguarding ecosystems under increasing pressure from deforestation, overgrazing, and climate-related stresses.
- **National Agriculture Policy** – The policy aims to improve agricultural productivity while promoting sustainable and climate-smart farming practices. It emphasizes efficient water use, drought-resilient crops, soil conservation, and the integration of modern agricultural technologies. By strengthening food security and supporting rural livelihoods, the policy directly contributes to climate adaptation efforts in both farming and agro-pastoral communities.
- **National Climate Change Strategy (Under Development)** – Somaliland is in the process of formulating a comprehensive national strategy to guide climate mitigation and adaptation measures. This strategy will outline priority actions for reducing climate risks, strengthening institutional capacity, enhancing early warning systems, and building community resilience. Once completed, it is expected to align climate action with national development goals and international commitments such as the UNFCCC.

Opportunities and Challenges to Capacity Building

Somaliland has considerable potential to strengthen capacity in environmental management, climate resilience, and sustainable development. However, despite promising opportunities, several challenges continue to limit the effectiveness and sustainability of capacity-building initiatives. A balanced understanding of both dimensions is essential for designing impactful training programmes and long-term institutional strengthening.

Opportunities to Capacity Building

- Highly motivated government staff and active NGOs create a strong foundation for expanding training and professional development initiatives.
- Growing access to online learning platforms combined with a tech-savvy youth population provides a powerful opportunity to scale up digital training, remote certification, and knowledge exchange.
- Potential for partnerships with international institutions, universities, and development agencies offers avenues for technical support, mentorship, research collaboration, and exposure to global best practices.

Challenges to Capacity Building

- Limited availability of specialized training in areas such as climate modelling, advanced forestry management, GIS, and long-term ecosystem monitoring.
- Inadequate resources for hands-on fieldwork, which restricts practical learning and applied research critical components of environmental training.
- High staff turnover within institutions, leading to loss of institutional memory and the need for repetitive training investments.

Training Needs

To address these gaps and strengthen institutional performance, Somaliland requires targeted training in several priority areas. These include:

- Sustainable land management and agroforestry, focusing on rangeland rehabilitation, soil conservation, and dryland restoration techniques.
- Climate modelling and data analysis, including the use of GIS, remote sensing, and climate information systems.
- Policy development and advocacy, enabling staff to design, review, and implement evidence-based environmental and climate policies.
- Project management and proposal writing, particularly for climate finance, donor engagement, and results-based project delivery.
- Renewable energy technologies, with emphasis on solar solutions as alternatives to charcoal and biomass energy.

Additional Information

Promoting climate-resilient forestry in Somaliland is crucial for addressing environmental degradation and improving the livelihoods of local communities. Despite persistent challenges such as deforestation and heavy reliance on charcoal for energy, significant opportunities exist to foster sustainable growth through community participation, innovative policy frameworks and international partnerships.

By prioritizing capacity building, adopting sustainable land management practices, and strengthening institutional support, Somaliland can safeguard its forest resources while enhancing economic resilience. Collaborative efforts among the government, non-governmental organizations, and local communities will remain essential to achieving long-term environmental sustainability and climate resilience.

7.9 Promoting Climate Change Resilient Forestry in Zambia

Hachilensa Ngoza Jones

Forestry Department – Ministry of Green Economy and Environment

Introduction

Land area, Climatic and Ecological Conditions

Zambia is a landlocked country in Southern Africa, covering a total land area of 752,614 km². The country is surrounded by eight countries: the Democratic Republic of Congo to the north, Tanzania to the north-east, Malawi to the east, Mozambique, Zimbabwe, Botswana and Namibia to the South, and Angola to the west. The country is situated on the plateau of Central Africa, between 1000–1,600 m above mean sea level, with an average altitude of 1,200m. Zambia is administratively divided into ten provinces, namely: Central, Copperbelt, Eastern, Luapula, Lusaka, Muchinga, Northern, North-Western, Southern and Western provinces (Ministry of Lands, Natural Resources and Environmental Protection, 2015).

Zambia's climate is not typically described as “moderate” in the classical sense, as it has distinct wet and dry seasons. However, the country's climate can be considered relatively mild compared to other parts of Africa, with temperatures rarely reaching extreme highs or lows. There are three seasons: rainfall occurs mainly between November and April, which is also the main farming season; the period from May to August tends to be cool and dry; and September and October are typically hot and dry.

The country receives moderate rainfall, ranging from an annual average of approximately 600mm in the south of the country to 1335.9mm per year in the north (Zambia National Water Policy, 2011). The rainfall data available for the country show a progressive reduction in annual cumulative rainfall amounts between 1950 and 2005 (ZEMA, 2008 cited by Campbell, D *et al* 2010), though further analysis has shown that this data is not statistically significant (New *et al.* 2006).

Zambia is divided into three main agro-ecological zones/regions based on annual rainfall, whose characteristics have a bearing on agriculture activity. An estimated nine million hectares of land (12%) are suitable for cultivation and 16 million hectares (21%) are suitable for rangeland grazing (Jain, 2007; World Bank, 2012). The first agro-ecological zone covers the plateau sub-region in southwest Zambia and the valley region in South Luangwa and Zambezi valleys. The region receives less than 800 mm of average annual rainfall and covers approximately 15 million hectares, equivalent to 20% of the country. The second agro-ecological zone consists of the sandveld plateau of Central, Eastern and Southern provinces and the Kalahari Sand plateau of Western Province. The region receives 800-1000 mm of average annual rainfall and covers approximately 27 million hectares, which is equivalent to 36% of the country. In addition, the third zone receives over 1000 mm of average annual rainfall and covers approximately 33 million hectares, equivalent to 44 % of the country. This region mostly covers the Copperbelt, Luapula, Northern and North-Western Provinces.

The predominant vegetation type is Miombo woodland. The intensity of natural vegetation cover diminishes from the high rainfall zone (northern part of the country) to the low rainfall zone (southern part of the country).

Major Landscapes

Zambia's natural environment is characterized by a diverse range of major landscapes that shape the country's ecological systems and land-use patterns. The landscapes include:

- Zambia's landscape is dominated by expansive plateaus ranging from 900 to 1,500 meters above sea level. These elevated areas support extensive miombo woodlands and are central to agriculture, settlement, and transportation. Their moderate climate and fertile soils make them the most productive and densely populated parts of the country.
- Major rivers such as the Zambezi and Kafue form vital lifelines for the country. They provide water for hydropower generation, irrigation, fisheries, and domestic use. These rivers also create important ecological corridors that support diverse aquatic and terrestrial wildlife.
- Zambia's major valleys, including the Luangwa and Zambezi valleys, are characterized by high temperatures, low rainfall, and poor soils. These climatic and edaphic conditions make them less suitable for conventional agriculture but highly significant for wildlife habitats and biodiversity conservation.
- The country hosts globally renowned protected areas such as South Luangwa, Lower Zambezi, and Kafue National Parks. These landscapes support rich wildlife populations, attract tourism and play a crucial role in conservation and ecosystem protection.
- Zambia's forest reserves and plantations supply timber, fuelwood, and non-timber forest products. Communal forests are an important resource for rural livelihoods, supporting charcoal production, medicinal plants, and household energy needs while contributing to biodiversity conservation.
- Rangelands cover large portions of Zambia and support livestock production, particularly in rural areas. These landscapes include grasslands and savannahs that provide grazing resources but are vulnerable to overgrazing and land degradation.
- Urban forests, found in cities such as Lusaka and Ndola, provide green spaces, improve air quality, and help regulate urban temperatures. These areas support urban biodiversity and enhance the quality of life for city residents.

Population Status

According to the Zambia Statistical Agency (ZamStats), 2022 Census report, Zambia conducted its first electronic census in 2022. This was the sixth National Census of Population and Housing conducted in the country since independence in 1964. So far, the country has conducted censuses in 1969, 1980, 1990, 2000 and 2010. The 2022 Census of Population and Housing was carried out from 18th August to 21st September, 2022. The total population as at 18th September, 2022 was 19,693,423. There were

more females (10,036,163) than males (9,657,260). The rural areas had more people at 10,900,054 compared with the urban areas at 8,793,369. According to ZamStats, 2022, the female population size by sex and rural/urban was more than the male population in both rural and urban areas. The growth rate is estimated to be about 2.8% annually (ZamStats, 2022).

The population of Zambia has been increasing over the years, as shown in Figure 7.6. The Zambia’s population has more than quadrupled from 4,056,955 in 1969 to 19,693,423 in 2022 (ZamStats, 2022).

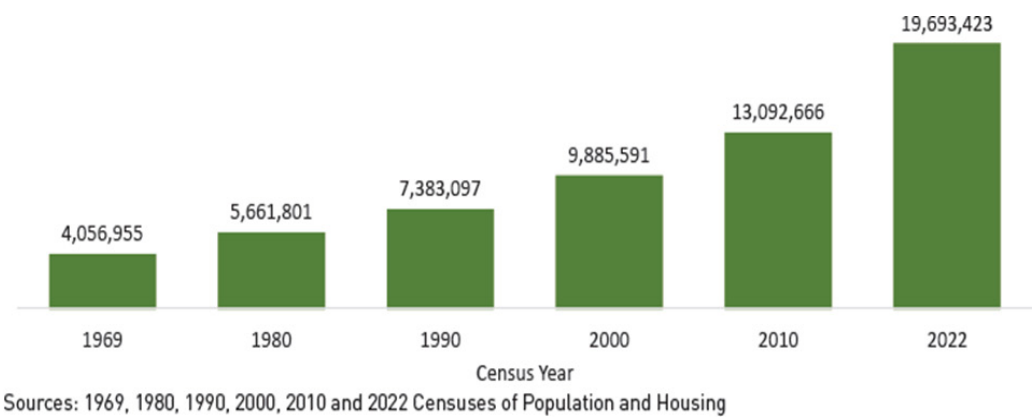


Figure 7.8: Trends in Population Size, Zambia 1969-2022

According to ZamStats, 2022 Census report population of Zambia, it can be deduced from the demographic data that Zambia’s population is predominantly young and experiencing a large demographic shift. There are numerous implications for this, but the most crucial one is increased pressure on job creation interventions that target at absorbing the youth into gainful employment. If the number of young people seeking employment exceeds the available jobs, as the current case in Zambia, the youth seek survival through various income generation ventures including those that contribute to deforestation and environmental degradation such as Charcoal burning.

Zambia’s Major Economic Activities

Major economic activities in Zambia include:

Mining, Zambia is rich in mineral resources, particularly copper and cobalt, making mining a key driver of the Zambian economy for many years. The Government, however, has continued to diversify the economy to emphasize on other key economic sectors such as agriculture, energy, transport, construction, manufacturing, and tourism (GRZ, 2020). Employment in the services sector increased from 26.9% in 2010 to 40.7% in 2021 (United Nations, 2021). Zambia’s agricultural sector is the socio-economic backbone of the rural population, with 60% relying on the sector as the main source of income and livelihood (GRZ, 2020). Key crops include maize, soybeans, and cotton. In 2021, agriculture contributed approximately 3.4% of GDP, while employing 48.5% of the total labour force (United Nations, 2021).

