TERMINAL REPORT

INSTITUTIONAL STRENGTHENING FOR THE FOREST SECTOR DEVELOPMENT IN ETHIOPIA

REPORTING PERIOD: 2015 –2021

PROGRAMME SUMMERY

Programme Title & Project Number	Strategic Results[1]
• Program Title: **Institutional Strengthening for the Forest Sector Development** • MPTF Office Project Reference Number: **00094308**	**UNDAF Outcome 5:** By 2021 key Government institutions at federal and regional levels including cities are better able to plan, implement and monitor priority climate change mitigation and adaptation actions and sustainable resource management.
Participating Organization	**Implementing Partners**
• UNDP Ethiopia Office	• Ethiopian Forestry Development (the then Environment, Forest and Climate Change Commission) • Ministry of Finance
Programme/Project Cost (US$)	**Programme Duration**
• Total approved budget as per document: **2,576,716USD (22,550,500NOK)**	• Overall Duration: **78 months** • Start Date : **2/06/2015** • End Date: **31/12/2021**

[1] Strategic Results, as formulated in the Strategic UN Planning Framework (e.g. UNDAF) or project document;

ACRONYMS

AWP: Annual Work Plan
CRGE: Climate Resilient Green Economy
CSO: Civil Society Organization
GTP Growth and Transformation Plan
LPAC: Local Project Appraisal Committee
EFCCC: Environment Forest and Climate Change Commission
EFD: Ethiopian Forestry Development
MPTFO: Multi Partners Trust Fund Office
MoU: Memorandum of Understanding
NFSDP: National Forest Sector Development Program
PSNP Productive Safety Net Program
REDD+ Reduction of Emission from Deforestation and Forest Degradation
RFSDP: Regional Forest Sector Development Program
SLU: Swedish University of Agriculture
SLM: Sustainable Land Management
SNNP: Southern Nations Nationalities and Peoples
UNDP: United Nations Development Programme

EXECUTIVE SUMMARY

The Institutional Strengthening for the Forest Sector Development Project in Ethiopia has supported the development of a ten-year National Forest Sector Development Program (NSDP) (2018-2028) for the sector, which was officially launched at the end of 2018. The National Forest Sector Development Program prepared in three volumes, namely: *Situation Analysis*; *Program Pillars, Action Areas and Targets and Synthesis Report*. The NFSDP will serve as a road map to lead all governmental, non-governmental, private sector and Civil Society Organizations (CSO) with regard to forest conservation and development in the country.

The NFSDP will be realized at the sub national level through the development of Regions and City administrations specific forest sector development programs. Accordingly, work is currently underway to develop forest sector development plans customized for specific regions and cities.

The institutional set up at federal and regional levels has been strengthened. One national and nine woreda forest sector development offices have been set up and strengthened through the deployment of additional six personnel which bring the total number to 92 skilled personnel and establishment of forestry data bases infrastructure.

Nationally, 16,239.19 hectares of land have been covered with Afforestation/Reforestation activities in the project lifetime. With regard to rehabilitation activities through Assisted Natural Regeneration, 154,308.15 hectares of land were nationally delineated, demarcated and rehabilitated.

In the project lifetime, the project helped to increase employment and income generation opportunities for 258,671 (F = 106,773) people living around the targeted areas through engagements in the forest sector and other livelihood options.

I. Introduction

The Institutional Strengthening for the Forest Development Project in Ethiopia is aiming to strengthen national capacity to help Ethiopia deliver on the forestry targets contained in the Climate Resilient Green Economy Strategy and Growth and Transformation Plan. The project also aims to contribute for the implementation of UN Development Assistance Framework (UNDAF), specifically on the Resilience and Green Economy pillar.

The project has the following five expected outputs:

i. Strengthened institutional capacity of the forest sector at all levels
ii. Forest conservation and development for their multiple benefits in selected areas piloted
iii. Broad-based stakeholder engagement in forest conservation and development enhanced
iv. Private sector involvement in forest development strengthened
v. Science and innovation in the forest sector strengthened

This project is designed to contribute towards reversing negative trends through building the capacity of the national institution and at the same time piloting strategic interventions. The project implementation is supported by the strong commitment of the Government of Ethiopia (GoE) and the involvement of key stakeholders, in particular local communities.

Priority Areas

Forest development, conservation and management activities have been made in selected degraded areas of Amhara, Tigray and Southern Nations, Nationalities, and Peoples Regional States (Figure 1).

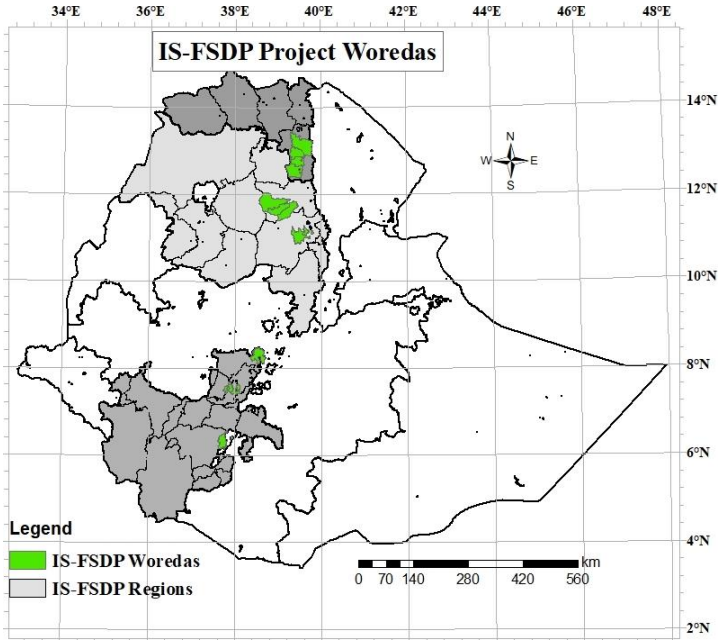


Figure 1. Pilot regions (grey) and districts (green) for Afforestation/Reforestation and Rehabilitation activities

Implementation Arrangement

Environment, Forest and Climate Change Commission (EFCCC), with the technical support of United Nations Development Programme (UNDP) leads the implementation of the Project. Monitoring of the program is conducted jointly by Ministry of Finance (MoF), UNDP, the Norwegian Embassy, the Swedish Embassy and EFCCC. The project is monitored based on the Monitoring and Evaluation guidelines of the CRGE Facility, UNDP and EFCCC. Technical and administrative bodies at regional and local levels are also responsible for the implementation, monitoring and follow up of the project execution on regular basis. Moreover, nine project offices have been set up in the selected project districts to coordinate project activities in the thirteen districts. These offices are linked with the National Project Coordination Office. The overall guidance of the project implementation is provided by a steering committee, while at district level there is additional technical committee, which provides technical guidance including quality assurance for each activities of the project.

II. Impacts

The project has recorded impact level achievements for all projects

- Institutional capacity of forest sector strengthened
- Local youth migration and conflicts reduced due to the additional income generated

- Private sector involvement and promotion of science and innovation supported and improved
- Strong sense of tree-based livelihoods in degraded highlands developed
- Degraded areas restored through Forest Landscape Restoration or Assisted Natural Regeneration
- Soil and water conserved and erosion controlled
- Displacement of local communities reduced as landslides hazards have been reduced and floods are controlled
- Participation of local community in forest development and management enhanced
- The local government structure supported and engaged at all stages of project interventions
- Sustainability ensured through cooperative establishment of tree growers and linked with relevant stakeholders
- Forage and fodder supply for livestock improved
- Food security enhanced as income has increased and diversified
- Pressure on fragile ecosystems reduced
- Floral and wildlife biodiversity has increased in the rehabilitated areas
- Scenic views and mental satisfaction of communities have increased

III. Results

UNDAF Outcome 5: By 2021 key Government institutions at federal and regional levels including cities are better able to plan, implement and monitor priority climate change mitigation and adaptation actions and sustainable resource management.

During this reporting period the project is contributing to the restoration of Ethiopia's forest through afforestation/reforestation and rehabilitation of degraded lands.

The key progress areas during the reporting period under the planned-outputs are briefly described as follows:

Output I: Strengthening the Institutional Capacity of the Forest Sector

Through the support of the project, Ethiopia has established a national and regional forestry database infrastructure that will help the country to address the gap in knowledge management. The forestry database contains information that is relevant for the sustainable management of plantation

and natural forest resources, including species types and distribution both in the natural forest and planation in the regions; status of management; as well as indigenous knowledge on the use of tree species by local communities. All regional states are now equipped with key database facilities procured and distributed through the support of this project. Training on those facilities has been provided.

- Trainings on Geo-informatics, Participatory Forest Management (PFM) and forest product value chain had also been provided to 251 trainees (7 Female). As part of building institutional capacity, web-based platform is established at EFCCC to improve future data management, monitoring, reporting and verification. The online portal (https://fsdp.efccc.gov.et/) is currently at its test run stage. The accumulated effect of capacity training and adequate guidelines has yielded a good capacity at Federal, Regional and Wereda levels.
- Training on Forest Management and Practical GPS usage, GIS Map Making and Map data management have been given to all project staffs of the nine woredas and one regional expert.
- One national and nine woreda coordination offices have been set up and are now active with 92 (additional 6 personnel in the reporting period) project staff hired at various levels.
- Environmental and social management framework preparation process finalized for fast rotation plantation and rehabilitation of degraded lands for nine districts
- The National Forest Sector Development Program (NFSDP) prepared in three volumes, namely: *Situation Analysis*; *Program Pillars, Action Areas and Targets*; and *Synthesis Report*. The NFSDP has got three volumes, which serve as a road map to lead all governmental and non-governmental private sector and Civil Society Organizations (CSOs) with regard to forest conservation and development in the country. Three tractors with trailers and ploughs, two field cars and one dump-truck have been procured and distributed to project districts.

Output 2: Forest Conservation and Development Enhanced

This project emphasizes supporting land use plan based rehabilitation efforts in targeted micro-watersheds. The project has helped initiate short rotation forestry activities as community forestry scheme. This include primarily the careful selection of species, raising seedlings and establishment of plantation of fast-growing species to fill the pressing need on wood products while reducing

pressure on the remaining natural forests and woodlands. During the reporting period, the following progress was made.

Nationally, 16,239.19 hectares of land have been covered with Afforestation/Reforestation activities in the project lifetime. With regard to rehabilitation activities through Assisted Natural Regeneration, 154,308.15 hectares of land were nationally delineated, demarcated and rehabilitated.

In the project lifetime, the project helped to increase employment and income generation opportunities for 258,671 (F = 106,773) people living around the targeted areas through engagements in the forest sector and other livelihood options.

In nine pilot districts selected from Amhara, SNNP and Tigray regions clearly defined construction and management of soil and water conservation structures which enhance forest development and conservation efforts.

Output 3: Private Sector Involvement in Forest Development Facilitated

A national guideline is prepared to encourage the private sector. This includes various incentives mechanisms to be proposed by the government. The incentives includes among others: tax exemption for importing equipment and materials for commercial forestry; availing land for tree planting, etc. By doing so, the private sector involvement in forest conservation and development will be promoted.

As a result, a workshop on “Harnessing Forest based Private Sector Development in Ethiopia” was held between 22 and 23 September 2021 at Adama town. A number of presentations were delivered by experts on different topics of private sector on the forestry sector.

Output 4: Forest Science and Innovation Promoted

Forest enterprise development challenges and opportunities have been studied and a document produced. A manual for forest enterprise development has been published. A draft on restoration technical backstopping guideline is prepared and will be published soon.

In collaboration with forestry research and higher learning institutions, 13 demand driven and forest conservation and development relevant research thematic areas have been selected and being financially supported. In line with this, four MSc theses published in forest value chain, dryland livelihood and forest business topics. Some of the research projects are completed and respective

reports are produced. The remaining research projects are still ongoing in the reporting period. Research review has been conducted and evaluated all the research project based on their current status and set goals. Most of the research projects are completed and some are still ongoing. The list of selected research projects, their status and implementing institutions can be found in Annex 1 and the list are shown in Table 1.

Table 1 list of selected research projects and their implementing institutions

No	Title	Implementing Institution	Status
1	Improving management and performances of smallholder's forest plantation systems in the highlands of Amhara Region, Northern Ethiopia.	University of Gondar	Completed
2	Conservation through utilization: product chain development of underutilized Non-timber forest products for rural development and sustainable dry-forest management.	University of Gondar	Completed
3	Development and validation of species and site specific biomass models for carbon stock estimate of Combretum-Terminalia woodland vegetation in Western and north western Ethiopia.	University of Gondar	Completed
4	Composition and Structure of forest Resources under Successional Stages across Chercher Afromontane Forest Landscapes of Eastern Ethiopia: prerequisite for conservation strategy.	Oda Bultum University	Completed
5	Allometric equations for estimating aboveground biomass of some selected native woody species grown in four major vegetation biomes of Ethiopia. Moist Evergreen Afromontane Biome.	Wondo Genet College	Ongoing
6	Forestry Innovation for Improving Forest Product Demand-Supply Mismatches & Improving forest enterprises' competitiveness in Ethiopia	Wondo Genet College	Completed
7	Domestication and Seed Source Establishment for selected indigenous timber tree species in west and south western Ethiopia	EEFRI	Completed
8	Developing Allometric Equation for Estimating aboveground biomass of selected tree species from Dry Afromontane forests of Ethiopia	EEFRI	Ongoing

9	Enhancing Field establishment and management of seedlings in degraded frost affected highlands of Ethiopia.	EEFRI	Ongoing
10	Developing appropriate in-vitro propagation protocol for endangered and important multipurpose trees and assess their adaptation and growth using halophilic and thermophilic nitrogen fixing microbes.	EEFRI	Ongoing
11	Integrated Multidisciplinary Land Management Intervention and research for improved Agroforest Biodiversity, Economic Wellbeing and Ecosystem Services at the Landscape level	EEFRI	Ongoing
12	Development of Multi-Species Riparian Vegetation Buffer for Bank Stabilization and Sediment Control.	EEFRI	Ongoing
13	Developing Allometric Equation for Estimating Aboveground Biomass of selected tree species from Acacia commiphora forests of Ethiopia	EEFRI	Ongoing

IV. Monitoring and Evaluation

Progress was made in strengthening the overall M&E system with attention given to the improvement of the quality of the data reported, data management and overall reporting.