The forestry sector contributes around 5.2 percent to the national GDP and is estimated to employ about 1.1 million people, encompassing both formal and informal employment, particularly in rural areas with scarce job opportunities. Timber exports generate revenue and job opportunities, benefiting many local communities. Additionally, forests fulfill 70 percent of the country's energy requirements, primarily through the provision of firewood and charcoal (Zambia's Forest Reference Emissions Level (FREL), 2021). For rural communities, forests are vital for sustenance as they provide energy in the form of charcoal and firewood. In addition, forests are a source of timber. Construction poles and non-timber forest products (NTFPs), such as wild fruits, mushrooms, leafy vegetables, and edible caterpillars. Further, forests are not just a source of income but also a lifeline that sustains rural livelihoods and enhances socioeconomic wellbeing. The dependence on natural resources underscores the importance of sustainable management practices to ensure that both agriculture and forestry can thrive while supporting local communities and the national economy. Zambia's economy is supported by a range of dynamic and emerging sectors that contribute to national development and regional integration.

- Zambia's energy sector is dominated by hydroelectric power, with major dams on the Zambezi River such as the Kariba Dam providing a significant share of the country's electricity. However, frequent droughts have exposed the vulnerabilities of hydropower, prompting the government to invest in solar and wind energy to diversify the energy mix. Large-scale solar projects and off-grid solar solutions are expanding, improving rural electrification and strengthening energy security.
- Tourism is a key pillar of Zambia's economy, anchored by world-renowned attractions such as Victoria Falls, one of the Seven Natural Wonders of the World, as well as rich wildlife found in national parks like South Luangwa and Kafue. The sector supports thousands of jobs and contributes significantly to foreign exchange earnings. Investments in eco-tourism, conservation areas, and improved infrastructure continue to boost tourism growth.
- Zambia's manufacturing sector is steadily expanding as the country aims to increase value addition and reduce reliance on imported goods. Major activities include food and beverage processing, textiles, leather, fertilizers, and consumer goods production. Growth in agriculture and mining has created opportunities for agro-processing and mineral-based industries, contributing to job creation and industrial development.
- The financial sector in Zambia has grown considerably, with the establishment of numerous commercial banks, microfinance institutions, insurance firms, and mobile money operators. These services have expanded financial inclusion by improving access to loans, savings, and digital payment systems. The rise of mobile banking has particularly enhanced access in rural and underserved areas.
- Zambia's ICT sector is evolving rapidly, driven by increasing internet penetration, affordable mobile phones, and digital innovation. Growth in this sector has improved access to information, e-services, online education, and digital financial tools. The government and private sector continue to invest in broadband infrastructure, strengthening Zambia's digital economy.
- Zambia's central location makes it a critical transport and logistics hub for Southern Africa. The country provides transit routes for goods moving to and from neighbouring

land-linked countries through road, rail, and air networks. Improvements in transport corridors, including the TAZARA railway and major highways, have boosted regional trade and economic integration.

- The construction sector is experiencing rapid expansion, driven by investment in infrastructure development such as roads, bridges, housing, and commercial buildings. Urbanization has also spurred demand for residential and commercial real estate. This sector contributes significantly to employment and supports the growth of complementary industries such as cement, steel, and construction materials.

Land Use and Land Use Change

Land Use

In Zambia, all land is legally vested in the President, who holds it perpetually on behalf of the people of Zambia, Zambian land is divided into two main categories: state land and customary land. The major land uses are Agriculture, Wildlife, Rangelands and Forestry. A significant amount of land use is in the form of protected areas in form of forest reserves, Game Management Areas and National Parks. Agricultural expansion, illegal logging, charcoal production, human settlement and climate are the primary causes of deforestation in Zambia. Agricultural activities form the major component of land use in rural Zambia as well as in the designated areas for agricultural development (ECZ, 2001).

Drives of Land Use Change

Population Growth

Zambia's population was approximately 7.4million in 1990, then rose to 9.9 million in 2000 and 13.1million in 2010 (Tiamgne *et al.*, 2021) In the year 2022 the population had increased to 19.6+ million people and the growth rate is estimated to be about 2.8% annually (ZamStats, 2022). Population increase in any given area is accompanied by pressure on natural ecosystems and resources, accompanied by land use changes to accommodate the increasing demand for food, goods and services. This also applies to Zambia, as shown by various research and data from land cover maps for the past years, human activities have resulted in land use changes. The country has witnessed land use changes to accommodate agricultural expansion, increasing settlements, and mining activities, urban growth and infrastructure development to meet the demands of an increasing population.

Agricultural / Cropland Expansion

The largest driver of deforestation in the country is agricultural expansion, which increased by 0.95% from 2000-2014 and accounts for approximately 60% of the total forest cover loss (ILUA, 2016). Lusaka Province has the highest forest cover loss due to agricultural expansion (ILUA, 2016). A remarkable forest cover loss due to land use changes is also exhibited in localized areas like the Solwezi Copper Mining District. In 1995 research showed that the forest area in this region covered about 82% of the total area but this declined to a staggering 54% by the year 2019 (Tiamgne *et al.*, 2021). Whilst the forest area shrunk, land converted to agriculture increased by 255% from 1995 –

2015 (Tiamgne *et al.*, 2021). Migration is also linked to agriculture, as depicted by the movement of commercial farmers from Zimbabwe to Zambia as a result of political and economic instability (Day *et al.*, 2014).

Urban Growth and Settlement Expansion

The Integrated Land Use Assessment Phase II: Final Report (2016) mentions that nationally, settlements have expanded by 0.48% from 2000 to 2014. Additionally, residential expansion accounts for approximately 36% of forest reduction. In Lusaka province, forest areas have been converted into other land uses in the outskirts, such as urban land use. In Solwezi, the built-up area and settlements increased from approximately 7000 ha to about 16400 ha in that era as the barren land (Tiamgne *et al.*, 2021).

Infrastructure Development

The population growth in Zambia leads to urban and settlement expansion and the growth of infrastructure to support built-up areas, whilst the resultant vegetation clearing when the development is happening on woodland or forest exacerbates deforestation (Day *et al.*, 2014). Infrastructure development still has to increase as Zambia is still a developing country and as economic growth increases so will the need to develop structures to support different areas of growth.

Mining Activities

Mining activities across the country convert large areas into barren lands and at the start it requires the clearance of vegetation and there is a need for large quantities of wood for tunnel supports (Day *et al.*, 2014). Charcoal and fuelwood are also used by miners as sources of energy and income for surrounding communities. In Kalumbila mine, the development of infrastructure resulted in the loss of approximately 7000 ha of forest cover (Day *et al.*, 2014). In North-Western Province, approximately 350,000 ha of natural forest is under conversion driven by mining (MLNREP, 2015).

Wood Extraction

In Sub-Saharan Africa, high levels of poverty have led to the dependence of fuelwood and charcoal as the sole energy source and the shift to more sustainable energy sources is far-fetched because they are inaccessible or expensive (Chidumayo, 2013). In Zambia, charcoal production use about 6 million tonnes of wood biomass, with approximately 73% of household produce charcoal from natural forests and less from forest plantations (Day *et al.*, 2014). Fuel wood and charcoal are major energy resources covering approximately 75% of Zambia's demand for energy (Dietz *et al.*, 2023).

Wild Fires

Severe uncontrolled fire incidents that are spread throughout the country in late dry seasons are damaging and destructive to forests. The highest anthropogenic fires in the nation are found in the Northern parts of the country (MLNREP, 2015). These fires escape through human activities such as controlling vegetation, clearing land for agriculture, creating potash for chitemene practices, and facilitating hunting. In other cases, fires escape spreading to other areas during charcoal production, in sugar plantation burning, as well as the creation of fire breaks (Day *et al.*, 2014).

Status of Forestry and forest resources, woodlands, and allied natural resources in Zambia

Forestry and Forestry Resources

Zambia boasts an extensive array of forest resources, covering approximately 45.94 million hectares (ha) (Table 7.8-forest Area by Province), representing approximately 60.3% of the country’s total land area (ZNFP, 2024), and is one of the most forested countries in Southern Africa. The forest area comprises Forest Reserves, Game Management Areas, National Parks and Customary Land. Forest Reserves are designated forest areas directly under the control of the government through the Forestry Department. Gazetted forests cover 9% while 8% is under National Parks and Game Management Areas. Zambia has a total of 481 Protected Forest Areas. 181 are National Forests while 300 are Local Forests (Jachmann, 2000). In National Forests, logging and the collection of forest produce are regulated by the Forestry Department whereas Local Forest Reserves are meant to serve the needs of the local people in the surrounding area. The government, through the Forestry Department equally regulates the local forests. Forests also occur in Game Management Areas, National Parks and Customary Land (ECZ, 2001).

The Forest Reserves are further categorized as production forests and protection forests. Production forests are managed for present and future production of forest requirements. Protection forests are managed and maintained as conservation areas for environmental stability.

Table 7.8: Forest Area by Province

N/S	Name of Province	Total land area (ha)	Forest cover (ha)	% Proportion of forest cover	
				of country forest cover	of provincial area
1.	Central	11, 002, 944	5, 701, 471	12.41	51.81
2.	Copperbelt	3, 132, 839	1, 896, 348	4.13	60.53
3.	Eastern	5, 097, 587	3, 599, 412	7.83	70.61
4.	Luapula	5, 056, 908	3, 269, 517	7.12	64.65
5.	Lusaka	2, 550, 745	1, 409, 189	3.07	55.25
6.	Muchinga	8, 680, 596	6, 359, 200	13.84	73.26
7.	Northern	7, 682, 748	4, 277, 891	9.31	55.68
8.	Northwestern	12, 582, 816	8,833, 712	19.23	70.21
9.	Southern	6, 835, 816	3, 756 345	8.18	54.95
10	Western	12, 638, 580	6,840, 231	14.89	54.12
TOTAL		75, 261, 400	45, 943, 316	100.00	-

Source: Forestry Department, 2016

Woodlands and Allied Natural Resources

The country's vegetation is classified into four major categories. These are Closed Forests, Open Forests, Termitaria and Grasslands (Storrs, 1995). The Closed Forests are limited in extent covering only about 3.5% of the country's land area. The Open Forest or Savannah Woodlands, which are the dominant vegetation type, occur in four types. These are Miombo, Kalahari, Mopane, and Munga woodlands. The most extensive is the Miombo Woodland, covering over 42% of the total land area (ECZ, 2001). Kalahari Woodlands: Covering around 11.36% of the wooded forest area. Mopane Woodlands: Covering about 5.15% of the wooded forest area.

The Miombo woodland is two-storeyed woodland with an open or lightly closed canopy of semi-evergreen trees 15-21 m high characterized by species of *Brachystegia*, *Isorbelinia*, *Julbernardia*, and *Marquesia macroura*. There may or may not be a vaguely defined lower storey characterized by species such as *Albizia antunesiana*, *Anisophyllea boehmii*, *Brachystegia stipulata*, *Dalbergia nitidula*, and a few others. The undergrowth consists of either a dense grass/suffrutex layer 0.6 m - 1.3 m high or a dense evergreen thicket 1.3m-3.6m high. Suffrutices are a very marked feature of Miombo woodland. Over time, numerous fires have modified the vegetation, from inaccessible thick primary forest to produce the current woodlands (Fanshawe, 1971).

The Kalahari Woodland embraces all woodlands on Kalahari Sands. The vegetation is derived from the partial destruction of the dry deciduous *Baikiaea* forest. It represents a catenary regression from *Baikiaea* forest to suffrutex savanna to grassland on Kalahari Sands. Five stages are distinct in composition namely Guibourtia woodland, *Burkea-Erythrophleum* woodland, *Burkea-Diplorhynchus* scrub, *Diplorhynchus* scrub and *Parinari* suffrutex savanna. The Kalahari woodland is wide spread in the Western Province and the western half of the North-western Province (Fanshawe, 1971).

The Mopane woodland is one storeyed woodland with an open deciduous canopy 6 - 18m high. The dominant *Colophospermum mopane* is pure or almost pure. Scattered elements of the Munga woodland occur in places represented chiefly by *Acacia nigrescens*, *Adansonia digitata*, *Combretum imberbe*, *Kirkia accuminata* and *Lannea stuhlmannii*. Mopane woodland is found in the valleys (Fanshawe, 1971).

The Munga woodland, usually called savanna woodland, is a park-like, 1-2 storeyed deciduous woodland with scattered or grouped emergents to 18 m high, characterized by *Acacia*, *Combretum* and *Terminalia* species. The undergrowth is absent, patchy or very dense and thicket-like, 1.3 - 4.5 m high, semi deciduous or deciduous (Fanshawe, 1971).

Termitaria woodland is found scattered throughout Zambia wherever soil is not pure sand. All the basic physiognomic vegetation types - forest, woodland, thicket, scrub and grassland - can be found on termitaria woodland. Termitaria occur all over the country except on the Kalahari sands proper, some very sandy plateau soils, montane and swamp forests and flood plain grassland (Fanshawe, 1971).

Zambia's allied natural resources are abundant and diverse, playing a crucial role in the country's economy and livelihoods.

- **Biodiversity:** Zambia is home to a diverse range of flora and fauna, with many species found in its forests and woodlands.
- **Water Resources:** The country has significant water resources, including rivers and wetlands, which support agriculture, industry, and domestic use.
- **Wildlife:** Zambia's wildlife is an important natural resource, supporting tourism and contributing to the country's economy.

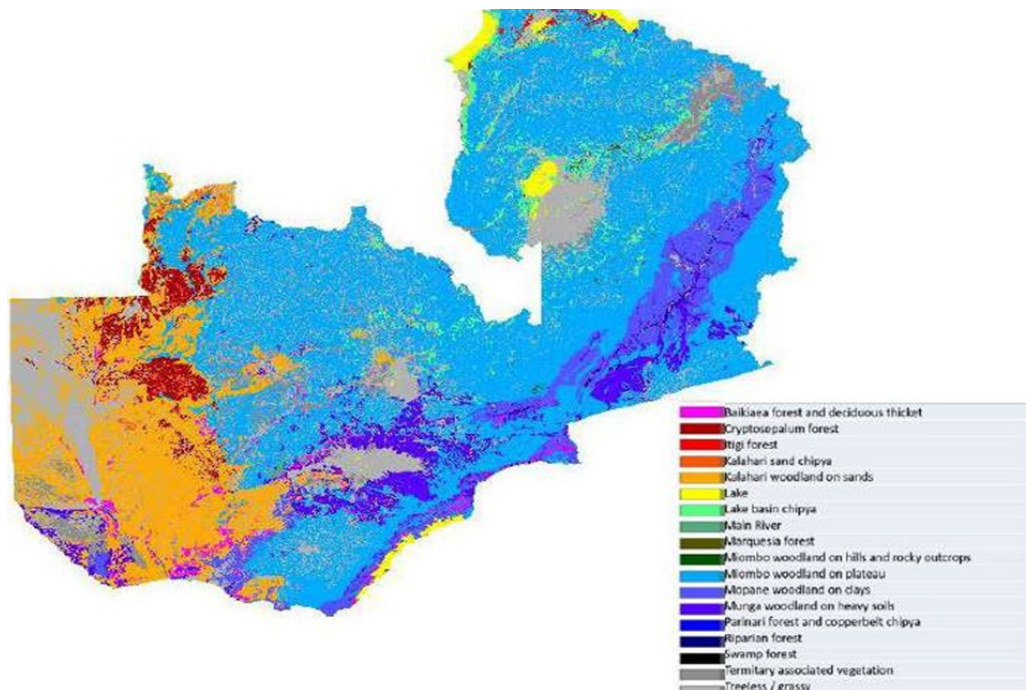


Figure 7.9: Vegetation type (source: Fanshawe, D. B., (1971).

Trends of Forestry/Agricultural Development in Zambia

The forestry and agricultural development trends reveal a concerning decline in forest cover due to agricultural expansion, especially in small-scale farming and fuelwood consumption.

Forestry Trends

The key drivers of deforestation and forest degradation in Zambia are agricultural expansion (commercial and subsistence), heavy reliance on wood fuel for energy (charcoal and firewood), unsustainable timber extraction (both legal and illegal), forest fires, and infrastructure development (e.g., mining and other large infrastructural developments) (Ministry of Lands and Natural Resources, 2017).

At the global level, Zambia has been identified as one of the top 10 greenhouse gas (GHG) emitting countries for deforestation and forest degradation (Ministry of Lands and Natural Resources, 2017).

Based on a land cover change analysis between 2000 and 2014, the official annual deforestation rate was estimated to be 0.6%, a loss of approximately 276,021 ha per annum for the period 2000 to 2014. This rate is presented and endorsed as the official deforestation rate for Zambia. The national average of forest area cleared per household was estimated at 0.73 ha in 2015. Forest clearing for agriculture was highest in Lusaka Province and lowest in Luapula Province, suggesting that provinces with a high income cleared more forest area than provinces with a low income (Clearing House Mechanism, 2018).

Agricultural Trends

The agriculture sector known to be a crucial sector for food security is marked by a contrast between commercial and subsistence farming, contributing significantly to deforestation. Agriculture in Zambia is characterized by a mix of commercial and subsistence farming, with the latter being widespread and a significant driver of deforestation.

The land use change exhibits a decline in forest area and an increase in cropland, highlighting the impact of agricultural expansion. Increasing population growth and food security have put pressure on land resources, further driving agricultural expansion. In Zambia, rain-fed agriculture dominates, with limited irrigation development, making the sector vulnerable to rainfall patterns. There is a need to promote sustainable agricultural practices to enhance productivity and minimize environmental impact, such as Climate Smart Agriculture. Commercial farms are concentrated along the railway line, with a higher level of mechanization.

Current Situation on Land Degradation

Zambia is vulnerable to climate change, which largely contributes to land degradation. Degraded land often has significant impacts on the lives and livelihoods of many people, especially those communities that depend on natural resources. The low productivity of land caused by land degradation results in low crop yields, poor animal productivity and animal diseases. As Zambia's population, especially the rural population, is dependent on agriculture, these factors undermine social economic and environmental development and continue to deepen the poverty crisis (Ministry of Water Development, Sanitation and Environmental Protection, 2019).

Rapid population growth comes with demands for more land for settlement, agricultural and infrastructural development, among others, which eventually contributes to land degradation.

Deforestation caused by agriculture, infrastructure development, and charcoal production has contributed to land degradation and loss of soil fertility in Zambia (ibid). Forests are also threatened by prolonged droughts, which can result in land degradation, soil fertility loss, and forest fires (GRZ, 2020). Both small scale farmers who shift from land to land in search of fertile land, and commercial farmers who expand vast areas of land and extensively use inorganic fertilizers contribute greatly to land degradation (Ministry of Water Development, Sanitation and Environmental Protection, 2019).

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

Over the years, Zambia has been receiving funding from bilateral and multilateral partners to implement various projects related to climate adaptation actions. Some of the implemented projects include:

Climate Change Mitigation and Adaptation

- a) Accelerate Water and Agricultural Resources Efficiency in Zambia (AWARE): aims to enhance climate-smart water resource management and efficient agricultural water use for smallholder farmers
- b) Pilot Programme for Climate Resilience (PPCR) Phase II: Support countries in integrating climate resilience into their national development planning and budgeting processes.
- c) Strengthening Climate Resilience in the Kafue Sub-Basin (SCRICA) Project: flagship initiative under PPCR. To strengthen the adaptive capacity of rural communities to better respond to current climate variability and long-term consequences of climate change in the Kafue sub-basin.
- d) Transforming Landscapes for Resilience and Development (TRALARD) project: development initiative aimed at improving natural resource and promoting sustainable livelihoods in Zambia
- e) Ecosystems-based Adaptation (EbA) project: approach to climate change adaptation that involves harnessing the benefits of nature to help communities and ecosystems adapt to the impacts of climate change.
- f) Civil Society Organisations are also implementing adaptation projects, such as the *Voices for Climate Action (VCA) project* implemented by a consortium of Civil Society Organisations, which include the Wild Wide Fund (WWF), Zambia Climate Change Network (ZCCN), Action Aid Zambia, Civil Society for Poverty Reduction (CSPR) and many others.

Landscape Restoration Programmes for Forest and/or Agricultural Landscapes Rehabilitation

- In addressing the issues of landscapes restoration for forest and agriculture, in 2018, the Government of Zambia, with support from the World Bank and Bio-Carbon Fund Initiative for Sustainable Forest Landscapes, launched a \$33 million project ***Zambia Integrated Forest Landscape Program (ZIFLP)*** to improve sustainable land management, diversify livelihoods options available to rural communities, including climate-smart agriculture and forest-based livelihoods, and reduce deforestation in the country's Eastern Province. The program promotes climate-smart agriculture, agroforestry, and community forestry management, benefiting rural communities. An estimated 215,000 people benefited directly from this program, of which at least 30% are women, while the other percentage consisted of youths and men. Key beneficiaries are rural communities in the Eastern Province's nine districts, namely Chadiza, Chipata, Katete, Lundazi, Mambwe, Nyimba, Petauke, Sinda, and Vubwi (The World Bank, 2018).

- **Strengthening Climate Resilience of Agricultural Livelihoods in Agro-ecological Regions I and II (SCRALA):** Financed by the Green Climate Fund (GCF) and implemented by the United Nations Development Programme (UNDP). It supports the Government of Zambia in building climate- resilient food security and poverty reduction measures for approximately 940,000 people. It focuses on promoting climate-resilient agricultural practices, improving access to climate information, and enhancing market access for smallholder farmers.
- **Sustainable Land Restoration Project:** World Vision Zambia and Copperbelt University are partnering to restore 150,000 hectares of degraded land through the Farmer Managed Natural Regeneration (FMNR) model.
- **Africa Forest Landscape Restoration Initiative (AFR100):** Aims to restore 100 million hectares of degraded land across Africa by 2030. AFR100 responds to the African Union’s mandate to combat desertification, promote sustainable land management, and enhance climate resilience.
 - * 17 countries have committed, including Zambia, which has pledged to restore a minimum of 2 million hectares of forests by 2030.
 - * 13.5 million hectares are targeted: The Forest Landscape Restoration in Africa Programme, supported by WWF and other partners, aims to restore degraded and deforested landscapes across 9 African countries, including Zambia.
 - * Community engagement: Initiatives like WeForest focus on community-led restoration efforts, providing alternative livelihoods and promoting sustainable land use practices.
- **We Effect** is a Swedish development organization that works to eradicate poverty and inequality. In Zambia, We Effect focuses on various areas, including.
 - * Sustainable Agriculture: We Effect supports smallholder farmers, especially women and youth, to improve their livelihoods through sustainable agriculture practices.
 - * Food Security: The organization works to enhance food security by promoting climate-resilient agriculture, improving access to markets, and supporting farmers’ organizations.
 - * Water, Sanitation, and Hygiene (WASH): We Effect aims to improve access to clean water, sanitation facilities, and hygiene practices in rural communities.
 - * Rights and Governance: The organization supports local communities in claiming their rights and promoting good governance, particularly in the context of natural resource management.
- **Zambia for Agroforestry, Biodiversity, and Climate (Z4ABC) Project:** A four-year project funded by the European Union and implemented by the *Center for International Forestry Research (CIFOR)* and *World Agroforestry (ICRAF)*. The project aims to transform agriculture, forestry, and food systems in Zambia, reaching at least 50,000 smallholder farmers and community members, and introducing climate-relevant management practices.