As part of improving the M&E of the project, technical team formed by EFCCC has went to project woredas in Amhara and SNNP regions to evaluate the progresses and achievements made by the progress. The team has found that the project activities are being implemented with good momentum and the results are being taken as exemplary work in their respective areas.

Furthermore, documentation of best practices through documentaries (https://www.youtube.com/watch?v=y9WFasLaAZo) and brochures are produced to reach out the public and wider stakeholders. Quarterly discussions with regional and woreda level stakeholders on the progress of the project are well underway as per the plan which benefitted the scaling-up and expansion of the intervention to additional 54 project woredas through RIP-A/R program.

Acceleration plan devised to spearhead implementations and meet targets. Mechanisms of implementing the acceleration plan are in place. The major mechanisms are conducting regular meetings from woreda up to national level, exchanging reports frequently on each meetings without

waiting for regular reporting periods and engaging the steering committees at different level. This has been giving a chance for all actors to know the status of each region and project woredas and created an opportunity to solve the challenges faced at different levels. As a result most targets set by the project are overachieved by regions and districts.

V. Challenges and Lessons Learned

The Project both at strategic level (e.g. by designing a ten-year National Forest Sector Development Programme (NFSDP) and piloting model approaches, has gained the trust of stakeholders and is starting to be showcased to other similar government interventions. Recently, government and donor showed strong interest to expand the model and accommodate additional activities in the coming few years. The 80 million USD grant, of which 35 million USD is for Afforestation /Reforestation for REDD+ Investment funded by the Norwegian is one testimony for this.

Due to the trust, interest and sense of ownership of the project felt by the local communities, the communities have been engaged heavily in rehabilitation of degraded forest lands and establishment of fast rotation plantation. Accordingly, the monetary value of the free community contribution for rehabilitation and fast rotation plantation has amounted USD 323,076 and 232,481 USD respectively during the reporting period.

However, there were some key challenges faced during the implementation of the projects.

1. The global public health crisis, COVID19, caused a lot of disruptions from woreda up to national level. It took some time to adapt to the conditions created by COVID 19 and continue the momentum of project implementations.
2. Some of the sites selected for afforestation have environmental constraints and demanded extra investments in site amelioration efforts. This called for extensive consultations and costs on the ground in order to reduce the risk of compromised results and quality.
3. Delay in fund transfer from the donor end has caused some activities to be postponed for the coming seasons
4. Security situation in some areas has affected the fast rotation plantation and rehabilitation of degraded lands in the districts. Moreover, technical support, monitoring and evaluation activities in the districts by the National Project Coordination Office have been negatively affected by the security situation.

ii) Indicator Based Performance Assessment:

For the overall project lifetime achievements, please see an update on the achievement of indicators at both the output and outcome level in the table below..

Outputs:	**Baseline**	**Target**	**Achievement**
Output 1.1 The Institutional Capacity of the forest sector is strengthened at all levels. **Indicators** ○ Number of offices equipped with office facilities and skilled human resources; ○ Presence of National Forest Sector Development Program; ○ Presence of Regional Forest Sector Development Programs; ○ Existence of coordination mechanisms at federal and regional levels ○ Presence of ESMF	○ Existence of Ministry of Environment and Forest with limited capacity; ○ Ethiopian Forestry Action Plan prepared in 1994 ○ Woody Biomass Inventory and Strategic Plan Project findings in 2004 ○ Absence of strong regional/sub national structure ○ Emerging Forest Based enterprises ○	○ NFSDP developed ○ 9 regional and 2 city administrations Forest Sector Development Plans developed ○ Office facilities procured for EFCCC and regional replica; ○ ESMF prepared; ○ Coordination mechanism in place at regional and federal levels	○ One national and nine woreda forest sector development offices established and operationalized through the deployment of 92 skilled personnel and fulfilling office facilities ○ Forestry data bases infrastructure established and the required facilities at national and regional levels fulfilled ○ The 10 years NFSDP developed and ready to be launched ○ Regional RFSDP under preparation ○ ESMF for fast rotation plantation and rehabilitation of degraded lands for nine districts prepared; ○ Coordination Mechanism to lead the forest conservation and development exists and regions and city administrations have also established offices with different naming; ○ 92 project staffs deployed and are currently working at federal and regional levels
Output 2 **Indicators** ○ Presence of clearly defined and integrated rural land use plans	**Baselines** ○ Absence of clearly defined rural land use plan that supports the	**Planned Targets** ○ Clearly defined and integrated rural land use plans that support	○ Achievements ○ In nine pilot districts selected from Amhara, SNNP and Tigray clearly defined land use plans prepared for

that support forest conservation and development of forest resources in pilot regional states; ○ Proportion of degraded lands demarcated and mapped; ○ Proportion of degraded lands rehabilitated; ○ Presence of Project Design Document to access carbon finance; ○ Existence of road map for implementation of agroforestry system in Ethiopia; ○ Number of pilot sites per region effectively implemented Payment for Ecosystem Services; ○ Number of areas covered per region and city administration through short rotation plantation program	conservation and development of forest resources; ○ Degraded lands Rehabilitation program exists in some parts of Ethiopia; ○ Absence of harmonized agroforestry systems and practices by agro ecological zones ○ Lack of comprehensive evaluation system for ecological, social and economic benefits of forest resources and their contribution to GDP	conservation and development of forest resources in pilot regional states; ○ 150,000 hectares lands demarcated and mapped; ○ 150,000 hectares degraded lands rehabilitated; ○ Presence of Project Design Document to access carbon finance; ○ 10,000 hectares mapped and covered by short rotation plantation program; ○ One Project Design Document to access carbon finance prepared ○ Criteria for the implementation of agroforestry system in Ethiopia developed;	conducting forest conservation and development; ○ 223.56 km Bench terrace constructed ○ 5408 m Brush wood check dam constructed ○ 1641 km Bund maintained ○ 11959.6 m^3 Cut off drain constructed ○ 2422.33 km Deep trench constructed ○ 35601 Eye brow basins constructed ○ 69.95 km Fany juu bund constructed ○ 8706 km Gabion check dam constructed ○ 939.65 ha of Gully reclaimed ○ 5515 Half-moon constructed ○ 2003 Herring bones constructed ○ 5 HH pond constructed ○ 4922.73 Hillside terrace constructed ○ 2158.2 km of Soil bunds have been constructed ○ 65753 m^3 Stone check dam constructed ○ 12406.22 km Stone faced bunds constructed ○ Plantation has been conducted on 16,239.19 ha of land which is 162.4% of the project target. ○ In the project lifetime, the project helped to increase employment and income generation opportunities for 258,671 (F = 106,773) ○ Rehabilitation of 154,308.15ha of land is achieved which is 103% of the project target.

VI. Assessment of Efficiency of the Project

This project is designed in the result-based scheme and resources are especially targeted towards supporting delivery of outputs. Most of the resource was planned for field level Afforestation/Reforestation and Rehabilitation works including livelihood activities and hence significant focus and resource support is provided accordingly.

This project has ample evidence already to show that different stakeholders were quickly mobilized for the actual implementation of the project. This indicated that afforestation in Ethiopian landscapes (even on degraded ones) can be achieved quickly if the assumed conditions are in place, i.e. good site rehabilitation conditions, guaranteed quality of plant material, proper management, reasonable investment and access to markets for products.

In practice, the entire exercise was translated into important outcomes of increased employment and income generation while arresting land degradation, which is one of the main targets in the GTPII. The project is also likely to contribute to biodiversity conservation, and the country's climate change adaptation and mitigation efforts.

The project implementation manual set a certain level of free labor participation from the community for various field activities to promote the participation of the wider public and other stakeholders, while at the same time maintaining a reasonable level of efficiency in financial disbursement. The top leadership in the three regions have directly dedicated personnel and institutions to monitor this project and provided guidance on the selection of sites for its implementation and its implementation approaches. Previous experiences in other similar projects like (e.g. SLM, PSNP etc.) have helped to quickly start the implementation of this project. In many cases, the steering committee for the other projects similarly led the implementation of this project.

VII. Conclusion

This project is a key mechanism to build institutional capacity at all levels and pilot new approaches on rehabilitation and afforestation by triggering more stakeholders' engagement in the forest sector. The project supports the national green growth strategy, CRGE, and the work started under this project can make a significant contribution towards the achievement of the forest sector target in the green growth development agenda of the country.

The commitment of the project and government staff at various levels, the participation of communities in project sites, the leadership by the government bodies at various levels and support provided by the Norwegian and Swedish Governments, UNDP and MoF is encouraging. Considering the time since inception to implementation on the ground activities, the project is well positioned to deliver the outcomes and targets as per the plan. Sustaining the existing momentum will help to prove that the project's implementation model is working for the Ethiopian landscape and livelihood systems.





VIII. Annex 1.

Domestication and Seed Source Establishment for Selected Indigenous Timber Tree Species in West and South-Western Ethiopia

(Yigardu Mulatu, PhD; PI of the project)
20 July 2021; EEFRI, Addis Ababa, Ethiopia

SUMMARY OF PROJECT PROGRESS

- **Objective of the project:** the main objective of the project is to domesticate *Milicia excelsa, Antiaris toxicaria, Pouteria adolfi-friderci* and *Prunus africana* and integrate them into the wider ecological and social environment, and sustain the seed system by developing Seed Production Area (SPA) in western and south western parts of Ethiopia.

- **Major achievements:** The following are the major activities and outcomes accomplished so far:

  - **COMPONENT 1: The following activities are so far carried out.**
  - **Activity 1: Population study and identifying best phenotypes / population**
    - The population dynamics and genetic qualities of stem height and dbh of the populations of *Milicia excelsa, Pouteria adolfi-fridercii, Antiaris toxicaria* and *Prunus africana* were assessed and studied in 13 forest ecosystems in south and south-western Ethiopia. **The finding is published in International Peer Review Journal.**
    - *Milicia excelsa* was assessed in four forest ecosystem, and Bebeka-Duduka natural forest and Bebeka 1 coffee mixed forest are identified for SPA establishment project; *Pouteria adolfi-friderci* was assessed in eight forest ecosystems; Bebeka 2 natural forest and Bebeka-kebereta forest are identified for SPA establishment project; *Prunus africana* was assessed in three forest ecosystems, and Kaho-shemeta natural forest and Bonga-Teja-adela forest are identified for SPA establishment project; and *Antiaris toxicaria* was assessed in two forest ecosystems, and Bebeka-kebereta forest is identified for SPA establishment project.

  - **Activity 2: Phenological study (calendar) of the species**
    - The phenology of *M. excelsa, A. toxicaria and P. adolfi-friderci* is observed, studied and documented between 2010 and 2012 (three years) in Bench-Maji Wereda of Bench-Maji Zone, SNNPR. **The data is analyzed and prepared for publication.**

  - **Activity 3: Seed biology and behavioral study**
    - The *in-vitro* seed germination trial for *M. excelsa* is tested using four pre-sowing treatments and nine replications each, and experiment is now completed and **the reported is ready for publication**. Overall, however, the average seed germination was found to be less than 20% which is less than 45% of the expected germination rate of mature and healthy seed lots. So, our next assignment is to conduct *in-vitro* seed germination test for the other Domestication/SPA species; *Antiaris toxicaria, P. adolfi-friderci* and *Prunus africana.*

  - **Activity 4: Testing adaptability and growth performance of the targeted species under nursery and field conditions**

- The adaptability and growth performance of *M. excelsa* and *A. toxicaria* under nursery and field conditions is done. The same experiments are being carried out for the remaining project species, i.e. *Pouteria adolfi-fridercii and Prunus africana.*

- **COMPONENT 2: The following activities are so far carried out.**
  - **Activity 1: Domestication and Seed Production Area (SPA) establishment**
    - MOU is signed between EEFRI and Bebeka coffee estate and Masha Woreda environment, forest and climate change office
    - Demarcation of *in-situ* site for domestication and SPA for *Milicia excelsa, Antiaris toxicaria* and *Pouteria adolfi-fridercii* in Bench Woreda of Bench-Maji zone
    - Selection of mother trees and measuring height, dbh and GPS locations
    - 624 seedlings of *Milicia excelsa* are planted in Mizan-Aman station (on-station) domestication and seed source establishment
    - 1312 seedlings of *Milicia excelsa* are planted and established on-station-SPA in the 2020 rainy season
    - 320 seedlings of *Milicia excelsa* are planted in collaboration with ten farmers in Yayu Woreda of Ilu-ababora in the 2020 rainy season
    - Seedlings of *Milicia excelsa* (10,0000), *Antiaria toxicaria* (500) and *Prunus africana* (500) produced Aman and Boye (Jimma) nurseries are produced and are waiting for establishment for ex-situ SPA in the 2021 rainy season.

  - **Activity 2: Management of SPA:** This activity is not started yet, will continue from now onwards on SPA established in-situ and on-station.

Remaining activities:

- Conducting in-vitro seed germination test for *Antiaris toxicaria, P. adolfi-friderci* and *Prunus africana;*
- Establish ex-situ SPAs for *Prunus africana and Pouteria adolfi-fridercii* in the 2021 rainy season.
- Collect growth and survival data for *Milicia excelsa* established under farmers' fields and on-station.
- Apply management practices on the already established seed sources.
- Manage the designated in-situ SPA sites,
- Production and processing of seeds of the target species for further rResearch and popularization purposes.

Financial performance

Approved and Transferred budget (ETB)	
Phase 1	440,000.00

Phase 2	149,000.00
Total	**593,000.00**
Utilized budget (ETB)	
The budget (**593,000.00) is** fully utilized. The details of budget utilization is reported to NFSDP through the finance directorate of EEFRI.	

- All the approved and transferred budget (ETB) to EEFRI for implementing the project is fully utilized. Besides budget utilized for field works, field instruments namely binocular, clinometer, GPS, caliper, and machetes are purchased and are in use.
- Additional budget is required to accomplish the aforementioned remaining tasks. Up on settling the already transferred budget with the NFSDP-EFCCC, detail request is hoped to be submitted.
- **Challenges**: The following are notable challenges faced during the implementation of this project.
  - ☞ Covid-19 pandemics,
  - ☞ Insecurity and instability in the country,

The Federal Democratic Republic of

Ethiopia Environment, Forest and

Climate Change Commission

Progressive report formats on research undertakings

Project Title: Conservation through utilization: product chain development of underutilized Non-timber forest products for rural development and sustainable dry-forest management

Principal Investigator: Dr Asmamaw Alemu

1. **Introduction (Brief)**

The extensive dry Combretum-Terminalia vegetation formation in the north-west lowlands of Ethiopia is known for its diversity and source of commercial NTFPs. However, despite the resource abundance and potential domestic and international markets for

high value NTFPs, many of the NTFP resources are underutilized (Personal observation). This could probably be attributed to the lack of scientific knowledge promoting the production, management and sus- tainable commercialization of the NTFPs. It is widely recognized that embedding the use of underutilized NTFPs into the traditional farming systems holds significant social, environmen- tal and economic potential for (i) improving food security and achieving more balanced nutri- tion for the rural and urban poo (ii) conserving biodiversity and stabilizing agro-ecosystems owing to the economic incentive to manage and domesticate the resources and (iii) generating income for the rural poor and creating employment along the value chain (Will 2008). Such initiatives are well aligned to the Ethiopian Government policies such as the Climate Resilient Green Economy (CRGE), the growth and Transformation (GTP II) plan, Environmental poli- cies and international conventions. However, a fundamental question relies on how to promote the underutilized NTFPs in a way they contribute to local economic development while sim- ultaneously contributing to the sustainability and development of the resource base. This de- mands an indepth understanding of the resource potential, production systems, the value chain dynamics and knowledge for the development and management of the resource base for guid- ing policy and development interventions (Gumaa 2011; Alemu 2016). Such interventions

based on scientific knowledge could enhance rural development contributions of underutilized NTFPs while ensuring conservation of the resources through sustainable use and commercialization. With the aforementioned premises, this research project aims at identification and promotion of underutilized high potential NTFPs value chains for enhanced rural livelihood while contributing to the conservation and sustainable management of the dryforests and hence their environmental benefits.

2. Objectives (Brief)

General objective:

The general objective of this research project aimed at contributing to the Development sustainable production and commercialization systems underutilized non-timber forest products through characterization, domestication and participatory market development. This is expected to contribute to rural livelihood improvement and conservation of local genetic resources.

The Specific objectives include:

a) Promote sustainable use of underutilized NTFPs and develop successful domestication and management technologies for targeted species

   □Participatory identification of underutilized NTFPs with high realistic and realizable prospective market potential

   □Develop conservation approach and sustainable management techniques for targeted species

   □Determination of phenology and optimal germination conditions for targeted species

b) Characterization of nutritional and medicinal properties of primary and secondary products

   □Document ethnobotanical knowledge and traditional processing and use of selected products in the major production areas

   □Analyse the chemical compositions of targeted products for nutrition and medicinal values

   □Develop technologies for improving local value addition and processing techniques

c) Value chain development of selected products for enhanced livelihoods and sustainable environmental benefits

   □Determine the production and rural urban marketing and consumption patterns

   □Analyze marketing of targeted products (structure, conduct and performance)

   □Analyse the socioeconomic significance of the selected NTFPs

3. Methods (Brief)

The research project is being conducted in two districts in the north-west lowlands of the Amhara region namely Metema and Quara districts. The districts are selected purposively owing to the dryforest po- tential, availability of abundant NTFPs, existence of commercial NTFPs traded illegally to Sudan but not utilized inland. The vegetation formation in these districts is classified as Combretum-Terminalia woodland (Eshete 2011; Friis 2011). The districts are situated in the dryland agroecology where the woodland vegetation resources play significant ecological benefits including the microclimate amelio- ration, carbon sequestration and desertification control. The target products and species are selected based on an assessment of their existing or realistic and realizable prospective market potential. The selection of the potential NTFPs will be implemented in a participatory process. This will combine the consideration of the existing resource potential and supply conditions as well as assessment of the mar- ket opportunities including the potentials of creating demand through information and education. Fol- lowing Will (2008), this project will use asset of criteria for the selection and prioritization of underuti- lized NTFPs with realistic potential for poverty alleviation and biodiversity conservation: i) potential for poverty reduction and social benefit, ii) characteristics and conservation potentials, iii) growth po- tential and competitiveness in local and international markets ,iv) prospects of success (cultural, indig- enous knowledge, product diversification, income potential), and v) potential relevance for economic indicators (return on investment, employment and value added). The candidate underutilized NTFPs considered and evaluated in the participatory approach are proposed based on prior observations of the researchers. These includes *Adansonia degitata* (Baobab), *Ziziphus spina-christi*, *Balanitus aegyptica*, *Tamarandus indica*, *oxythenanthra abyssinica*. Based on the set of criteria three products will be se- lected with the participation of the community and stakeholders for detailed characterization, domesti- cation and promotion.

4. Activities conducted so far and Results (Brief)

WP1: Identification and diagnosis of the current status and use of underutilized NTFPs

⌋ Participatory selection of underutilized NTFPs has been conducted in Metema, Merab Armacho and Quara districts. In each of the study areas three focus group discussions, 15 key informant interviews and 20 household surveys has been conducted. The participatory selec- tion process take in to account additional considerations such as Potential for poverty reduction and social benefit, characteristics and conservation potentials, growth potential and competi- tiveness in local and international markets, prospects of success (cultural, indigenous

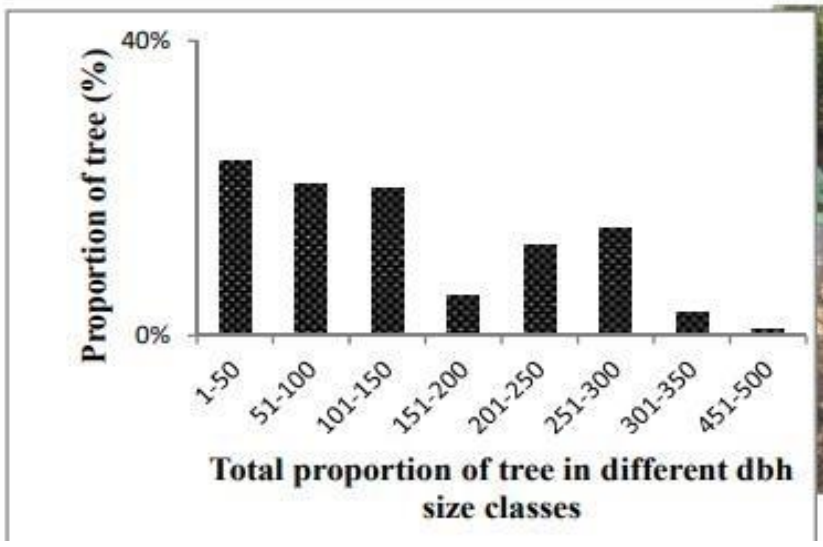
knowledge, product diversification, income potential). The data from qualitative interviews, group discussions and preference ranking exercises are being processed. Data has been encoded, processed and manuscript is under preparation for submission. Based on the participatory selection, *Adansonia degitata*, *Ziziphus spinachristi*, *oxithenanthra abyssinica*, and *Tamarandus indica* are considered for domestication.

- **Assessment of resource potential, status and distribution of *Adansonia degitata*, *Tama- randus Indica* and *Diospyros mespiliformis*** - Vegetation assessment data collected by three Msc students in Merab Armacho district specifically in Godebe national park, Metema and Quara districts. The distribution and regeneration status of three high value tree species and associated species were surveyed and recorded. Selected results are presented below: **Distribution and abundance of *A deegitata* across different land uses**

Land use	Density of *A degitata* (individuals/ha)
Agricultural	0.8 ± 3.34
Park	1.366 ± 2.2
Riverine land	2.2 ± 5.71

- ✓ **A. Degitata is solitary by its nature and scarcely distributed in the study area. The density of**

Adansoina digitata was statically significant between land use type (p=0.000). The highest baobab plant densities were found in riverine land use which is believed to have environmental benefits associated with the water balance in the area.



Distribution and abundance of *Tamarinds indicia* and *Diospyros mespiliformis* associated domi- nant tree species in Metema district riverine vegetation

Scientific name	local name	Average number of tree/ha	RD	RF	RDO	IVI
Diospyros mespiliformis	Serkin	129.09	34.63	16.55	31.05	82.23
Anogeissus leiocarpa	Kirkra	72.27	19.39	16.55	16.85	52.79
Ficus sycomorus	Bamba	30.45	8.17	8.99	24.75	41.91
Tamarinds indicia	Kumer	42.27	11.34	14.39	15.31	41.04
Croton macrostachyus Hochst	Bisana	2.27	0.61	0.36	22.55	23.52
Ficus vasta Forssk	Warka	3.64	0.98	2.88	13.33	17.18
Acacia polyacantha	Giramda	18.18	4.88	8.27	1.19	14.34
Stereospermum kunthianum	Zana	13.18	3.54	5.76	2.19	11.48
Ziziphus spina-christi	Gaba	14.55	3.9	3.6	0.47	7.97
Ficus thonningii Blume.	Chibha	4.09	1.1	1.44	3.51	6.05
Balanites aegyptiaca	Lalo	6.36	1.71	3.24	0.77	5.71
Peterocarpus lucens	Charia	3.18	0.85	2.52	0.66	4.03
Dalbergia melanoxylon	Zobie	4.09	1.1	1.44	0.19	2.73
Ximenia Americana	Enkuay	5.45	1.46	1.08	0.17	2.71
Ficus sur Forssk.	Shola	2.27	0.61	1.44	0.5	2.55
Combretum adenogonium	Ferwuha	3.64	0.98	1.44	0.11	2.52
Allophylus rubifolius	Nechlo	2.73	0.73	1.44	0.01	2.18
Flueggea virosa Guill. &Perr	Shasha	2.27	0.61	1.44	0.06	2.11
Combretum mole	Abalo	2.27	0.61	1.44	0.03	2.08
Piliostigmathonningii	YkolaWanza	2.27	0.61	1.08	0.22	1.91
Acacia seyal	key girar	1.36	0.37	0.72	0.33	1.42
Combretum collinum Fresen	Askir	0.91	0.24	0.72	0.13	1.09

Documentation of current production system and implication for the resource sustainability, estimation of production potentials-

Direct observation in production areas, three focus group discussions, household survey and 12 key informant interviews were conducted in the study districts to document the current production system of the selected high value NTFP species.

Production potentials of Baobab: data has been collected by two MSc students in Quara and Merab Armacho to estimate the baobab fruit production and productivity of trees from 90 sampled trees in each of the sites.

Findings:

- Harvesting from the wild resources with open access arrangement – for subsistence and few producers for sale
- No organized production and marketing of the products in west Gondar
- Informal market dominantly producers sell the products to traders transporting to Sudan through illegal boarder trade (5-7 Birr/kg, 35-40 Birr/kg)
- Local uses include food, fodder and medicinal uses
- 54% HH engaged in collection and trade ~ 5,899 Birr annual income

Fruit counting in Quara District _ fruit yield estimation from the sampled trees

Variation in Adansonia fruit productivity and morphology in Merab Armacho district

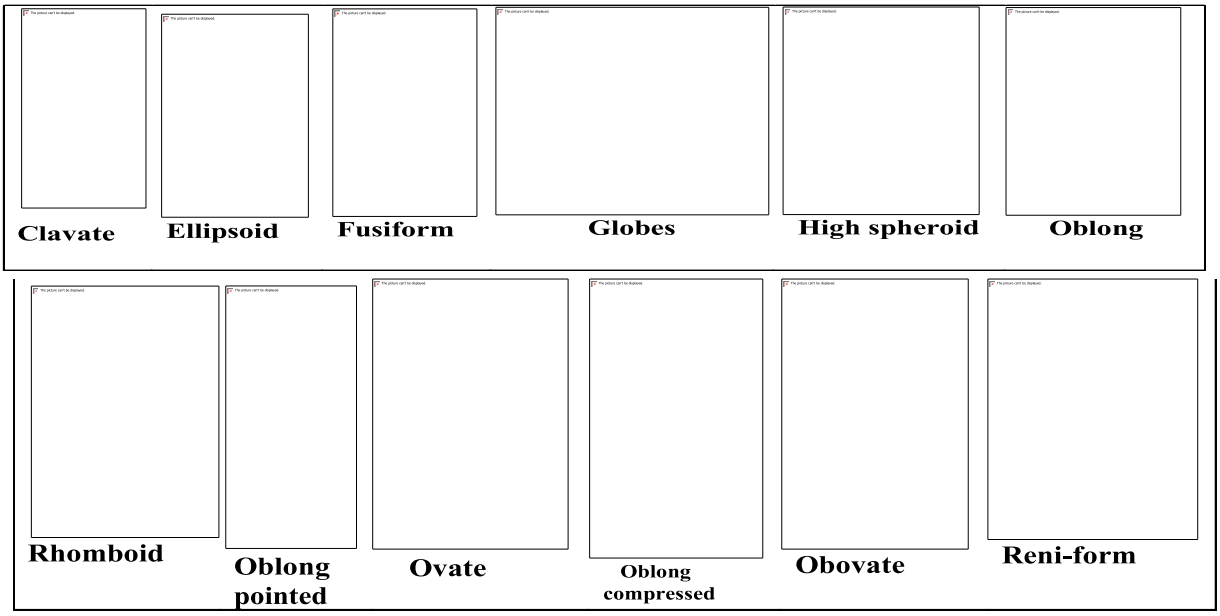
		N	Mean ±SD	Mini-mum	Maxi-mum
Number of fruit per tree	Forested land	25	417.76±335.34a	25	1375
	Homestead land	23	354.83±344.6a	20	1650
	Agriculture land	25	359.08±336.2a	58	1275
	Total	73	377.84±335.102	20	1650
Fruit weight per tree (kg)	Forested land	25	74.11±21.83a	2.00	555.50
	Homestead land	23	74.41±19.30a	4.98	405.90
	Agriculture land	25	49.39±7.80a	6.38	136.48
	Total	73	65.7398±85.07	2	555.5