- **Building the Resilience of Local Communities in Zambia through Ecosystem-based Adaptation:** A project implemented by UNEP, focusing on ecosystem-based adaptation in wetlands and forests, aiming to improve climate resilience of local communities and rehabilitate 11,600 hectares of wetlands and forests.
- **Global Environment Facility (GEF)-Funded Project** through the United Nations Environment Programme (UNEP): The GEF is supporting a project to strengthen community-based sustainable management of forest landscapes in Northwestern-Zambia. Spearheaded by *The Nature Conservancy (TNC)* in collaboration with the Government of the Republic of Zambia is implementing this five- year, “Ecosystem Conservation and Community Livelihood Enhancement Project” (the GEF 7 Project), The main purpose of the Project is to address the barriers to sustainable land management and biodiversity conservation at three project sites in three districts in the province. The project is supporting activities to develop and strengthen systems for community management of forests and other natural resources, provides support towards development of productive nature-based investments for sustained self-financing to conservation and enterprise development and supports the adoption of sustainable agricultural practices and technologies to improve agriculture production and productivity, while also reducing the deforestation footprint of agriculture activities on communal lands adjacent to the Community Forest Management Areas (CFMAs). The Project support is targeted for forest-dependent rural communities on the north central portion of the West Lunga Complex (the 50,000 hectares of Ntambu Community Forest Management Area which is part of the 147,000 ha Chibwika Ntambu Game Management Area (GMA) including an additional 104,822 hectares within Ntambu Chiefdom customary lands; the 50,000 hectares of Kelongwa Makaba Community Forest Management Area that is part of the Greater Kafue Ecosystem (GKA) comprising the Kafue National Park and its surrounding GMAs and approximately 6,000 hectares of Kamikolo future CFMA on the communal lands northeast of Kalumbila town under Senior Chief Mukumbi.
- **Promoting Community-Based Climate Resilient Forest Regeneration:** A project implemented by UNDP, focusing on climate-resilient agroforestry and assisted natural regeneration in miombo woodlands, aiming to strengthen technical and institutional capacity of foresters and communities.

Major Achievements, Challenges and Opportunities

Zambia has made significant progress in addressing climate change through various initiatives. Some major achievements, challenges, and opportunities:

Major Achievements

- **Climate Change Policy Framework:** Zambia has developed a National Climate Change Policy (NCCP) to mainstream climate change into all sectors of the economy, promoting adaptation and mitigation strategies.
- **Renewable Energy Initiatives:** The Scaling Solar Project aims to increase Zambia’s renewable energy capacity and reduce dependence on hydropower, which is vulnerable to climate variability.

- **Sustainable Land Management:** Initiatives like the Zambia Integrated Forest Landscape Project (ZIFLP) promote sustainable forest management, agroforestry, and conservation agriculture to enhance ecosystem services and livelihoods.
- **Community-Based Adaptation:** Various NGOs and international organizations are working on community-based adaptation projects to build local resilience, focusing on improving water management, diversifying livelihoods, and enhancing food security.

Major Challenges

- **Limited Financial Resources:** Zambia faces significant challenges in securing funding for large-scale climate resilience projects.
- **Capacity Building:** There is a need for greater capacity building at local and institutional levels to effectively implement and manage climate initiatives.
- **Awareness and Education:** Increasing awareness and education on climate change and sustainability practices is crucial for widespread adoption.
- **Regulatory and Compliance Risks:** Organizations face financial penalties for non-compliance with environmental regulations, highlighting the need for effective regulatory frameworks.

Opportunities

- **International Cooperation:** Zambia can leverage international partnerships and funding opportunities to build capacity on climate change mitigation and adaptation.
- **Sustainable Development:** Climate change initiatives can contribute to sustainable development and poverty reduction in Zambia.
- **Green Economy:** Zambia has opportunities to transition to a green economy, creating jobs and stimulating economic growth while reducing environmental degradation.

Strategies being applied to Promote Adoption of Technologies:

- **Capacity Building:** Building technical and institutional capacity among stakeholders, including local communities and extension officers.
- **Partnerships:** Fostering partnerships with international organizations, research institutions, and other stakeholders to leverage resources and expertise.
- **Awareness and Education:** Promoting awareness and education on climate change and sustainability practices among stakeholders.
- **Policy Support:** Developing and implementing policies that support the adoption of climate-smart technologies and practices.

Policy, Legislation, Strategies and Guidelines

Several legislations have been put in place to address climate change in Zambia. For instance, the *Zambian Constitution*, Article 257 provides for establishment of mechanisms to address climate change. Zambia has made significant progress on developing conducive policy and legislative instruments as well as strategic plans for addressing climate change within the broader national economic development context. Specific achievements that form the building blocks for promoting climate change mitigation and adaptation, landscape restoration, and forestry development in Zambia include, among others, the following:

- ***Zambia's vision 2030 of 2006***, sets the country's long-term development vision emphasizing development based on "sustainable environment and natural resource management principles" with an overarching principle to have a competitive national economy that is dynamic, resilient to external shocks and supports the stability and protection of the biological and physical systems characterized by development of policies consistent with sustainable environment and natural resources conservation.
- ***Eighth National Development Plan (8NDP) of 2021*** emphasises an integrated (multi-sectoral) development environment and implementation approach with a goal to create a diversified and resilient economy for sustained growth and socio-economic transformation driven, among others, by agriculture. This is in support of Smart Zambia Transformation Agenda 2064 in line with the UN 2030 Agenda for Sustainable Development and the African Union Agenda 2063.
- The ***National Policy on Climate Change (NPCC) of 2016*** defines the climate change coordination structure in the country (GRZ, 2020-First Biennial Update Report to the UNFCCC). Its overall objective is to provide a framework for coordinating climate change programmes in order to ensure climate resilient and low carbon development pathways for sustainable development towards the attainment of Zambia's *Vision 2030*. The policy promotes mainstreaming of climate change into policies, plans and strategies at all levels to inform decision-making and implementation. As a result of this policy direction, the country has implemented measures to integrate climate change into the national development planning process, including within the Eighth National Development Plan (8NDP) (GRZ, 2020-Third National Communication to the UNFCCC). The Council of Ministers serves as the highest decision-making body for supervising climate change initiatives in the country (GRZ, 2020-First Biennial Update Report to the UNFCCC).
- ***National Climate Change Response Strategy of 2012*** identifies clear priorities for adaptation and mitigation activities in various sectors of the economy and emphasises a multi-sectoral and coordinated approach among different stakeholders to effectively reduce emissions towards a climate resilient and green economy.

- ***Second National Biodiversity Strategy and Action Plan of 2015*** set out overarching objectives for biodiversity conservation in the country and emphasises multi-sectoral coordination. The vision of Zambia's NBSAP2 is that by 2025, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy environment and delivering benefits for all Zambians and the Zambia economy.
- ***National Agriculture Policy of 2016*** explicitly recognises the significance of climate change adaptation by promoting Climate Smart Agricultural practices such as conservation agriculture and agroforestry and linkages to other sectors such as forestry, energy, land use and infrastructure development.
- ***National Environment Policy of 2007*** focuses on the achievement of measures that address the pressing need to manage the impact of human activities on the environment, including biodiversity loss, deforestation, land degradation, air pollution, inadequate management of water resources and water pollution.
- Zambia's latest ***National Forest Policy of 2024*** and the *Forest Act No. 4 of 2015* offer a conducive legal framework for sustainable forest management that seeks to involve communities and non-state actors. They recognize the country's forests as central for sustainable development, climate change mitigation and adaptation, and biodiversity conservation (World Bank Group, 2019).
- The ***National Gender Policy of 2014*** addresses gender mainstreaming across relevant sectors including energy, water, sanitation, transportation, and tourism sectors, and makes note of climate change. Gender is considered as a cross-cutting issue in many of Zambia's sustainable development strategies and national legislation. Men, women and youth are primary users of forests. Their subsistence activities and indigenous knowledge of the forest can aid forest-related activities, such as species monitoring, soil management and forest restoration functions, which can then contribute positively to outcomes.

The country has also developed several climate-related sectoral policies and measures including, among others, the following:

- The ***National Energy Policy of 2019*** recognises the potential role that renewable energy sources can play in meeting the country's energy demand and cushioning the Zambian economy against the impacts of climate change and variability. It emphasises the development and development of off-grid renewable energy technologies (RETs) through public and private sector investments in solar, mini-hydro, wind, biomass and geothermal power generation., *National Industrial Policy of 2018*, the *Second National Agriculture Policy of 2016* and Reducing Emissions from Deforestation and Forest Degradation, Conservation of Carbon Stocks, Sustainable Management of Forests and Enhancement of Carbon Stocks (REDD+) *Strategy, 2015* (GRZ, 2020-Third National Communication to the UNFCCC).

- Zambia's **REDD+ Strategy, 2015** aims to contribute to national reductions in GHG emissions by improving forest and land management and to ensure equitable sharing of both carbon and non-carbon benefits among stakeholders. Objectives include, among others: (i) to effectively manage and protect threatened and unsustainably managed national and local forests so as to reduce emissions from deforestation and forest degradation and contribute to ecosystem services across selected landscapes; (ii) promote adoption of good agricultural practices that mitigate carbon emissions; (iii) regulate production of wood fuel (charcoal & firewood) and improve its utilization; (iv) promote wide adoption of appropriate and affordable alternative energy sources; and (v) threatened and sensitive protected areas legislated as “no-go areas” for mining and infrastructure development (GRZ, 2020-Third National Communication to the UNFCCC).

Table 7.9: Summary of Important Legal and Regulatory framework

Enabling Act	Purpose	Remark
Forests Act No. 4 of 2015	The Act provides for the conservation and protection of forests and trees	The Act sets the standards for forest resources Management
The Zambia Wildlife Act No. 12 of 1998	The Act is largely responsible for the management of wildlife but it is also responsible for the management of forests as habitats for animals	In order for wildlife to thrive in their habitats, the forest resources need to be well managed and therefore linked to forest resource management
Lands Act Cap 184	The act is responsible for the management and administration of land in Zambia on which forests grow	Forests grow on land and therefore regulations associated with land management may affect forest resource management. For example, giving title deeds in protected forest areas
Agriculture Act	The Act provides for agricultural practices, development, investment and management	Forest loss through deforestation is one of the challenges for sustainable forest management. In order to reduce deforestation Agricultural practices need to be appropriate

Enabling Act	Purpose	Remark
Energy Regulations Act No. 16 of 1995	The Act among other issues regulates energy use	Most people use charcoal and firewood as a source of energy. Therefore, appropriate provisions in the Act will facilitate sustainable forest management. For example, rural electrification. The regulations of the growing of bio-fuels are important for biodiversity conservation and management.
Environmental Management Act No. 12 of 2011	The Act provides for the management of environment and natural resources	Appropriate regulations in the environment and natural resources for example in terms of controlling pollution, emissions, need of environmental impact assessments will help in ensuring sustainable forest management
Mines and Minerals Act of 1995	The Act provides for mineral and mimes development	All mines are initiated in forests and therefore appropriate technologies and practices in the mining sector are required to ensure sustainable forest management. If mining operations takes precedence over forests, sustainable forest management will be a challenge.
Local Government (Amendment) Act No. 9 of 2004	The Act among others provides for decentralization	The promotion of decentralization is on line with participatory forest management. Therefore, appropriate local government Act will support sustainable forest management
Water Act Cap 198	The Act provides for the regulation and management of water resources	Forests protect water catchment areas, which ensure continued flow of water.