Variation in Adansonia fruit productivity and morphology in Quara district

Fruit production	***Land use type***	***Mean***	***min***	***Max***	***P value***
	Agricultural land	***464.9±396.3a***	***105***	***1500***	

Number of Fruit per tree	***Park land***	***234.9±238.7b***	***30***	***750***	***0.037***
	Riverine land	***211.9±182.5b***	***50***	***607***	
fruit weigh t (kg)per tree	***Agricultural land***	***64.95±41.77a***	***19.13***	***157.98***	***0.030***
	Park land	***34.77±35.53b***	***4.76***	***111.53***	
	Riverine land	***33.87±25.95b***	***9.36***	***86.44***	
Size class	***Adults***	***319.05 ± 308.45a***	***30***	***1500***	
	Sub- adults	***91.67 ± 52.042a***	***50***	***150***	***0.214***

- **Characterization of fruit and seed morphology of Adansonia degitata, Tamarandus and Diosperus*;*** Fruit samples has been collected from Quara, metema and Merab Armacho both by the re- search team and the Msc students. Fruit and seed morphology parameters of the samples from Metema has been collected by extracting the seeds and weighting the seed, pulp and coat weights, measuring the diameter and length of the seeds and pods and categorizing the shapes of the fruit capsuls. For Quara and Merab armacho, fruit samples has been collected by the students and will be transported to the CAES laborators for further investigation and relevant data collections.
- Fruit morphology characterization and analysis for Adansonia, Tamarandus and Dyosperus completed. *For Adansonia degitata* 12 distinct fruit shapes were observed this could be an indication for genetic variation of the tree species. However, three fruit shapes were dominant that about 55.6% the sampled trees depict the three dominant fruit shape. Fruit morphology characterization and analysis for Adansonia, Tamarandus and Dyosperus completed. *For Adansonia degitata* 12 distinct fruit shapes were observed this could be an indication for genetic variation of the tree species. However, three fruit shapes were dominant that about 55.6% the sampled trees depict the three dominant fruit shape.



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Fruit collection from the sampled trees in Quara district (Altash park area) for productivity estimation and further characterization (Photo by Yeshitela Damtie, MSC student)



Fruit morphometric variation of Adansonia degitata from Quara district

Fruit trait	Mean	Min	Max	P value
Fruit length(cm)	14.69 ±2.870cm	8	26	0.000
Fruit width(cm)	8.052 ±1.34cm	4	17	0.239
Fruit weight(g)	158.47 ±58.09g	41	458	0.000

Pulp weight(g)	**25.71 ±13.659g**	**4**	**117**	**0.000**
Seed weight(g)	**62.92 ±23.218g**	**12**	**148**	**0.000**
Number of seeds	**111.76 ±48.427**	**10**	**274**	**0.000**

Manuscript is to be completed soon on the characterization of fruit morphology of the three un-derutilized NTFP species.

WP2: Production and marketing chain analysis, including socioeconomics and SWOT analysis

The activities under this working package been accomplished, the value chain map and marketing channels as well as the profitability analysis conducted. Manuscript is being developed.

WP3: Characterization of nutritional and medicinal properties of primary and secondary products

Physicochemical analysis of targeted products for nutrition and medicine is characterized partly by a master's thesis. Further chemical analysis for the three products is going to be conducted at

Proximate composition of baobab fruit pulp

Parameters	**Districts**			**P-value**	**CV (%)**
	Metema	**Quara**	**West Armachiho**		
Moisture (%)	**8.50 ± 0.50^{a}**	**9.33 ± 0.29^{b}**	**8.50 ± 0.00^{a}**	**0.034**	**3.80**
Ash (%)	**4.83 ± 2.89^{a}**	**5.17 ± 2.89^{a}**	**5.83 ± 2.89^{b}**	**0.014**	**5.46**
Crude fat (%)	**0.24 ± 0.04^{a}**	**0.76 ± 0.04^{b}**	**0.55 ± 0.61^{c}**	**0.000**	**8.67**
Crude fiber (%)	**5.00 ± 0.50^{a}**	**7.00 ± 0.50^{b}**	**5.50 ± 0.50^{a}**	**0.007**	**8.57**
Crude protein (%)	**4.67 ± 0.20^{a}**	**2.45 ± 0.35^{b}**	**3.38 ± 0.20^{c}**	**0.000**	**7.45**
Carbohydrates (%)	**76.76 ± 0.56^{a}**	**75.29 ± 0.47^{b}**	**76.24 ± 0.32^{a}**	**0.021**	**0.60**

Energy (Kcal/100g)	**327.87 ± 3.13[a]**	**317.80 ± 1.80[b]**	**323.40 ± 2.60[a]**	**0.009**	**0.79**

Further, samples are prepared for physicochemical analysis of the fruits of the three species to be analysed in the Ethiopian Public Health and Nutrition Institute (EPHI).

WP4: Development of domestication technologies and sustainable management techniques

⌋ Documentation of phenological records of selected species:

Phenology data on Adansonia degitatahas been collected by the Msc student in Quara district. Data has been collected starting from July. Sample trees of Tamarandus indica and Ziziphus spinachristi has been tagged for phenology data collection in Metema district.

Reproductive and vegetative phenology of A. Degitata in Quart district

Phenology	Apr.	May	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Leave shedding												
Leaf setting												
Flowering												
Fruit budding												
Fruit maturity												
Fruit harvesting												

Determination of best propagation techniques for Adansonia degitata Tamarandus indica and Dyosperous : fruit samples collected in Metema district , seeds extracted in CAES seed laboratory and greenhouse, laboratory and field experiments conducted in university of Gondar and Metema field site.

Determination of best Presawing treatment for **Adansonia degitata Tamarandus indica and Dyosperous (laboratory and greenhouse experiments)**

Nursery trial – seedling production of the selected priority species

Oxythenanthra abys-sinica

Evaluation of Early establishment and field performance of Adansonia, Tamarandus, Oxythenenthra, Ziziphus and Dyosperus species

Seedlings of the target species were raised in Metema and planted in field trial site. Survival data for the first year as well as the height and RCD growth of the respective species were recorded. Besides field demonstration was conducted with local community, local experts and district and zone experts followed by second round planting as illustrated below.

5. Remaining activities

- **Filed demonistration for local community on performance of the planted species**
- **Final field early establishment and performance data collection**
- **Chemical analysis of fruit samples of four wield edible fruit tree species**
- **Completion of manuscript development and submission**

6. Completed MSc thesis works

i. Population status, morpholog, yield and use of A*dansonia digitata* l. In west armachiho districet northe west ethiopia
ii. Phenology, morphology and fruit production variabilities of *adansonia digitat*a l. (african baobab) in quara district north west ethiopia
iii. Evaluation of nutritional and biochemical composition of baobab (adansonia digitata l.) Fruit pulp from three districts of west gondar zone north west ethiopia

iv. Pre-sawing treatment and seedling performance of high value wield edible tree species in the northwest lowlands of Ethiopia

7. Problems encountered

Problem encountered	Actions taken
Transport service problem	Requesting and using different collaborator organization cars such as SUNARMA arranging rented cars
Security problems in the study areas	Working in times when there are relative stabilities Working closely with stakeholders already in the study area
Work load	Recruiting MSc students
Delay in disbursement of project funding	Using other sources with the arrangement to reimburse from the project

The Federal Democratic Republic of Ethiopia

Environment, Forest and Climate Change Commission

Progressive report formats on research undertakings

Project Title: Improving management and performances of smallholder's forest plantation systems in the highlands of Amhara Region, Northern Ethiopia

Principal Investigator: Dr Asmamaw Alemu

1. Introduction(Brief)

Forest plantation is a wide spreading economic activity in the highlands of the Amhara region mainly attributed to the degradation and limited access to the natural forests, introduction and popularization of fast growing tree species, as well as the awareness of smallholder farmers on the financial returns from plantations. Forest plantations in the region exist in different forms such as i) private, ii) community, and iii) state (Tadesse et al. 2015). Recent emerging approaches also involve plantation development on communal lands under Joint Forest Development (JFD) scheme (Raphael and Alemu 2016). Hence, smallholder farmers are the main actors in the plantation development and commer- cialization systems in the region and the country at large. Consequently, private small-scale planta- tions constitute by far the largest proportion of the plantation resources accounting more than two third of the overall plantation area of the region (Tadesse et al. 2015). These plantations are typically monocrops of exotic tree species and managed with short rotation of 5-7 years. They are chiefly char- acterized by poor establishment and management practices, with low productivity and negative eco- logical effects (Yitaferu et al. 2013; Lemeneh and Kassa, 2014; Tadesse et al. 2015). The current trend of small-scale plantation expansions in the country also indicates the popular acceptance of forest plantations as an attractive business for smallholder farmers in the region. Despite the growing ex- pansion of smallholder forest plantations over the past decades in Amhara region, the socioeconomic and environmental outcomes of plantations are compromised by inter related technical and institu- tional constraints. The improvement of technical and economic efficiencies and hence environmental

outcomes, call for an integrated and interdisciplinary actions. This research project deals with a serious of issues in the value chain of smallholder plantations development and commercialization.

2. Objectives (Brief)

The general objective of this research project is to contribute to the promotion of smallholder plantations through improvement of their production and commercialization system in the high lands of Amhara Region towards achieving enhanced development and conservation out- comes. The specific objectives include:

I. Diagnosis and understanding of smallholder plantation production and management systems

II. Analyze and understand the plantation based wood products commercialization system

III. Evaluate the socioeconomic and environmental outcomes of small-scale plantation systems

IV. Identify constraints and opportunities in the production and marketing systems

V. Documentation of existing best practices for promotion of smallscale plantations

VI. Evaluate the management and performance of smallholders' plantations VII. Design and implement innovative pilot measures (management practices) for improvement of the production and marketing systems

VIII. Development and delivery of technologies, methodological approaches and experimental plots for further research and extension endeavors

3. Methods (Brief)

The research project is being conducted in purposively selected districts of three administrative zones of the Amhara region namely North Gondar (Wogera district), West Gojam(Mecha District) and Awn zone (Fageta Lokoma District). The respective Administrative zones and districts were selected purposively with a set of criteria such as the prevalence and expansion of smallholder tree plantations, access to market and socioeconomic conditions. Moreover, the strategic location of the districts for the promotion and scaling-out of the research findings to other potential plantation production areas in the zones. Districts situated in a highland and midland agroecology and mainly characterized by the expansion of small-scale forest plantations particularly of exotic tree species such as Eucalyptus globlus , E. camaldulensis and Acacia decurense were considered in this study. The research project apply a participative action research approach following the Participatory Innovation Platform (PIP) (Alemu and Eckhard, 2016). It involves various activities for the collection of data, synthesis and presentation of the research findings with active engage- ment of the key stakeholders such as smallholder farmers, district agricultural and natural re- source management offices and research institutes so as to improve institutional capacities

through capacity building trainings and demonstration of the research results. It starts with diagnosis phase describing the framework conditions and characterization of the production and marketing systems. The second phase deals with the detail system analysis for understanding of the multilevel decisions in the production and commercialization system as well as evaluation of the performance of the system. Phase three and four deals with the design and pilot implementation of innovative upgrading measures that will be identified in a participative manner. Finally, the remaining phases will evaluate the short impacts and dedicated for communication of the research findings and lessons learned throughout the research project.

Summary of methods and tools to be used per working package

Components/ Working package/theme	Variables and indicators	Data sources and collection methods/ tools	Analytical techniques
WP1: Diagnosis of small-scale plantation development and commercialization systems			
1.1 Management and performance of smallholder plantations	Establishment & management practices (planting & post-planting tending operations), harvesting practices, rationales & decision factors for management practices (eg. rotation age), quality standards, demand and seasonality, growth & yield parameters	Producers' survey (Random sampling, 5-10% intensity), direct observation, inventory of plantations/woodlots	Qualitative analysis, binary logit for identification of decision factors, Stand structure, volume table and form factors derivation (Forest growth and yield analysis) (Weiskittel et al. 2011; Herbohn et al. 2013)
1.2 Smallholder plantation products commercialization	Typology of actors, drivers for participation, functions, interaction; input-output structure, marketing arrangements, channel choice, profitability, value added & distributional equity	Actors' interviews (Snowball and purposive sampling), group discussion, key informant interviews, market survey, review secondary data, direct observations	Value chain analysis (mapping actors and flows, financial and economic analysis) (Kaplinsky and Morris, 2001; Marshall et al. 2006; Alemu, 2016) Econometric model (Binary logit)
1.3 Profitability of smallholder woodlot production systems	Cash flows (Costs & revenues), income from woodlots & alternative land uses, additional benefits, determinants of income & profitability, determinants of woodlot expansion	Household survey, key informant interviews, group discussions, in-depth cases	Financial analysis (cash flows, NPV, sensitivity analysis) (Duguma, 2013; Econometric models (multiple regression)

Components/ Working package/theme	Variables and indicators	Data sources and collection methods/ tools	Analytical techniques
1.4 Role of small-scale plantations in livelihood strategies of smallholder producers	Livelihood strategies, income portfolio, income seasonality, labor distribution, gender dimensions, poverty alleviation roles	Household survey (Random sampling, 5-10% intensity), key informant interviews, group discussions	Livelihood analysis (Cavendish,2000; Angelsen et al. 2014)- Descriptive statistics, correlation analysis, econometric model (multiple regression).
1.6 Environmental and social effects of exotic monocrop plantations	Perception of producers, soil physical and chemical properties, competition effects, conflicts	Factorial experiment (parameters measures from different plantations and farm fields)	Soil analysis, descriptive statistics, t test
WP 2: Identification of pilot intervention measures	Strength, weakness, opportunities and threats of current production systems, problem analysis, proposed solutions	Participatory diagnostic workshop (stakeholders workshop), focus group discussion	SWOT analysis, problem and solution appraisal
WP 3: Identification and testing of improved silvicultural management techniques	Species (3), spacing (3), establishment techniques (2), thinning regimes (3), coppice thinning (5regimes), growth, yield, quality, profitability	Factorial experiments (on station and on-farm)	ANOVA, t-test and multiple regression analysis
WP 4: Participatory evaluation of effect of silvicultural managements	Growth and yield parameters, round wood quality, environmental parameters	Field day demonstration, group discussions	Farmer's field evaluation
WP 5: Communication of the research findings		Stakeholders' workshop, trainings, publications in conference proceedings and peer reviewed journals, posters, working papers, management guidelines and teaching materials Scaling up of promising interventions (trainings, extension manuals)	

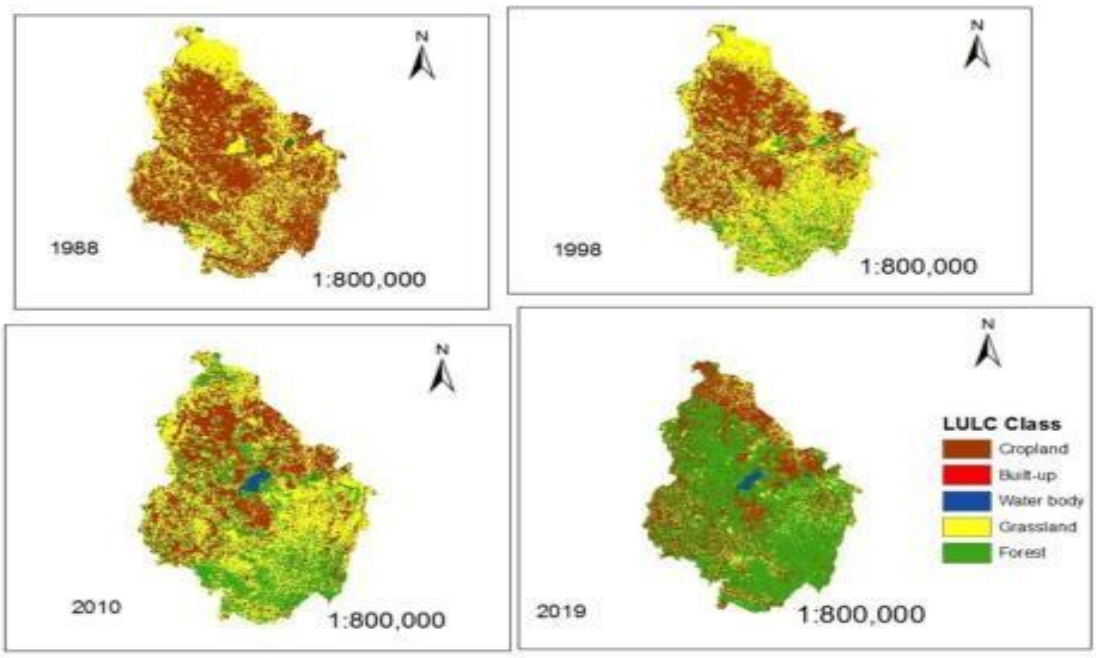
4. Activities performed sofar and results (brief)

WP1: Diagnosis of small-scale plantation development and commercialization systems

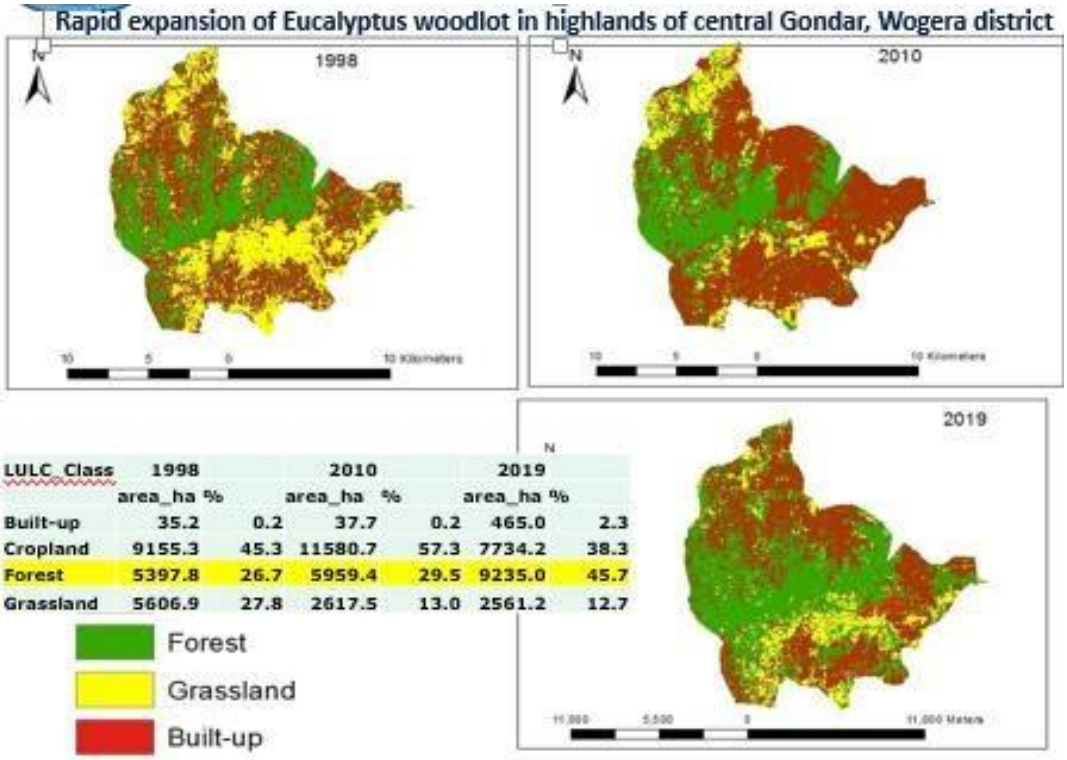
There has been a rapid expansion of smallholder plantations in the selected study districts . LULC analysis has been conducted to detect the expansion of smallholder plantations over the last three to four decades and to link with the driving forces that determine the expansion of the tree based land use. Mecha District : The LULC analysis revealed that there has been a huge transfor- mation of land use over the last three decades (1988- 2019). The significant transformations from crop land to plantation forests followed by grasslands to forest plantations. As indicated in the starlight image analysis, there has been a massive expansion of Eucalyptus plantation from 2010- 2019.

Table 1. Land use transformation in Mecha district (1988-2019)

		2019					
		Built-up	Cropland	Forest	Grass-land	Water body	Grand Total
1988	Built-up	2	0	0	0	0	2
	Cropland	721	30358	56312	6001	169	93561
	Forest	36	187	5230	124	234	5810
	Grassland	443	16749	35989	7741	871	61794
	Water Body	0	0	2	0	19	21
	Grand Total	1202	47294	97533	13866	1293	161188



LULC analysis in Mecha District



LULC_Class	1998		2010		2019	
	area_ha	%	area_ha	%	area_ha	%
Built-up	35.2	0.2	37.7	0.2	465.0	2.3
Cropland	9155.3	45.3	11580.7	57.3	7734.2	38.3
Forest	5397.8	26.7	5959.4	29.5	9235.0	45.7
Grassland	5606.9	27.8	2617.5	13.0	2561.2	12.7

Similar lULC analysis was conducted for Wogera and Fageta Lokoma districts to investigate the expansion of smallholder woodlot production systems as illustrated with the following images. In Wogera district there has been expansion of E. Globules over the last three decades . However, the expansion was limited to certain PAs in the Eastern parts of the district such as Kossoye and Yiesk Debir and Ambagiorgis zurya. In these PAs there has been extensive conversion of crop lands and grazing lands to Eucalyptus woodlots in the form of smallholder woodlots and communal plantations. Again, the largest expansion was took over the last two decades (2010-2019).

Drivers of smallholder woodlot expansion

Variables	Robust Coef.	Std. Err.	T	P>t
Land holding (ha)	0.1279169	0.022008	5.81	0.000***
Livestock (TLU)	0.0045595	0.0095247	0.48	0.633
Experience (Years)	-0.0007679	0.0025117	-0.31	0.760
Distance of Land from main road	-0.0199061	0.0045495	-4.38	0.000***
HH size	-0.0400019	0.0135023	-2.96	0.004***
No. of educating HH mem- ber	0.0324021	0.0151125	2.14	0.034**
Pressure of neighbor	0.1651874	0.0291497	6.39	0.000***
Wealth status rich	0.0451784	0.0545343	0.83	0.409
Wealth status medium	-0.037783	0.0320432	-1.18	0.240
Credit access	0.0332124	0.0343844	0.97	0.336
Participation in training	0.1259246	0.0641293	1.96	0.052*
CONS.	0.42879	0.0820645	5.23	0.000***
Number of obs. = 150 F (11, 138) = 60.36 Prob > F = 0.0000 R-squared = 0.7996				

The smallholder Woodlot producers' survey conducted in both districts also highlighted the pull and push factors that drive smallholder farmers engagement and expansion of woodlot plantations as well as conversion of crop lands to woodlots. The most important factors include financial profitability and attractiveness of woodlots, high demand on woodlot products, low labour input, low recurring management and inputs, neighbors pressure of plantation expansion that affect land productivity, land fertility decline.

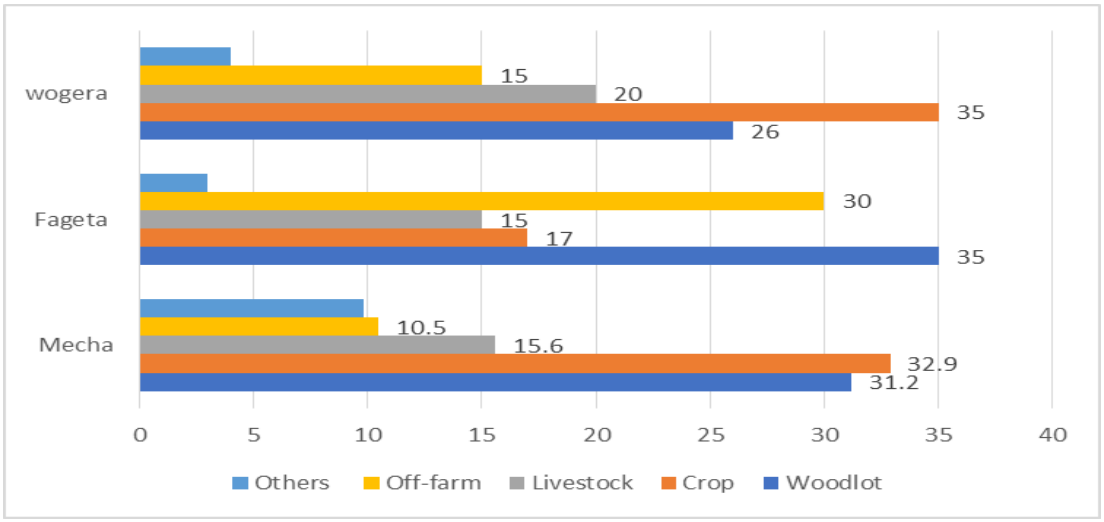
As that of the expansion of the land use system, smallholder woodlot production is becoming the main livelihood activity in the area. Forinstance, 98.65% the interviewed households in fageta district engaged Acacia decurense woodlot production as Damian income source. In the three study areas, woodlot production also constitute constitutes to 32- 100% of the household annual incomes.

In both study areas, management of the smallholder woodlots is poor and not following the rec ommended practices. Farmers plant seedlings in a overhand density that affects the subse- quent growth performance of the trees. No silvicultural practices are conducted except coppice reduc tion in E. Globules and E. camaldulensis. The common practice is clearcutting followed by coppice management in the Eucalyptus woodlot areas.

Smallholder plantation production and management system

- Rapid expansion of *Eucalyptus globlus, E. Camaldulensis and A decurense* woodlots in Amhara region
- Significant transformations from crop land to woodlot followed by grasslands to woodlots´- massive expansion over the last two decades
- Drivers of smallholder woodlot expansion- both pull and push factors including income potential, labour leasure and offfarm income, low input, land degradation, low crop productivity, neghbour influence
- Woodlot production is becoming major land use & livelihood activity: Quarter to half of total HH land allocated, second source of income (25-35%), off-farm opportunities

✓ additional jobs for landless youth ,opportunity for livelihood diversification, base for other livelihood strategies, job for all age groups



✓

Contribution of smallholder woodlot production for household livelihood (income)

WP2. Smallholder plantation products commercialization

- Charcoal and Different assortment of logs and twiges for charcoal making
- Lucertive business engaging several actors : Village traders, charcoal makers transporters , wholesalers , retailers, exporters
- No collective action (horizontal cooperation across the VC)
- Selling stratagy: stand level, harvestd and assorted/processed (Limit gained value)
- Value appropriation –profit , job creation, government revenue (less external inputs & transport)
- ~ 5.32 M Suck of charcoal from fageta in 2019, 771M Birr, spillover benefits

Woodlot inventory

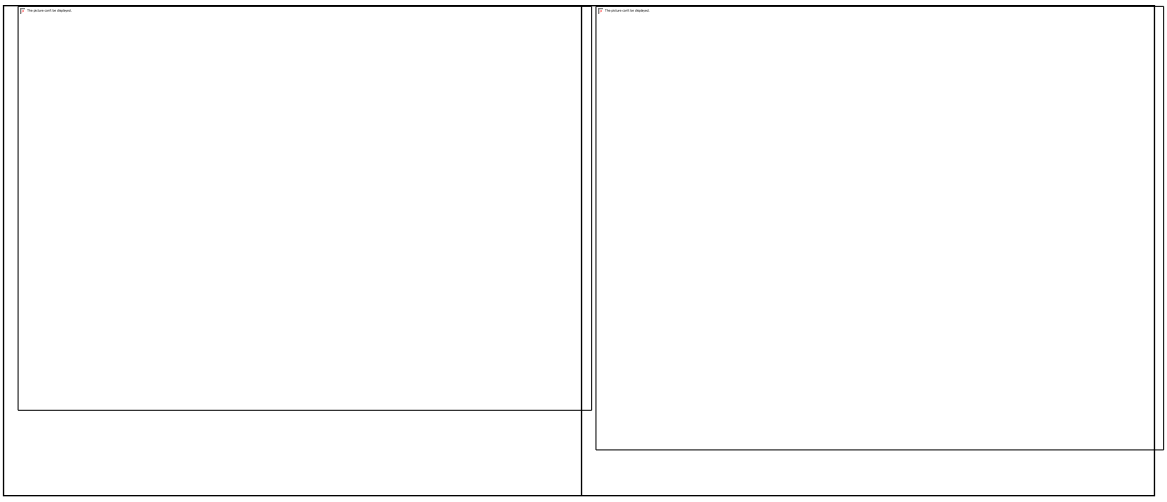
For the evaluation of growth performance and volume under the farmers practice, woodlot inventory is conducted in the three districts. In total, 12 A decurense stands representing three age classes, 27 E camaldulensis and 27 E. globlus stands (three age classes on standard, first coppice and second coppice stands) wenventoried. Besides data is collected on coppice stands so as to evaluate the coppice performance of E. globlus (18 coppice stands) and E. camaldulensis (18 cop- pice stands) .Database of the inventory data is being created and the next step will be analysis and growth modelling.