Enabling Act	Purpose	Remark
Zambia Development Agency Act No. 11 of 2006	The Act provides for the trade, investment and industrial development in Zambia.	Sustainable forest management can be achieved if appropriate trade, investment and industry development measure are put in place to protect the forests.
National Heritage Conservation Commission Act, Cap 173	The Act provides for heritage conservation and management.	Forests provide support to some natural heritage areas and therefore promotion of heritage sites may also enhance sustainable forest management.
Urban and Regional planning act No. 3 of 2015	The act provides for development planning and administration principals, standards and requirements for urban and regional planning processes and Systems.	The act sets standards for land use and settlement planning.
Disaster Management Act No. 13 of 2010	The Act provides for the maintenance and operation of a system for anticipating, preparing for, preventing, coordinating, mitigating, and managing disaster situations.	Aims to establish a system for managing disasters The Act provides for the declaration of disasters and outlines the procedures for doing so.

Source: National Forestry Policy, 2024

Opportunities and Challenges to Capacity Building

Some of the opportunities and challenges to capacity building on Climate Change mitigation and adaptation measures, landscape restoration and forestry development in the Forestry Department-Zambia include:

Opportunities for Capacity Building

- **International Cooperation:** Zambia can leverage international partnerships and funding opportunities to build capacity on climate change mitigation and adaptation, landscape restoration, and forestry development.
- **National Priorities:** Climate change and sustainable development are national priorities in Zambia, providing a strong foundation for capacity building initiatives.

- **Existing Infrastructure:** Zambia has existing infrastructure, including research institutions and extension services, that can be leveraged for capacity building initiatives.
- **Growing Demand:** There is a growing demand for climate change mitigation and adaptation measures, landscape restoration, and forestry development in Zambia, creating opportunities for capacity building.

Challenges to Capacity Building

- **Limited Resources:** Zambia faces challenges in terms of limited financial and technical resources to invest in capacity building initiatives.
- **Inadequate Institutional Capacity:** Zambia's institutions, including government agencies and research institutions, may lack the capacity to effectively implement capacity building initiatives.
- **Limited Awareness:** There may be limited awareness among stakeholders, including local communities and policymakers, about the importance of climate change mitigation and adaptation, landscape restoration, and forestry development.
- **Coordination Challenges:** Capacity building initiatives may face coordination challenges, including duplication of efforts and lack of harmonization among different stakeholders.

Areas of Particular Training Needs

Other training needs apart from the ones highlighted to be covered by this programme as indicated in the training objectives are:

- GIS and Remote sensing.
- Carbon sequestration and trade.
- Forests and tree health (pests and diseases).
- Soil fertility management.
- Pasture/fodder grass farming.
- Management and control of invasive plant species.
- Water harvesting.
- Cell and Tissue Culture.
- Botany and Taxonomy.
- Seed biology and banking ex situ.
- Statistics and data analysis.
- Article writing and publications.

Additional Information

In fulfilling its obligation to the United Nations Framework Convention on Climate

Change (UNFCCC), Zambia has submitted three National Communications (2004, 2014 and 2020), its First Biennial Update Report (2020), and its revised *Nationally Determined Contribution (NDC)* in 2021 (GRZ, 2020-Third National Communication to the UNFCCC); (GRZ, 2020-First Biennial Update Report to the UNFCCC). Through its updated *NDC*, Zambia intends to reduce its greenhouse gas emissions by 25% (at Business as Usual (BAU) level of international support prevailing in 2015) and towards 47% (with substantial international support) compared to 2010 levels.

The mitigation actions are focused on three programmes:

(i) sustainable forest management; (ii) sustainable agriculture; and (iii) renewable energy and energy efficiency. Adaptation actions in the *NDC* are focused on strategic productive systems (agriculture, wildlife and water), strategic infrastructure and health systems and enhanced capacity building, research, technology transfer and finance for adaptation (GRZ, 2021).

7.10 Promoting Climate Change Resilient Forestry in Zimbabwe

Tendai Mudzinganyama

Forestry Commission

Introduction

Zimbabwe's forestry sector is central to the country's environmental health, economic stability, and rural livelihoods. However, increasing climate variability, land degradation, and socio-economic pressures continue to threaten the nation's forests and natural ecosystems. Promoting climate-resilient forestry aligns with Zimbabwe's commitments to sustainable development, ecological restoration, and improved natural resource governance.

Zimbabwe is a landlocked country in southern Africa with diverse ecological zones ranging from Miombo and Mopane woodlands to grasslands, wetlands, and highland areas. Rainfall distribution is highly variable and strongly influenced by El Niño and La Niña cycles, leading to recurrent droughts, heatwaves, and occasional flooding. These climatic stresses directly affect water resources, agricultural output, and the productivity of natural ecosystems.

Status of the Forests in Zimbabwe

Forests play a critical role in supporting rural livelihoods in Zimbabwe. Many households rely on forests for fuelwood, timber, wild foods, medicinal plants, and income from non-timber forest products. The country's economy rooted in agriculture, mining, tourism, and forestry depends heavily on climate-sensitive sectors. Population pressure, economic instability, and limited livelihood alternatives have accelerated forest loss through agricultural expansion, charcoal production, and unsustainable harvesting. Zimbabwe's forest estate is dominated by Miombo and Mopane woodlands that provide essential ecosystem services such as carbon sequestration, soil protection, and hydrological regulation. Despite their importance, deforestation and forest degradation remain significant. An estimated 30–40% of the country's land area is degraded, driven by poor land management, overgrazing, mining, and the impacts of climate change. Key environmental challenges include declining soil fertility; loss of biodiversity; increased wildfire frequency; agricultural encroachment and unsustainable fuelwood harvesting. These issues greatly reduce ecosystem health and community resilience.

Zimbabwe's forests comprise mainly Mopane woodlands (43.3%), followed by Miombo woodlands (36.8%), Combretum/Terminalis (6%), Zambezi Teak (5.6%), Acacia Savannah (5.3%) and mixed woodland (2.9%). Exotic plantations (0.5%), primarily in the Eastern Highlands, supplement the natural forest estate. Zimbabwe has experienced significant forest cover loss over the past three decades, with an estimated annual loss of 262 000 hectares between 1992 and 2017 (Forestry Commission of Zimbabwe (2020). Land cover mapping indicates a decline in forest area from 53.21% in 1992 to 38.37% in 2020, accompanied by an increase in bushland and a decrease in wooded grassland. Concurrently, land use changes have also influenced forest cover. Area under settlement expanded from a 36% in 1992 to 0.66% in 2017, before slightly decreasing to 0.5%

in 2020. Cropland area, a primary driver of deforestation, increased from 27.48% in 1992 to 30.83% in 2020. These trends underscore the complex interplay between forest loss, land use change and socio-economic factors. Projecting into the future, population growth, agricultural expansion and increasing demand for land are likely to exert continued pressure on forest resources.

Climate change is expected to significantly alter the spatial distribution of Zimbabwe's primary forest ecosystems which are Miombo, Baikiae and Mopane. According to World Bank (2019), Baikiae forests currently covering 25% of the country may decline by 13% by 2070 due to changing precipitation and temperature patterns. The World Bank (2019) further projected that Miombo forests, currently occupying 30% of the land, are projected to shrink to 10% by 2050, retreating to higher altitudes. Conversely, Mopane, currently covering 45%, is expected to expand to 70% by 2050 and 75% by 2070.

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

Reforestation

The Zimbabwe Forestry Commission has planted a total of 60 million tree seedlings in 2024, a 50% increase from 40 million in 2023, as part of its commitment to restoring 20% of the country's forest cover by 2030. This effort has resulted in a 15% increase in forest cover in key regions and a 30% reduction in illegal logging incidents.

Zimbabwe National Forest Policy

The Zimbabwe National Forest Policy launched in 2023, aims to promote sustainable management of forests as a national heritage. The policy focuses on community participation, environmental impact and climate change mitigation. The key objectives of the Zimbabwe National Forest Policy are sustainable forest management, deforestation and degradation reduction as well as community-based forestry. In its implementation, the policy promotes strengthening policy frameworks, capacity building and public-private partnerships. The policy safeguards a total of 12 000 jobs in the forestry industry sector, improves welfare of rural communities through community based natural resource management initiatives as well as enhance environmental stewardship and fulfil international climate commitments. The Zimbabwe National Forest Policy also highlights the importance of gender-sensitive approaches, carbon credit framework and community resilience.

Agroforestry Programmes

The government has expanded agroforestry programmes, encouraging farmers to integrate trees into their crop systems, improving livelihoods and soil health. Some farmers have as a result earned an average of \$300usd each from selling fruits from indigenous trees in 2023 and doubled that income in 2024.

Drylands Forest Management Programme

The government launched a sustainable forest management programme to reduce land degradation, desertification and deforestation, focusing on Manicaland, Masvingo

and Midlands Provinces with a total of \$71.125 million funding from the Global Environmental Facility Agency. The Global Environment Facility (GEF) 7 project in Zimbabwe focuses on sustainable land and forest management. The GEF provided a total of \$71 million to Zimbabwe for land restoration and reforestation programmes under the GEF 7 Drylands Sustainable Landscapes Impact Programme. The project aims to restore 2 150 hectares and bring 172 540 hectares under improved practices through integrated land use. The project promotes community-led forest management, providing training and support to local communities. This approach has not only improved forest cover but also enhanced community livelihoods through sustainable land use practices. The project also focuses on agroforestry practices, encouraging farmers to integrate trees into their crop systems. This approach has improved soil health, reduce erosion and increased biodiversity. A total of 15 000 community members with at least 52% women shall benefit from the GEF 7 project in Zimbabwe.

Miombo Transboundary Project (FAO/Italy)

The Zimbabwe Miombo Protection Transboundary Project was launched in 2024 through a partnership between the Food and Agriculture Organisation (FAO) of the United Nations and the Forestry Commission of Zimbabwe. This initiative aims to protect and sustainably manage the Miombo woodlands, promoting climate resilience to a vital ecosystem supporting millions of rural residents in Zimbabwe and Mozambique.

Climate Change Adaptation Strategies

Research has been conducted on climatic change adaptation strategies for smallholder farmers in Zimbabwe, highlighting the importance of agroforestry, soil conservation and water harvesting techniques. A study in Nyanga District found that 56.8% of respondents prefer reforestation as a mitigation strategy while 43.2% focus on forestry preservation by avoiding veld fires.

National Forest Monitoring System

The Zimbabwe Forestry Commission launched a national forest monitoring system using satellite data and drones to track forest health in real-time, reducing illegal logging activities by 30% in 2024.

Community Engagement

Local communities have been empowered to manage forests sustainably with benefits including improved livelihoods and reduced poverty. The government is working with communities to develop land-use plans that recognise forestry at all governance levels, promoting sustainable forest management and community participation.

Community-Based Restoration and Assisted Natural Regeneration: Several local initiatives promote natural regeneration, urban tree planting, and rehabilitation of mined lands (e.g., Unki Mine in Shurugwi), helping recover degraded ecosystems using indigenous species.

International Recognition

Zimbabwe has been recognised as “Global Green Champion” by the United Nations

Environment Programme for its dedication to environmental sustainability. The country's efforts in sustainable forest management and climate change mitigation have garnered international attention with potential for replication in other countries.