WP 3: Identification and testing of improved silvicutural management techniques

Three experiment set up /established -These sites will be used as demonstration sites for the community as well as our students. 1. The effect of seedling type, spacing and site preparation on survival, growth and productivity of A decurense in Fageta Lokoma District Factorial experiment is established in Fageta Lokoma District on 0.5 ha of land in collaboration with PA office of Agriculture to determine the effect of site preparation, seedling type and initial spacing on the early establishment and performance and subsequent growth and biomass production. In this experiment three factors are being considered: seedling type with two levels, site preparation with two levels and spacing with three levels. Survival data, root collar diameter and height data were taken

and being processed for analysis. This experiment is being conducted together with the local community to facilitate learning.

Determination of optimum spacing and seedling types for enhanced productivity of Eucalyptus globules in Wogera district (follow up from Previous Research) This factorial experiment was set up to determine optimum spacing and seedling type for enhanced volume production of E. globlus in wogera district. The experiment was established on 0.6 ha of land. Survival, diameter and height data were taken and demonistration to the local community was conducted. 3. The effect of site preparation and spacing on survival and growth of E. camaldulencis, C. Lustanica, Cordia Africana and G. Robusta In Teda Factorial experiment is established in Teda campus (Expansion area) on 1 ha of land to evaluate the growth performance of Cupresus lustanica, E. camaldulensis, Cordia Africana and Gravilia robusta This experimental site is also intended to be used as a learning site for our students. Species, spacing and site preparation are the three factors in this experiment. Survival , RCD and height growth data was collected.



5. Completed Masters thesis works

i. Eucalyptus woodlot expansion and its contribution to food security and livelihood of smallholder farmers in north mecha district, west gojam
ii. The effect of *acacia decurrens* woodlot expansion on household economy in fagita lekoma, awi zone
iii. Structure and governance of smallholder *acacia decurrens* woodlot products value chain from fageta lakoma, awi zone
iv. Management and productivity of *eucalyptus globlus*, *e. Camaldulensis* and *a de-curense* under farmers practice
v. Assesment of tree seedling production systems and seedling quality in five zones of amhara region

6. Remaining activities

- Management of field trial sites
- Field demonistration for local communities
- Field data collection and completion of manuscript preparation

8, Problems encountered

Problem encountered	Actions taken
Transport service problem	Requesting and using different collaborator organization cars
Security problems in the study areas	Working in times when there are relative stabilities Working closely with stakeholders already in the study area
Work load	Recruiting MSc students
Delay in disbursement of project funding	Using other sources with the arrangement to reimburse from the project

Project Title: Developing allometric equation for estimating aboveground biomass of selected tree species from Acacia-Commiphora forests of Ethiopia

1. Rationale of the project

Dry forests are Africa's largest vegetation formation. Ethiopia owns one of the largest dry forests in the continent, rich in biodiversity of high value tree species such as commercial gums and resins bearing species. Dry forests are an integral part of the ecological and social-cultural framework of smallholder farmers and pastoral social groups. Recent professional discourses show that, strategic integration of dry forests in Ethiopia and in the sub-Saharan Africa at large would profoundly contribute to poverty alleviation, climate change adaptation and mitigation, biodiversity conservation and combating desertification. Despite its diverse social and ecological contributions, various factors undermine mainstreaming dry forests in the dry zone development plan in Ethiopia and many other African countries. Among others, there are little empirical evidences demonstrating the actual and potential contribution of dry forests to climate change adaptation and mitigation. In spite of some efforts, there is lack of suitable model to effectively estimate the carbon stock of dry forests and its dynamics across land use and forest type gradients and in response to changing climate. There is lack of in-depth understanding on the effect of current and future climate change on the biological and ecological perpetuation of dry forests, mainly these that have high economic and ecological significance. Similarly, little is understood about the actual and potential significance of dry forests for ex-ante coping and ex-post climate change related risk management at regional and national level. Such gaps undermine the advice available to policy makers to strategically integrate dry forests. Thus, the aim of this study is to develop allometric equations for selected native woody species to improve biomass estimates in major forest biomes, thereby helping in the determination of emission factors due to changes in land uses in the framework of the activities considered by REDD+.

2. Objectives of the study

I. To develop site and species specific allometric equations for biomass estimation.

- To develop site and species specific biomass estimation models

- To determine the best predictor and explaining biometric parameter
- To determine the wood basic density for the dominant tree species
- To determine biomass expansion factors (BEF) for above ground biomass

II. To validate and evaluate the existing generic models developed for pan-tropical forest and the newly developed allometric models:

- To compare and evaluate biomass estimates computed by the newly developed allometric equations and the commonly used generic biomass estimation models
- To validate the commonly used generic allometric models developed by Brown (1997), Chave et al. (2005), Chave et al. (2014) and other relevant equations using the collected data from *Acacia-Commiphora* forests.

3. Methodology

Different dry forests will be selected for this particular activity. Once the specific site will be selected, nested sample plot design will be used 20 m x 50 m for large plot for DBH > 50m, 17m x 35 m intermediate for DBH 20-50 m, 5m x 10m small plot for 5-20m, 2m x 2m for sapling and seedling and 1m x 1m for litter fall and soil samples. The distances between plots 100 m apart will be assigned systematically along transect lines. The transect lines will be established along elevations and forest type gradients and should be 500 m apart (Pearson, 2005). To avoid edge effect transect lines will be established 100 m away from road sides. The underlying assumption to use elevation for stratification of the sample plot is due to its impact on diversity, biomass and soil carbon stocks in tropical regions (Leuschner et al., 2007; Alves et al., 2010). Elevation will be selected at different range following the procedures in (e.g. Mohammed et al., 2014; Tibebu et al., 2014; Belay et al., 2014). Site characteristics such as site history, vegetation distribution, elevation range and aspect will be recorded. The intensity of sampling varies based on diversity of species, available resources and time frame work (Picard, 2012). To conduct allometric equation, available data inventory data may be utilized. Once trees in the plots will be assessed, five most abundant and dominant tree species in different forest type and land uses will be considered for allometric study.

Trees will be felled using axes and cut saw close to the ground. Wood samples will be extracted using crosscut saw and chain saw. Selection of 10-20 trees (per species) may represent the entire diameter classes. A total of six cross-sectional discs (5 discs from stem and one disc from big branches) having a size of 30-50 mm thick, will be collected per single tree. Discs will be taken from each section, starting from stump height and every one meter along the stem up to the end of the commercial height (=7 cm) and one sample for large branches per tree. Leaves samples will also be taken from each tree for the same purpose. Fresh weights of each wood and leave samples will be prepared in the field and taken to the laboratory (Picard, 2012).

4. Progress and remaining works

4.1 Progress of the project

Major achievements	• Three sites were selected in Afar, SNNP and Somali Regions • Forest inventory was conducted in the three sites ○ Species composition (relative frequency) and distribution was analyzed based on diameter class

	○ Identification of dominant species based on IVI ○ Determined the number of tree species to be harvested in each dominate tree species and diameter class **South Omo site** ○ Selected tree species (#180 trees) were harvested per DBH classes proportionally. Sample of discs size 5 cm thick (at 1m and 1.3 m height) were collected from individual trees ○ The volume of the disc sample is measured by water displacement method based on the Archimedes principle. ○ The wood basic density = mean oven dry mass of the disc sample (g) / green volume (cm-3) has been measured ○ Set of 511 Tree disc samples (stem, branch, leaf) were delivered to laboratory. ○ Oven dry weight and wood density analysis has been done so far.
Remaining activities	**Somali and Afar Sites** • Tree felling and sample disk taking from the selected dominant species like that done for South Omo site • Lab analysis • Data analysis and develop the biomass equation
Total and utilized budget	• Total Project Budget = Birr **990,450.00** • Utilized Budget **= Birr 483,450.00+** • Unreleased budget **= Birr 507,000.00**
Challenges	• COVID-19 pandemic • Budget is not released on time and in required amount since the work is seasonal (we expect the urgent release of the remain budget to do the remaining works) • Conflicts and instability in the country

Photo 1: Measurements before tree harvesting of live tree.


Photo 2: Measurements after tree harvesting and sorting.

Photo 3: Fresh weight measurements of harvested tree logs and leaf samples.

Photo 4: Fresh weight measurements of disc samples and leaf.

4.2 Action plan for Remaining Work

No	Activities	Months/2021			Month/ 2022			
		Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	Forest inventory and dominate tree/ shrub species selection							
2	Sample tree harvesting and disc collection							

3	Laboratory Analysis and data organization							
4	Data Processing and Analysis							
5	Write up of different reports							
6	Submission of terminal report							
7	Organizing Workshop to share results							

4.3 Budget breakdown for the remaining work

Project title	Activities	Required budget to be	Year 2021 Q4	Year 2022 Q1	Total (Birr)
Developing allometric equation for estimating aboveground biomass of selected tree species from *Acacia-Commiphora forests* of Ethiopia	Purchase of field equipments	Plastic bag,chain saw chain (70 cm and 50), Caliper and Diameter Tape, Weight 25 kg and 200 kg digital(2 for each)	30,000	-	30,000
	Facilitating permission, forest inventory	Per-diem, Car rent (2), Fuel and maintenance and Daily Labor	110,000	-	110,000
	Sample tree harvesting and Laboratory analysis	Per-diem, Car rent(2), Fuel and maintenance, Daily Labor and Laboratory coast	218,000	40,000	258,000
	Data processing and analysis, write up of different reports and submission of terminal report	Per-diem, Meeting hall rent, Refreshment	25,000	50,000	75,000
	Organizing debriefing workshop to share results		-	34,000	34,000
		TOTAL	**383,000**	**124,000**	**507,000**

The Federal Democratic Republic of Ethiopia
Environment, Forest and Climate Change Commission

Progressive report on : Developing appropriate in vitro propgation protocol for endangered and multi purpose trees .

Prepared By: Adugnaw Admas

Date :9/06/2021

1.Introduction

Currently *O. lanceolata* is considered endangered due to over harvesting the root (Mbuya *et al.*, 1994; Burgess *et al.*, 1998; Ruffo *et al.*, 2002). Generally roots are believed to contain more oil compared to an equal amount of wood from other part. While the resource has been declining, the markets of sandalwood and its products have been rising (Rai and Sarma, 1990; Srinivasan *et al.*, 1992; Coppen 1995). By 1996, sandalwood oil was being sold at US$ 1500/Kg (Nasi and Ehrhart, 1996). The increase in demand and attractive prices offered for the wood, oil and its products have increased the pressure on the present sandalwood resource base (Rai and Sarma, 1990).

Currently, in Ethiopia *O. lanceolata* is Known as ye Kola Kerete and ye Dega Kerete.

In addition in Ethiopia, *Oxytenanthera abyssinica A.Rich. Munro* has varies economic importance. However, conventional propagation methods of *O. abyssinica* are generally inefficient due to their low multiplication rate, time consuming, labor intensive, and too costly.

Therefore, to conserve this endangered and economically important plants biotechnology-based research were attemted in this research project .

2. Results

Result 1: Clonal propagation of *Osyris lanceolata* through air layering at Bazawit Hill, Northern Ethiopia.An Endangered, Medicinal and sandal wood Plant in East Africa

Air layers were applied root hormone to the stem branches of *Osyris lanceolata*(still attached to the plant) during Novmbere 2019,at Bazawit Hill,Nothern Ethiopia at edge of Blue-Nile River from its source at Lake Tana .Root initiation were starts after 12weeks of the experments.The factors assessed in this experiment were the effect lndole-3-Butyric Acid (IBA) hormone as rooting promoter at three concentrations (0,50, 100and 150ppm).

From the data collected it was observed 88.8% rooting were achieved from air layers in the mother plants it selef those treated by IBA hormone and the controls not responding root. Making this propagation technique is a viable alternative to the

use of seed or cutting propagation. Rooting response success were influenced by application of rooting hormone of IBA, soil composition and the seasons. At a rate of 150 ppm 100% all experimented plants were initiated and primarily other than other treatmeants responded root.The significance enhancing of root making on Osyrislanceolata plants stem via air layers is linked to the advantage of more rooting hormone concentration.

Figure 1 . Initiating root in osyris plant by air layering by IBA horomone solution

Figure 2. Intiated New roots by air layer propagation after 12 weeks of treated hormone

Result 2: Develop Micro clonal -propagation protocol for *Oxytenanthera abyssinica A.Rich. Munro* **to large scale micro-propagation**

Murashige and Skoog (MS) medium augmented with 6-Benzylaminopurine (BAP) was used for shoot initiation and multiplication. For in vitro rooting, MS medium supplemented with 3-Indole –butric acid (IBA) was used.

In shoot initiation experiment all viable seeds were proliferated in 5-7 days of culturing. In shoot multiplication at 0.004 g/L BAP was Successfully shoot multiplied, also best root responding were found at 0.005 g/l IBA.

Figure 1. Intiated leaf from cultured low land bamboo seed

Figure 2. Multiplication of new leaf from initiated seed at 0.004 g /L BAP hormone

Figure 3: Root formation of Low land bamboo via IBA hormone after one month.

Figure 4.Acclimatizing in green house

3. Implication for development

economically important plants like osyris lanceoleta are declined and became extinct due to drought, salinity, diseases, pests, deforestation and naturally inefficient seed regeneration. From recent field observation highly economically important plants like *Osyris lanceolata* are under high pressure to become endangered, extinct and unable to propagate in larger amount due to inefficient seed germination behavior of the plant, inadequate seed setting, inadequate and delayed rooting of seedlings and unsustainable harvesting of seed. Therefore ,Our research brought an options to propagate the most econnomical important plant material of Osyris lanceoleta via clonal propagation and by tissue culture low land bamboo.

The present optimized protocol of *Oxytenanthera abyssinica* enables for any actors who needs large numbers of low land bamboo seedling for industry, small and micro enterprise or for reafforestation programs.

Research Progress Report on

Integrated Multidisciplinary Land Management Intervention and Research for Improved Agroforest-Biodiversity, Economic Wellbeing and Ecosystem Services at the Landscape Level

Submitted to:

Environment, Forest and Climate Change Commission

May, 2021

Addis Ababa

1. Introduction

Agriculture is the main stay of the Ethiopian economy and contributes to the significant proportion of the rural employment and the export market. Anthropogenic pressures however have reached a scale where agriculture's sustained development cannot be guaranteed with business as usual. Land and forest resources are severely degraded and this in turn has resulted in low agricultural productivity, food, water and energy insecurity and rural poverty. The impact is further compounded and is becoming complex by the increasing climate risks.

Various efforts have been made by the government of Ethiopia and non-government organizations to mitigate these impacts and improve the livelihood of the rural communities. The various policies and strategies including the Growth and Transformation Program (GTP I & II); the Agriculture led Development Industrialization (ADLI) and the CRGE are testaments to the many efforts made towards

this end. The country has also embarked on the Sustainable Land Management Program (SLMP) as a tool for agricultural transformation and development.

Resources are needed by rural people simultaneously not alternatively. People require food, fiber, fuel wood, fodder and environmental services- all at the same time. Integrated land management and development at the landscape level has the potential to address many of the above stated needs. It recognizes a holistic and participatory approach to rural development. The landscape is made up of water, land, soils and vegetation. At the socio- economic level it is made up of people, farming systems, and interactions, coping strategies, social and economic activities and cultural aspects. Thus any development initiative has to emphasize on a holistic approach.

This particular research and development program intends to use the various available opportunities for restoring degraded watersheds and landscapes through well thought integration of various interventions to create mosaic landscapes. Mosaic landscapes can be created through a mix of various interventions and could enhance water resources; agro-biodiversity; carbon sequestration; improved and diversified livelihoods: increased adaptive capacity of the local community. Building on the experiences of the SLM, the initiative plans to magnify the role of forestry and bring it to the forefront in any integrated watershed development program. It plans to compliment the national effort to improve tree cover at the landscape level thereby contribute to the rural landscape transformation and development.

Integrated land management emphasizes the need for participatory approach involving communities and end users at all levels. This proposed developmental research initiative is thus a multidisciplinary and development oriented one. It will involve human resources development and participation of the whole community in the planning of the watershed development plan. The initiative is planned to create societal cohesion and enable the poorest members to benefit from the initiative.

The research approach is multidisciplinary and development oriented where stakeholders ideas and conclusions guide the next step in the research endeavor. The initiative will also greatly enhance the capacity of the institute to conduct multidisciplinary, multi-stakeholder and problem oriented research. It will be a learning process of doing research by action and in reiterative manner for many of the research staffs of the institute.

The initiative also plans to use various available information dissemination mechanisms to scale up best management practices (BMP) for the development of landscapes elsewhere in the country depending on site specific conditions.

1.1. Overall objectives of the project

To conduct multidisciplinary, multi-stakeholder and problem oriented research and come up with best management practices (BMP) for the development of landscapes in the country which will result in improving the livelihoods of the local community. It plans to magnify the role of forestry and bring it to the forefront in any integrated watershed development program.

1.1.1. Specific objectives:

- To conduct biophysical surveys on soils, vegetation, water resources which will be benchmarks for comparison with impacts of future intervention
- To conduct socio economic surveys to characterize the socio economic conditions of the watershed including gender analysis, livelihoods, vulnerability and constraints of production
- To identify potential development interventions that can be designed for the watershed area.

2. Progress of the project

2.1. The consultative and experience sharing period

Before watershed area selection, as part of the initiation phase of the research project, members of the research team visited and consulted persons and institutions involved in watershed research and development in Ethiopia. Among the institutions visited and consulted include Land and Water Resource Center (LWRC), Sustainable Land Management (SLM) and Amhara Institute of Agricultural Research (ARARI). Based on the recommendations of LWRC the team had also the opportunity to visit the learning watersheds of the center including Aba-gerima, DebreYakob and Enjeni watershed sites in Gojam. The team is with the impression that the learning watersheds have many insightful accomplishments from which others can learn. The stature of these community based watershed activities are testament to the level reached in watershed management and development in the country. Following the visits and consultations the team conducted a thorough discussion on how these interventions and approaches would fit into its research agenda and idea.

2.2. The Process of watershed selection for the project

The key activity was to visit and select suitable watersheds that would meet the requirements of the intended watershed project. The team visited areas including many locations in Western and Eastern Gojam, Western and Southern Shoa and some parts of Eastern Shoa. During the selection process the team followed five principles in identifying the right watershed for the intended project:

- Site accessibility, and proximity
- Whether the watershed area is part of the main drainage systems of Ethiopia i.e. it has to be part of either Awash and/or Abay water basins
- Manageable size and within the limited resources of the institute
- The level of degradation that entails interventions
- The potential for commitment and willingness for cooperation by the community- based on personal communications

Based on the above premises the team has identified one potential watershed area:

This particular watershed is within the *Tarmaber woreda, Armania kebele, Tornosamba* watershed and is part of the *Awash River basin*. It is located at approximate 190 km from Addis Ababa. The watershed size is about 739.08 ha and is therefore manageable and fits in to our limited resources. The area is accessible and is very proximate to Addis Ababa. The site can be used by EFFRI as a good research and learning watershed ground. Based on modest field observations and for starters, some preliminary efforts have been made to identify potential development interventions for the watershed.
Additionally, we have prepared questionnaires for baseline studies (biophysical, socioeconomic) and conducted the household survey. Nursery site selection was done at *Arminia Kebele*. And also we planned to conduct the community engagements, formation and training of working group and participatory selection and implementation of selected rehabilitation and economic schemes to be done.

3. Preliminary progress of the project

3.1. **Data on land use and land cover change**

Present land use and land cover including data on forest and range cover, crop land, plantations, wildlife, urban and rural settlements and water bodies were collected. Land use history, which helps reveal past lessons and experiences, also obtained. Mapping through standard method (remote sensing and GIS based techniques) was conducted. Interviews and secondary data collection from reports, records has been conducted.

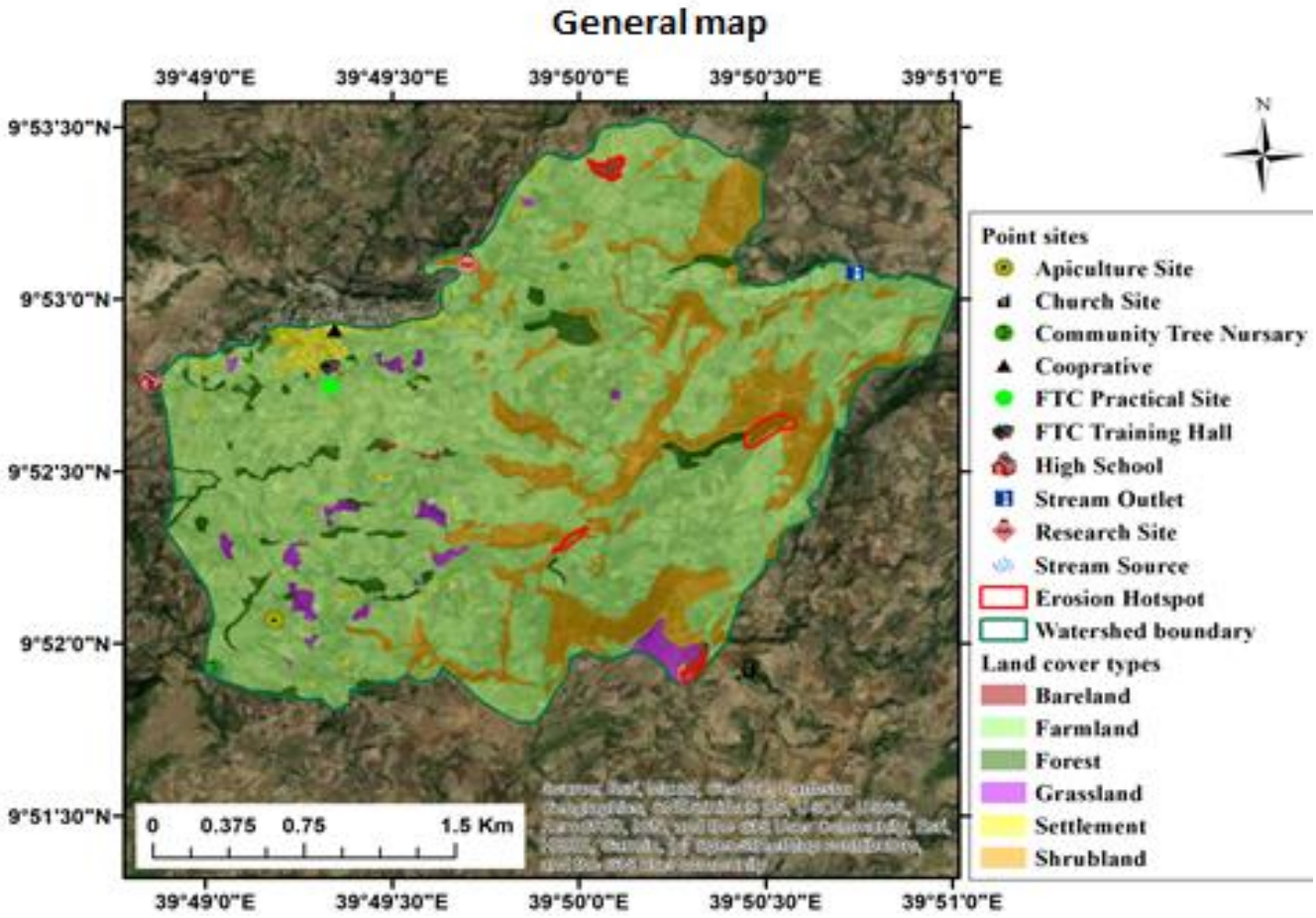
3.2. Socio economic survey

Data on major household characteristics, Livelihood and Socio-economic have been collected. Population data as well as other demographic factors, constraints and opportunities for development, level of education, extension services, availability of incentives, tenure rights, risks, availability of labor, unemployment migration, causes and problems facing the watershed, social structures, systems, and hierarchy were conducted. Economic activities including farm production, income, land use patterns, employment, marketing, access to new technology, infrastructure needs, access to credit and

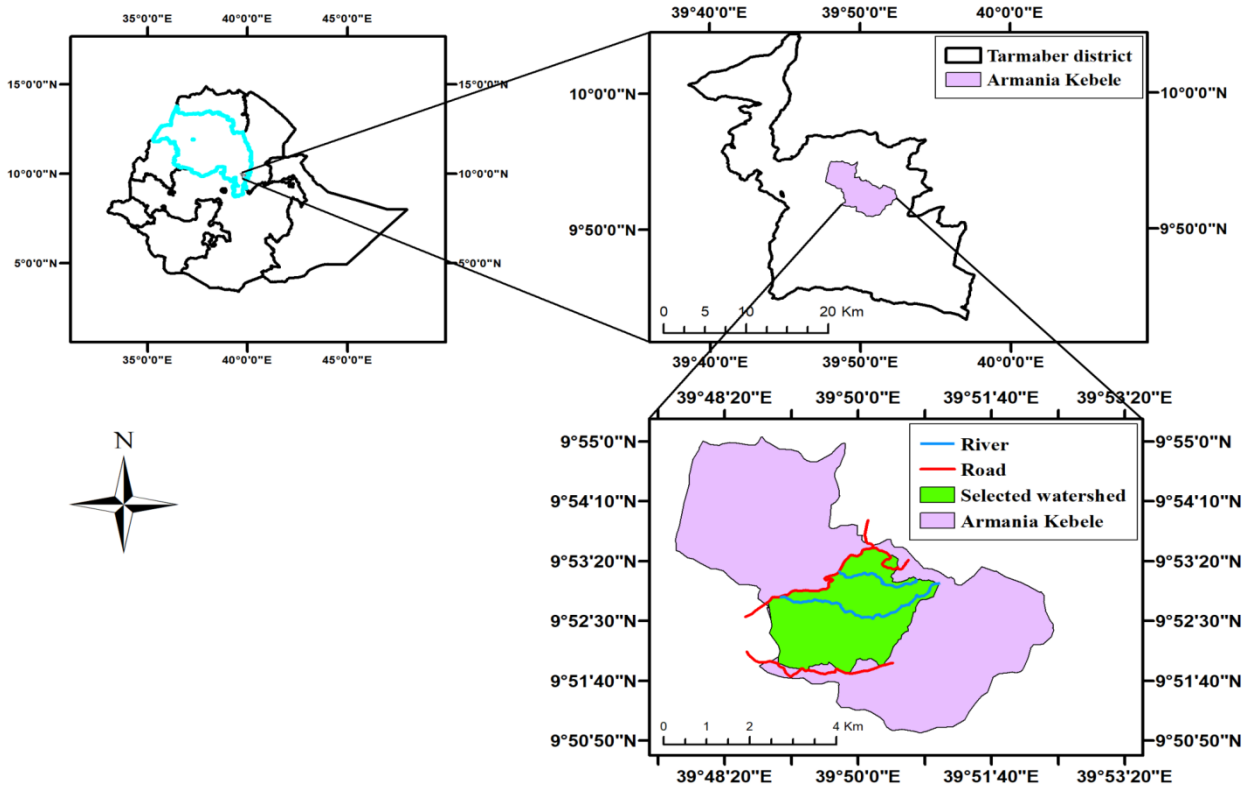
financial aid, availability of agro industry, farm rental, farm size, fragmentation, prices, availability of transport, ecosystem payments were assessed. All these collected data were fed in the computer and the analysis and report writing was underway.