Sustainable Forest and Land Management in Save and Runde Catchments (2021–2026): This initiative focuses on restoring degraded land, mainstreaming climate-smart livelihoods, and improving district-level land-use planning.

Major Achievements, Opportunities and Challenges to the Forestry Sector

Major Achievements

Zimbabwe has made notable progress in strengthening its forestry sector despite economic and climatic pressures. Key achievements include:

- **Expansion of Forest Restoration Initiatives:** Significant progress has been made through programmes such as the Dryland Sustainable Landscapes Impact Programme (DSL-IP), Miombo Transboundary Project, and national reforestation campaigns. Thousands of hectares have been restored and placed under improved land management practices.
- **Strengthening of Policy and Legislative Frameworks:** The adoption and revision of key policies such as the National Forest Policy (2016), Environmental Management Act (2002/2007), and National Climate Policy (2017) have enhanced governance, clarified institutional mandates, and supported sustainable forest management.
- **Community-Based Natural Resource Management (CBNRM):** Rural communities have increasingly engaged in participatory forest management, beekeeping, fire control, woodlot establishment, and sustainable harvesting of non-timber forest products.
- **Improved Monitoring and Data Systems:** Increased use of GIS, remote sensing, forest inventories, and environmental information systems has strengthened the country's ability to monitor land degradation, track deforestation, and support informed planning.
- **Implementation of REDD+ Readiness Activities:** Zimbabwe has undertaken steps to align forest management with global climate mitigation initiatives, improving capacity for carbon accounting and unlocking potential for future climate financing.

Opportunities

The forestry sector has numerous opportunities that can enhance resilience, expand forest cover, and support green economic growth:

- **High Potential for Forest Restoration:** Large areas of degraded Miombo and Mopane woodlands offer opportunities for rehabilitation, carbon sequestration, and ecosystem-based adaptation..
- **Strong International Partnerships and Climate Finance:** Support from GEF, FAO, UNDP, World Bank, SADC, COMESA, and bilateral partners provide access to funding, technical expertise, and global best practices.

- **Growing Demand for Renewable Energy:** The shift toward solar and clean energy presents opportunities to reduce dependence on fuelwood, helping curb deforestation and promote sustainable energy alternatives.
- **Expansion of Forest-Based Livelihoods:** Non-timber products such as honey, mushrooms, marula, baobab, medicinal plants, and wildlife-based enterprises offer potential for value addition, job creation, and community income.
- **Youth Engagement and Innovation:** Zimbabwe's youthful population presents an opportunity to train new professionals in forestry, climate science, GIS, and ecosystem restoration using digital technologies.
- **Alignment with Global Restoration Initiatives:** Zimbabwe's commitments under the Bonn Challenge, AFR100, and UNCCD Land Degradation Neutrality targets position the country to attract further investment and technical assistance.
- **Increased forest cover:** Satellite imagery confirms a 15% increase in forest cover in key regions, with illegal incidents dropping by 30% due to better enforcement and community involvement.
- **Carbon Sequestration:** Zimbabwe's forests captured an estimated 1.2 million tonnes of carbon dioxide in 2024 up from 800,000 tonnes in 2023.
- **Community Benefits:** Reforestation efforts have improved livelihoods for local communities resulting in farmers earning income from selling fruits from indigenous trees and benefiting from agroforestry practices.

Challenges

Despite progress, the forestry sector faces persistent constraints that undermine sustainable management and climate resilience:

Climate Change

Climate change has posed significant threats to forests in Zimbabwe. Climate change has brought with it a lot of changes in the physical environment as the environment has also tried to adapt to changing weather patterns and increased frequency of extreme weather events have had a significant impact on the health and resilience of forest ecosystems, increased susceptibility to pests and disease and extinction of other vegetation species. Climate change has brought about changes in rainfall patterns in Zimbabwe. The rainy seasons have become shorter and more intense, leading to increased rainfall variability. While some parts have received abnormal rainfall, some also now receive less than before as a result of climate change. This has disrupted the natural water cycle and affected the recharge of groundwater systems, leaving many areas vulnerable to water scarcity. The decreased rainfall has also affected the forest resources, resulting in reduced soil moisture and tree mortality.

Invasive Alien Species

Climate change has also increased vulnerability of Zimbabwe's natural ecosystem including its forests to pests and diseases. The changing climatic conditions have created favourable conditions for the spread of pests and diseases that were previously

constrained. Examples include the *Leptocybe invasa* which has affected the eucalyptus species, *Lantana camara*, the *venanonthura polyacantha (mupesepese)* weed which is believed to have originated from Mozambique and invaded forestry plantations in the Eastern Highlands and other natural ecosystems. These have had a negative effect of out competing the natural vegetation and established forestry plantations, hence disrupting ecological processes as they displace and dominate native species, leading to reduced overall biodiversity. The forestry landscape has also been affected by *Thaumastocoris peregrinus* also known as the bronze bug, which is a sap-sucking eucalyptus pest from Australia. This is believed to have invaded Zimbabwe from South Africa. Eucalyptus have also suffered from *Lectocype invasa* also known as the eucalyptus gall wasp. Infestations from these alien pests resulted in stunted growth and in severe cases tree death. However, there has been significant control measures to mitigate the effects of these alien species.

	
Figure 7.10: Reforestation efforts: Restoration of mined site through indigenous trees planting at Unki Mine, Shurugwi District in the Midlands Province of Zimbabwe in December 2024. Plantings carried out in collaboration with Zimbabwe Forestry Commission.	Figure 7.11: Community Engagement and Reforestation efforts: Enrichment planting through truncheons at Poshayi Community Woodlot in in collaboration with the GEF 7 Project in Shurugwi District, Zimbabwe. Drought resistant indigenous trees species used.

- High Rates of Deforestation and Land Degradation: Agricultural expansion, charcoal production, mining, and unsustainable harvesting remain major drivers of woodland loss.
- Climate Change Impacts: Recurrent droughts, erratic rainfall, and increased wildfire frequency worsen forest degradation and reduce regeneration capacity.
- Limited Institutional Capacity: Agencies such as the Forestry Commission and EMA face shortages of staff, limited vehicles and equipment, and inadequate funding to enforce regulations effectively.
- Dependence on Fuelwood for Energy: More than 60% of rural households rely on firewood, increasing pressure on indigenous woodlands.

- **Slow Uptake of Alternative Livelihoods:** Despite efforts, many rural communities have limited access to diversified income sources, reducing incentives for forest conservation.
- **Fragmented Coordination Across Sectors:** Overlapping mandates and weak inter-agency coordination among forestry, agriculture, water, and local governance institutions hinder integrated forest landscape management.
- **Funding Limitations:** Forest restoration and monitoring require significant financial resources, but budget allocations remain low and heavily donor-dependent.

Land Degradation and its Impacts

Land degradation is widespread due to deforestation, overgrazing, unsustainable farming, and mining. Climate stress exacerbates soil erosion, reduces vegetation cover, and decreases agricultural productivity. The impacts include:

- Reduced grazing capacity.
- Loss of ecosystem services.
- Increased vulnerability to drought.
- Declining livelihoods for rural communities.

Addressing degradation is essential for sustaining economic recovery and long-term ecological resilience.

Policy and Legislative Framework

Zimbabwe has developed a comprehensive policy and legislative framework to guide sustainable forest management, climate resilience, environmental protection, and responsible land use. These instruments collectively provide the legal authority, institutional mandates, and strategic direction required to address deforestation, land degradation, and climate change impacts.

Forest Act

The Forest Act is the principal legislation governing forest protection, management, and utilisation in Zimbabwe. It establishes the Forestry Commission as the lead agency responsible for regulating forest resources, managing gazetted forests, issuing licences for timber harvesting, and enforcing laws to prevent illegal logging and wildfires. The Act also promotes the conservation of indigenous woodlands, supports the establishment of plantations, and provides mechanisms for community participation in forest management. Through provisions on reforestation, forest reserves, and fire management, the Act remains central to safeguarding Zimbabwe's forest estate.

Environmental Management Act

The Environmental Management Act (EMA) provides the overarching legal framework for environmental governance in Zimbabwe. Administered by the Environmental Management Agency (EMA), the Act covers key areas such as pollution control, environmental impact assessments (EIAs), biodiversity conservation, waste management,

and land degradation prevention. It mandates the integration of environmental considerations into all development initiatives and empowers EMA to monitor, enforce, and regulate natural resource use. The Act also supports ecosystem restoration and sets penalties for environmental violations, making it a cornerstone of Zimbabwe's sustainability agenda.

National Climate Policy (2017)

The National Climate Policy outlines Zimbabwe's strategic approach to climate change mitigation and adaptation. It seeks to mainstream climate considerations into all sectors—agriculture, forestry, water, energy, health, and infrastructure. The policy promotes climate-smart agriculture, sustainable forest management, renewable energy expansion, and strengthened early warning systems. It provides guidance for mobilising climate finance, implementing nationally determined contributions (NDCs), and improving climate governance. This policy positions Zimbabwe to respond effectively to climate-related disasters while supporting long-term resilience building.

National Forest Policy (2016)

The National Forest Policy aims to promote the sustainable management, conservation, and restoration of forest resources. It emphasises community involvement through participatory forest management, encourages the establishment of commercial plantations, and supports the use of indigenous species for reforestation. The policy guides interventions to reduce deforestation, regulate fuelwood harvesting, promote alternative energy use, and strengthen forest-based livelihoods. It also aligns forest management with climate change strategies, including REDD+, carbon sequestration initiatives, and biodiversity protection.

Other Policies and Strategies

To strengthen the sector, Zimbabwe also relies on complementary frameworks such as:

- National Environmental Policy – provides the vision for sustainable natural resource management.
- National Adaptation Plan (NAP) Framework – guides adaptation planning across sectors.
- Land Degradation Neutrality (LDN) Targets – aligned with UNCCD commitments to restore degraded lands.
- Zimbabwe's Nationally Determined Contributions (NDCs) – outline climate mitigation and adaptation commitments under the Paris Agreement.
- Rural Electrification and Renewable Energy Frameworks – reduce reliance on fuelwood by promoting solar and clean energy adoption.

Opportunities and Challenges to Capacity Building to the forestry sector

- Capacity building remains a cornerstone for strengthening climate-resilient forestry and sustainable land management in Zimbabwe. Effective capacity development

enhances the ability of government institutions, communities, and private actors to manage forests responsibly, restore degraded landscapes, and respond to climate risks. Despite significant efforts, the sector continues to face a mixture of promising opportunities and persistent challenges that shape progress.

Opportunities to Capacity Building

Zimbabwe has several emerging opportunities that can be leveraged to build a competent and climate-resilient forestry workforce:

- **Strong Global and Regional Partnerships:** Zimbabwe benefits from collaborations with international organisations such as FAO, UNDP, UNEP, GEF, the World Bank, SADC, and COMESA. These partnerships provide avenues for training, technology transfer, research cooperation, and access to global best practices in forest management, climate modelling, and ecosystem restoration.
- **Access to Technical Expertise Through Development Partners:** Ongoing donor-supported programmes such as the Dryland Sustainable Landscapes (DSL-IP), Miombo Transboundary Project, and Land Degradation Neutrality initiatives offer specialised technical support in GIS, monitoring, wildfire management, carbon accounting, and climate-smart forestry.
- **Growing National Commitment to Restoration:** Zimbabwe's engagement with projects like the Bonn Challenge, AFR100, and national reforestation campaigns has increased political will and institutional attention toward restoration. This commitment creates space for long-term training programmes and integration of capacity building into national policies.
- **Increasing Use of Digital Tools for Monitoring and Training:** Modern technologies remote sensing, drones, mobile data collection apps, and online learning platforms are gaining traction. Digital solutions enhance forest monitoring, data accuracy, early-warning systems, and make training more accessible to remote districts.
- **Youth Engagement and Education Expansion:** A large, educated youth population provides an opportunity to build a new generation of forestry and climate professionals through technical colleges, universities, and field-based training programmes.

Challenges to Capacity Building

However, progress is constrained by several structural and operational challenges that limit the effectiveness of capacity-building initiatives:

- **Limited Funding for Training and Technology:** Financial constraints reduce access to specialised equipment, field training, laboratories, and high-quality educational materials. Many institutions rely heavily on external funding to implement training activities.
- **Shortage of Specialized Forestry and Climate Experts:** Zimbabwe faces a gap in advanced skills such as forest biometric analysis, climate modelling, carbon finance, meteorology, GIS, and ecosystem restoration. Brain drain and limited postgraduate training opportunities exacerbate this shortage.

- **Weak Institutional Capacity for Enforcement and Monitoring:** Agencies such as the Forestry Commission and EMA often operate with inadequate staffing, outdated tools, and limited transport, affecting their ability to enforce laws, monitor forests, and conduct regular extension services.
- **Limited Community Awareness and Technical Knowledge:** Many rural communities lack adequate knowledge on sustainable land management, invasive species control, climate change adaptation, and alternative energy solutions. This reduces the uptake of climate-smart practices and restoration initiatives.
- **Coordination Gaps among Agencies:** Overlapping mandates and limited coordination between forestry, agriculture, water, and environmental institutions weaken implementation efficiency.

Additional Information

Zimbabwe's forestry sector stands at a crossroads facing serious environmental pressures but also significant opportunities for restoration and climate resilience. With sustained commitment, strengthened policies, community participation, and support from development partners, Zimbabwe can rehabilitate its degraded landscapes, promote sustainable forest management, and build resilience against climate change.

APPENDICES

Appendix I: Course Programme



PROMOTING CLIMATE CHANGE RESILIENT FORESTRY IN AFRICA



1st - 19th September 2025
at
KEFRI, Nairobi-KENYA

Course Programme

WEEK 1			
DAY / DATE	MORNING 8:30am-10:30am	MID-MORNING 11:00am-1:00pm	AFTERNOON 2:00pm-5:00pm
SAT 30/08/2025 INTERNATIONAL ARRIVALS SFS - CORECC TEAM			
SUN 31/08/2025 INTERNATIONAL ARRIVALS AND LOCAL ARRIVALS SFS - CORECC TEAM			
MON: 1/09/2025	- Welcome - Introductions - Overview of KEFRI - Course Brief - Programme Overview - Orientation - Participants Expectations <i>(SFS-CORECC Team)</i>	Development of forestry in Kenya: Successes, challenges, opportunities and synergies <i>(Z. Toroitch- KFS)</i> JICA strategies and activities in Africa on environment - <i>(JICA- Kenya Office)</i>	Official Opening Ceremony (PS -State Department for Forestry/Embassy of Japan /JICA/ KEFRI Embassies and High Commissions of participating countries 2.30pm - 4.30pm
TUE: 2/09/2025	Climate change: trends, impacts, challenges, opportunities, mitigation and adaptation measures in Africa <i>(R. Akombo - MECCF)</i>	Introduction to tree seed science in a changing climate <i>(M. Okeyo - KEFRI)</i>	Tree seed source identification and development <i>(S. Omondi - KEFRI)</i>
WED: 3/09/2025	Tree seed collection, handling and storage <i>(S. Ndungu- KEFRI)</i>	Tree seed quality control: Principles of seed testing <i>(M. Jephumba - KEFRI)</i>	Practical Session I: Tree seed handling and testing - Visit KEFRI Tree Seed Centre <i>(E. Ojuku - KEFRI)</i>
THUR: 4/09/2025	Technologies for rehabilitation, restoration and conservation of woodlands and forests landscapes <i>(J. Ngugi- KEFRI)</i>	<u>Learning Experience I:</u> Landscape restoration through re-afforestation: Case study of Nguriunditu Valley <i>(S. Wairungu- KEFRI)</i>	Presentation and discussions of country reports by participants <i>(Participants/SFS-CORECC Team)</i>
FRI: 5/09/2025	Forest Health I: Dynamics of plant diseases in a changing climate. Case studies from Africa <i>(J. Njuguna- KEFRI)</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: 6/09/2025	<u>Learning Experience II:</u> Participatory Forest Approaches: The case of Participatory Forest Management: Visit to Karura Forest <i>(M.T.E Mbuvi-KEFRI)</i>	Travel to Nairobi and its environs <i>(S. Mwalewa, R. Okello, N. Kemboi, and R. Mwangangi)</i>	
SUN: 7/09/2025	Free	Travel to Kitui	

WEEK 2			
DAY	MORNING 8:30am-10:30am	MID-MORNING 11:00am-1:00pm	AFTERNOON 2:00pm-5:00pm
MON: 8/09/2025	Dryland forestry R&D: Overview of KEFRI activities, achievements and challenges <i>(J. Musyoki- KEFRI DERP)</i>	Development of a centre excellence for dryland forestry research: KEFRI Pilot Forest on drought tolerant species activities at Tiva <i>(J. Musyoki- KEFRI DERP)</i>	Indigenous tree improvement and breeding- The case of <i>Melia volkensii</i> and <i>Acacia tortilis</i> <i>(V. Okul-KEFRI DERP)</i> Visit to Melia and Acacia breeding sites <i>(V. Okul-KEFRI DERP)</i>
TUE: 9/09/2025	Practical Session IV: Demonstration on long rooted seedling to enhance tree survival <i>(R. Wanjau- KEFRI DERP)</i>	<u>Learning Experience III:</u> Technology transfer through model farmers approach <i>(E. Kitheka- KEFRI DERP)</i>	Travel to Kibwezi <i>(SFC-CORECC Team)</i>
WED: 10/09/2025	Travel to farmer's field	<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>	Night in Kibwezi <i>(SFC-CORECC Team)</i>
THUR: 11/09/2025	Travel to farmer's field	<u>Learning Experience V:</u> Demonstration Improved natural pasture growing for sustainable livelihood in drylands <i>(J. Ngaya- Kibwezi)</i>	Travel to Machakos <i>(SFC-CORECC Team)</i>
FRI: 12/09/2025	Dryland agriculture for community and climate resilience <i>(KALRO Katumani - Machakos)</i>	<u>Learning experience VI:</u> On-station research and demonstration of dryland agriculture for climate resilience	Travel to Muguga <i>(SFC-CORECC Team)</i>
SAT: 13/09/2025	Compiling field reports by participants	<u>Learning Experience VII:</u> Visit historical sites in Nairobi <i>(S. Mwalewa, R. Okello, N. Kemboi and R. Mwangangi)</i>	
SUN: 14/09/2025	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: 15/09/2025	Policies and legal frameworks for Sustainable Forest Management (<i>J. Kagombe- KEFRI</i>)	Resource Mobilization: Proposal development and project planning and management (<i>B. Prissy- KEFRI</i>)	Compiling Field reports/ (<i>Participants</i>)
TUE: 16/09/2025	Travel to KEFRI Karura	Wood and Non-Wood Forest Product development and commercialization (<i>N. Oduor-KEFRI</i>)	Practical Session III: Visit Karura laboratories and demonstrations (<i>N. Oduor-KEFRI</i>)
WED: 17/09/2025	Gender analysis and inclusion in forestry (<i>S. Mwalewa- KEFRI</i>)	Participatory extension approaches in forestry in the era of climate change (<i>R. Nyambati- KEFRI</i>)	ToT tools: communication, facilitation and presentation skills (<i>AIRC</i>)
THUR: 18/09/2025	<u>Practical Session V:</u> Development and presentation of extension materials (<i>AIRC</i>)	Action plans development (<i>AIRC</i>)	Development of individual action plans (<i>Participants, AIRC</i>)
FRI: 19/09/2025	Presentation of individual action plan (<i>Participants AIRC/SFS-CORECC</i>)	Course evaluation Plenary/Way forward (<i>SFS-CORECC Team</i>)	Official Closing Ceremony (<i>PS - MECCF/JICA/KEFRI</i>)
SAT: 20/09/2025	International Departure		
SUN: 21/09/2025	International Departure		

Appendix II: List of Resource Persons

No.	Name	Institution	Contacts Address/ Email
1.	Dr. Jane W. Njuguna DG KEFRI	Kenya Forestry Research Institute	P. O Box 20412-00200, Nairobi Email.ijnjuguna@kefri.org
2.	Dr. M. T. E. Mbuvi (PhD)	Kenya Forestry Research Institute	P.O Box 20412-00200, Nairobi Email.tmbuvi@kefri.org
3.	Dr. Eston. Mutitu	Kenya Forestry Research Institute	P.O Box 20412-00200, Nairobi Email.emutitu@kefri.org
4.	Dr. Robert Nyambati	Kenya Forestry Research Institute	P.O Box 20412-00200, Nairobi Email: nyambatr@gmail.com
5.	Dr. Stephen Omondi	Kenya Forestry Research Institute	P.O Box 20412-00200, Nairobi Email.somondi@kefri.org
6.	Dr. Joram Kagombe	Kenya Forestry Research Institute	P.O Box 20412-00200, Nairobi Email.jokagombe@kefri.org
7.	Dr. Josephine Musyoki	Kenya Forestry Research Institute Dryland Eco-region Research Programme	Po Box 892-90200 Kitui Email.josephinemusyoki@ yahoo.com
8.	Dr. Michael. Okeyo	Kenya Forestry Research Institute Dryland Sub-region Research Programme	Kibwezi Email.mokeyo@kefri.org
9.	Mr. Stephen. Ndungu	Kenya Forestry Research Institute	P.O Box 20412-00200, Nairobi Email.sndungu@kefri.org
10.	Mr. Paul Tuwei	Kenya Forestry Research Institute	P.O Box 20412-00200, Nairobi Email.ptuwei@kefri.org
11.	Ms. Josephine Wanjiku	Kenya Forestry Research Institute	P.O Box 20412-00200, Nairobi Email.jwanjiku@kefri.org

No.	Name	Institution	Contacts Address/ Email
12.	Ms. Angela Muthama	Kenya Forestry Research Institute	P.O Box 20412-00200, Nairobi Email: amuthama@kefri.org
13.	Ms. Miriam Gathogo	Kenya Forestry Research Institute	P.O Box 20412-00200, Nairobi Email: mgathogo@kefri.org
14.	Ms. Milicent Jepchumba	Kenya Forestry Research Institute	P.O Box 20412-00200, Nairobi Email: mjepchumba@kefri.org
15.	Mr. Eugene Ojuku	Kenya Forestry Research Institute	P.O Box 20412-00200, Nairobi Email: ejuku@kefri.org
16.	Mr. John Ngugi	Kenya Forestry Research Institute	P.O Box 20412-00200, Nairobi Email: jkigomo@kefri.org
17.	Mr. Simon Wairungu	Kenya Forestry Research Institute	P.O Box 20412-00200, Nairobi Email: simonwairungu@gmail.com
18.	Ms. Valentor Okul	Kenya Forestry Research Institute Dryland Eco-region Research Programme	Po Box 892-90200 Kitui Email: vokul@kefri.org
19.	Ms. Rahab Wanjau	Kenya Forestry Research Institute Dryland Eco-region Research Programme	Po Box 892-90200 Kitui Email: rwanjau@kefri.org
20.	Ms. Emily Kitheka	Kenya Forestry Research Institute Dryland Eco-region Research Programme	Po Box 892-90200 Kitui Email: ekitheka@kefri.org
21.	Ms. Damaris Munyao	Kenya Forestry Research Institute	P.O Box 20412-00200, Nairobi Email: dmunyao@kefri.org
22.	Mr. Pius Matieka	Kenya Forestry Research Institute	P.O Box 20412-00200, Nairobi Email: pmatieka@kefri.org

No.	Name	Institution	Contacts Address/ Email
23.	Ms. Betty Prissy	Kenya Forestry Research Institute	P.O Box 20412-00200, Nairobi Email: pbetty@kefri.org
24.	Ms. Nellly Oduor	Kenya Forestry Research Institute The National Forest Products Research Programme	P.O Box 20412-00200, Nairobi Email: noduor@kefri.org
25.	Ms. Sylvia Mwalewa	Kenya Forestry Research Institute	P.O Box 20412-00200, Nairobi Email: suchi@kefri.org
26.	Ms. Tae Ose	Japan International Cooperation Agency Climate Change Sector, JICA Kenya Office	BRITAM Tower, 22 nd & 23 rd Hospital Road, P.O Box 50572-00200 Nairobi, Kenya
27.	Mr. Abednego Osindi	Japan International Cooperation Agency Climate Change Sector, JICA Kenya Office	BRITAM Tower, 22 nd & 23 rd Hospital Road, P.O Box 50572-00200 Nairobi, Kenya
28.	Emmanuel Kisangai	Japan International Cooperation Agency Climate Change Sector, JICA Kenya Office	BRITAM Tower, 22 nd & 23 rd Hospital Road, P.O Box 50572-00200 Nairobi, Kenya
29.	Ms. Zipporah. Toroitich	Kenya Forest Service	P.O. Box 30513-00100 GPO, Nairobi, Kenya Email: ziptoro@yahoo.com
30.	Dr. Rose. Akombo	Kenya Forest Service	P.O. Box 30513-00100 GPO, Nairobi, Kenya Email: rakombo@gmail.com
31.	Ms. Cariline Busuru	Kenya Forest Service	P.O. Box 30513-00100 GPO, Nairobi, Kenya Email: cnbcarol@gmail.com
32.	Mr. Jonathan Kituku	Melia Model Farmer-Kibwezi	Kibwezi

No.	Name	Institution	Contacts Address/ Email
33.	Mr. Jeremiah Ngaya	Model Farmer-Kibwezi	Kibwezi
34.	Dr. Emerita Njiru	KARLO, Agricultural Mechanization Research Institute, Katumani, Machakos	KALRO-Katumani, Machakos-Wote Road, P.O. Box 340-90100 Machakos: Phone (254) 710-906600, Email: director.amri@kalro.org : kalro.katumani@kalro.org : www.kalro.org
35.	Dr. John Wambua	KARLO, Agricultural Mechanization Research Institute, Katumani, Machakos	KALRO-Katumani, Machakos-Wote Road, P.O. Box 340-90100 Machakos: Phone (254) 710-906600, Email: director.amri@kalro.org kalro.katumani@kalro.org www.kalro.org
36.	Mr. Eliud Rotich	KARLO, Agricultural Mechanization Research Institute, Katumani, Machakos	KALRO-Katumani, Machakos-Wote Road, P.O. Box 340-90100 Machakos: Phone (254) 710-906600, Email: director.amri@kalro.org kalro.katumani@kalro.org www.kalro.org
37.	Ms. Miriam Mutua	KARLO, Agricultural Mechanization Research Institute, Katumani, Machakos	KALRO-Katumani, Machakos-Wote Road, P.O. Box 340-90100 Machakos: Phone (254) 710-906600, Email: director.amri@kalro.org kalro.katumani@kalro.org www.kalro.org
38.	Ms. Fatuma Adam	KARLO, Agricultural Mechanization Research Institute, Katumani, Machakos	KALRO-Katumani, Machakos-Wote Road, P.O. Box 340-90100 Machakos: Phone (254) 710-906600, Email: director.amri@kalro.org kalro.katumani@kalro.org www.kalro.org

No.	Name	Institution	Contacts Address/ Email
39.	Mr. Albanus Kimeu	KARLO, Agricultural Mechanization Research Institute, Katumani, Machakos	KALRO-Katumani, Machakos-Wote Road, P.O. Box 340-90100 Machakos: Phone (254) 710-906600, Email: director.amri@kalro.org kalro.katumani@kalro.org www.kalro.org
40.	Ms. Barbra Khainga	KARLO, Agricultural Mechanization Research Institute, Katumani, Machakos	KALRO-Katumani, Machakos-Wote Road, P.O. Box 340-90100 Machakos: Phone (254) 710-906600, Email: director.amri@kalro.org kalro.katumani@kalro.org www.kalro.org
41.	Mr. Dominic Muendo	KARLO, Agricultural Mechanization Research Institute, Katumani, Machakos	KALRO-Katumani, Machakos-Wote Road, P.O. Box 340-90100 Machakos: Phone (254) 710-906600, Email: director.amri@kalro.org kalro.katumani@kalro.org www.kalro.org
42.	Mr. Martin Gaita	KARLO, Agricultural Mechanization Research Institute, Katumani, Machakos	KALRO-Katumani, Machakos-Wote Road, P.O. Box 340-90100 Machakos: Phone (254) 710-906600, Email: director.amri@kalro.org kalro.katumani@kalro.org www.kalro.org
43.	Ms. Beth Wanjiku	KARLO, Agricultural Mechanization Research Institute, Katumani, Machakos	KALRO-Katumani, Machakos-Wote Road, P.O. Box 340-90100 Machakos: Phone (254) 710-906600, Email: director.amri@kalro.org kalro.katumani@kalro.org www.kalro.org

No.	Name	Institution	Contacts Address/ Email
44.	Ms. Roselida Osieko	KARLO, Agricultural Mechanization Research Institute, Katumani, Machakos	KALRO-Katamani, Machakos-Wote Road, P.O. Box 340-90100 Machakos: Phone (254) 710-906600, Email: director.amri@kalro.org kalro.katamani@kalro.org www.kalro.org
45.	Ms. Beatrice Nganga	KARLO, Agricultural Mechanization Research Institute, Katumani, Machakos	KALRO-Katamani, Machakos-Wote Road, P.O. Box 340-90100 Machakos: Phone (254) 710-906600, Email: director.amri@kalro.org kalro.katamani@kalro.org www.kalro.org
46.	Mr. Wycliff Langat	KARLO, Agricultural Mechanization Research Institute, Katumani, Machakos	KALRO-Katamani, Machakos-Wote Road, P.O. Box 340-90100 Machakos: Phone (254) 710-906600, Email: director.amri@kalro.org kalro.katamani@kalro.org www.kalro.org

Appendix III: List of Course Participants

S/No	Name	Country	Institution	Address/Contacts
1.	Ms. Gofaone Rammotokara	Botswana	Botswana University of Agriculture and Natural Resources	Private Bag 0027, Gaborone, Botswana Tel: +2673650100 Mobile cell phone: +26774446778
2.	Ms. Nezehty Abbay Asmerom	Eritrea	National Agricultural Research Institute	Mobile cell phone: 2917159349 Email: ntshtiabay@gmail.com
3.	Ms. Miheret Semere Negash	Ethiopia	Central Ethiopia forestry development center (CEFDC)	Tel: +251114044444 Email: meharia@efd.gov.et meharialebachew25@gmail.com
4.	Ms. Penina Ngugi	Kenya	Kenya Forest Research Institute	Mobile cell phone: 0702328549 Email: pengugi@kefri.org
5.	Mr. Wato Godana	Kenya	State Department of Forestry	Mobile cell phone: 0717383589 Email: watagodana@yahoo.com
6.	Ms. Elizabeth Kariuki	Kenya	Kenya Forest Service	Mobile cell phone: 0721484017 Email: ngatializ@gmail.com
7.	Ms. Baxter Mbalenhle Primrose	Kingdom of Eswatini	Ministry of Tourism and Environmental Affairs – department of forestry	P.O. Box 2652, Mbabane. Tel: +268240464/ +26824049420 Mobile cell phone: +26876063083 /+26876083669 Email: mbhekeninxumalo@gmail.com
8.	Mr. Rethabile Mathola	Lesotho	Lesotho Agricultural College	Tel: +26622322484 Mobile cell phone: +26658913298 Email: mamoeketsi.nthimo@gov.ls

S/No	Name	Country	Institution	Address/Contacts
9.	Mr. Alex Saffa Vandí	Sierra Leone	Ministry of the Environment and Climate Change (MoECC)	#55 Wilkinson Road, Freetown Mobile cell phone: +23276946363 Email: vandialexsaffa123@gmail.com
10.	Mr. Abdikani Yusuf Abdi	Somaliland	Somaliland Agriculture Society (SAS)	Hargeisa, Somaliland Mobile cell phone: +252634453056 Email: jfgalaydh@gmail.com
11.	Mr. Jones Ngoza Hachilensa	Zambia	Forestry Department – Ministry of Green Economy and Environment	Forest Road P.O. Box 22099, Kitwe Mobile cell phone: +260979214084 Email: forestutilisationresearchunit@gmail.com
12.	Ms. Tendai Mudzinganyama	Zimbabwe	Forestry Commission of Zimbabwe	Tel: +263542228911 Mobile cell phone: +263778128553 Email: tendaimudzinga107@gmail.com or midlandsforestry@gmail.com



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

ATTENDANCE REGISTER

Regional Training Course on Promoting Climate Change Resilient Forestry in Africa

No.	Name	Country	Organization	Contact	1/9/2025 DAY 1	2/9/2025 DAY 2	3/9/2025 DAY 3	4/9/2025 DAY 4	5/9/2025 DAY 5
1.	JONES NGOZI HACHNENSA	ZAMBIA	FORESTRY DEPT	+26 0974 914084	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
2.	TENDAI MUZONGANUYANGA	ZIMBABWE	FORESTRY COMMISSION	+263 775125	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
3.	ELIZABETH MUTHINI	KENYA	KENYA FOREST SERVICE	+254 0724454071	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
4.	MBALENHLE PRIMROSE BAXTER	ESWATINI	MITEA FORESTRY	+268 74180342 633737251	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
5.	ALEX SAFFA VANDI	SIERRA LEONE	MINISTRY ENVIRONMENT AND CLIMATE	+231 076746363	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
6.	BETHABWE MATHOIA	LESOTHO	MINISTRY OF AGRICULTURE	+266 6239544	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
7.	NERENITY ABBAY	ERITREA	NARI	+291 2152349	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
8.	Abdikani Yusufi Abdi Samadland	Ethiopia	SAS	+252 25263 4052050	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
9.	Mubelet Semes Alemayehu	Ethiopia	ETHIOPIAN FORESTRY DEPT	+251 9127 255600	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
10.	WARIO GODANA	KENYA	FORESTRY DEPT	+254 07133855	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
11.	PENINA NGUGI	KENYA	KEFRI	+254 072220711	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
12.	CROPKONE RANWICKO BURA	BURUNDI	BIAN	+267 74446778	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>

Appendix V: Sample Course Certificate





Kenya Forestry Research Institute and Japan International Cooperation Agency

P. O. Box 20412-00200, Nairobi, Kenya

Tel: +254-724 259 781/2, +254-722157414, +254-20-2010651/2

Email: director@kefri.org

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