3.3.Location and land use classification of the watershed

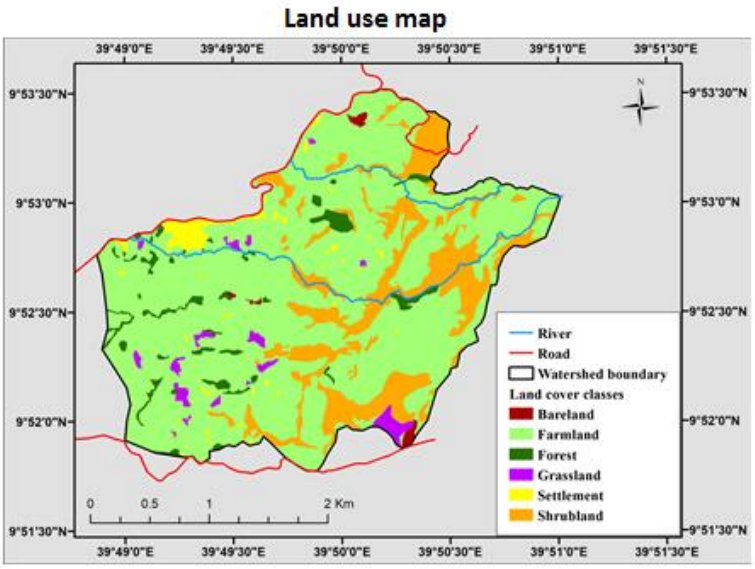
3.3.1. General map of the watershed



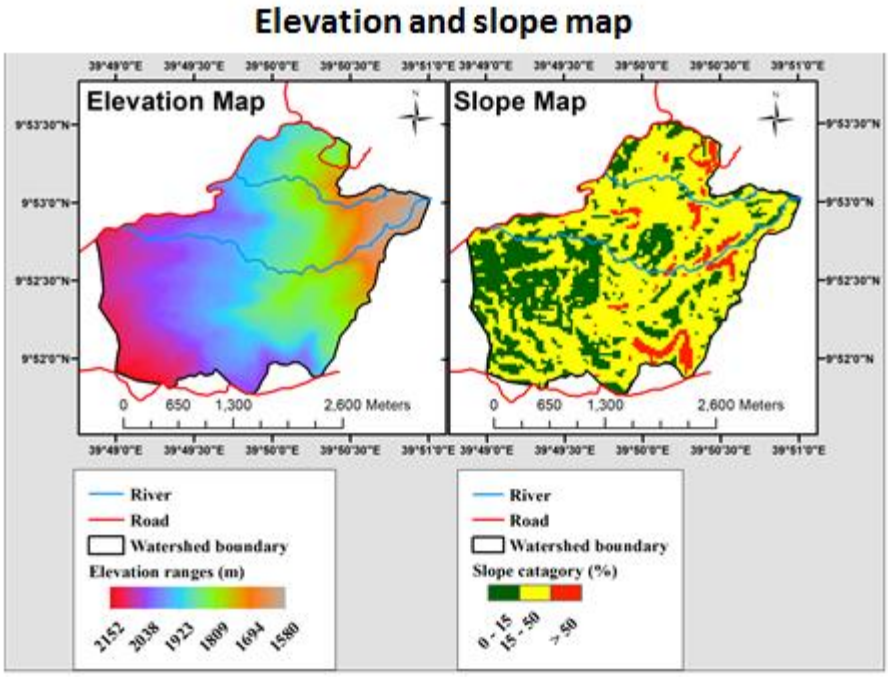
3.3.2. Watershed reference map



3.3.3. Watershed Land use classification map



3.3.4. Watershed Elevation and slope map

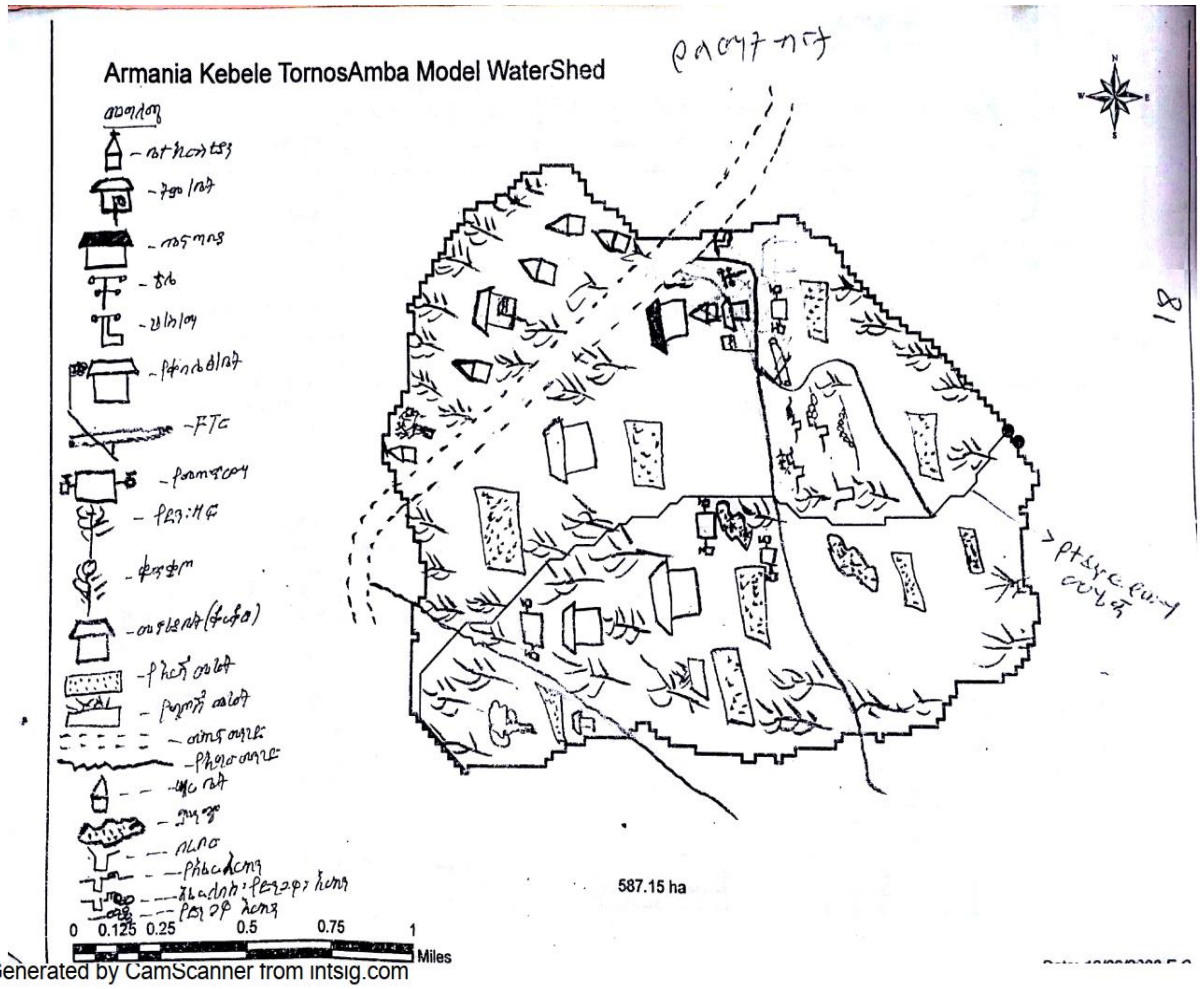


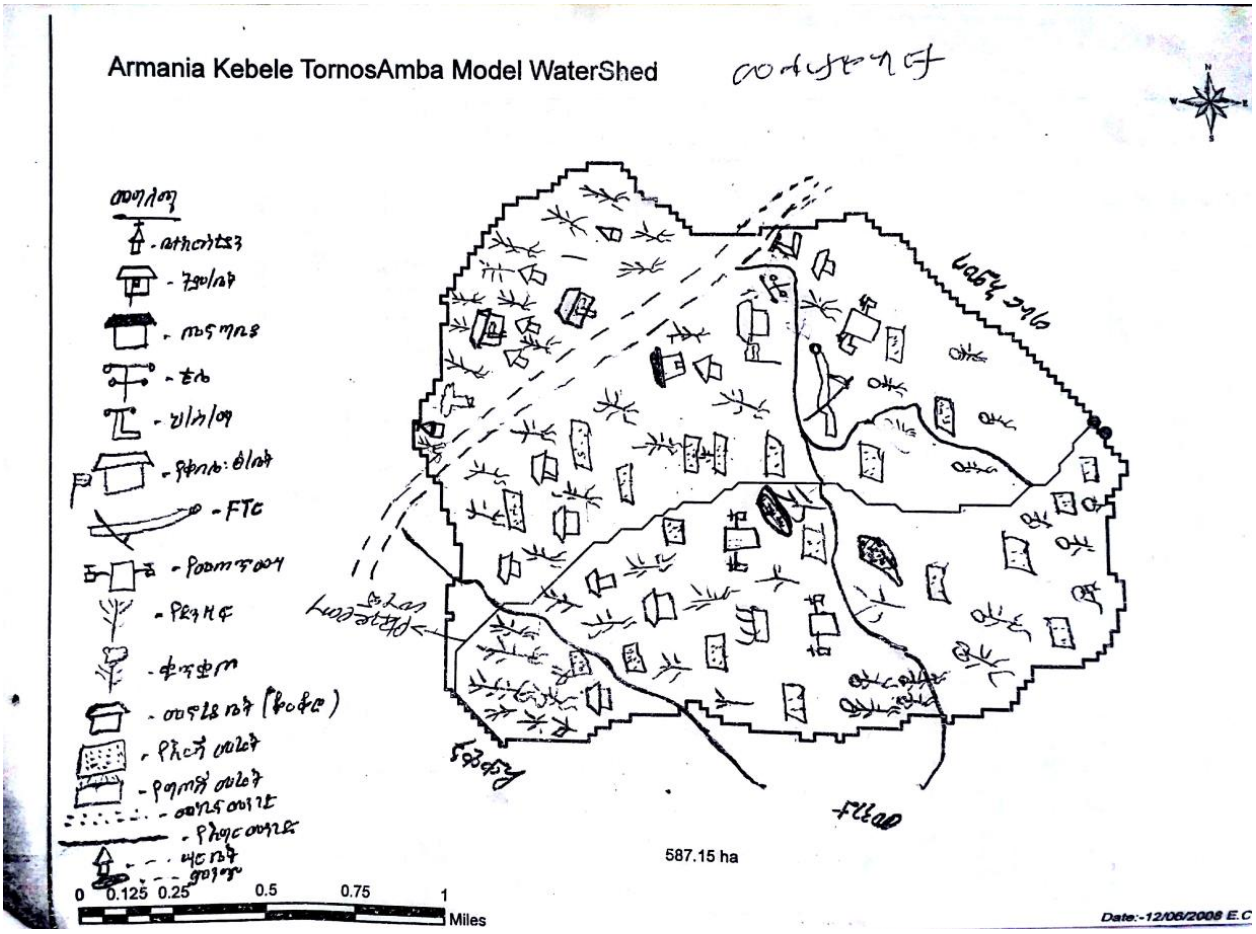
3.3.5. Land use distribution by area coverage in heactorage

land use classification	Area (ha)	%

Forest	22.04	2.98
Shrub land	127.30	17.22
Settlement	15.06	2.04
Grassland	13.22	1.79
Bare land	3.24	0.44
Farmland	558.22	75.53
Total	**739.08**	**100.00**

3.4. Watershed delineation and mapping by community participation





Remaining activities

- Data analysis and report writing on socioeconomic and biophysical baseline survey
- Organizing planning workshop for Research and Development interventions
- Prioritization the researchable and development intervention
- Actual field research and development intervention

Major Challenges

- Security problems
- Incidence of COVID 19
- Field Vehicle
- Delayed Budget

Progress Report:

Enhancing field establishment and Management of seedling in degraded frost affected highlands of Ethiopia

Submitted to Forest sector development UNDP-SWEDEN project, Environment Forest and Climate Change Commission of Ethiopian

Abera Tesfaye

June, 2021

Addis Ababa, Ethiopia

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1. Introduction and justifications

The Ethiopian highlands, endowed with more than 90% forest cover, are today the percentage of forest cover is less than 4% due to severe deforestation and forest degradation driving by alarming rate of population growth and its resultant effect of agricultural land expansion and highly dependence on biomass energy. Deforestation and forest degradation together with unbalanced crop and livestock production and severe soil loss in turn are underlying causes of land degradation in Ethiopian. Topography, soil types and agro-ecological conditions are also additional factors playing significant role in the degradation processes. Land degradation is a major ecological and economical problem in the highlands of Ethiopia. It is a continuous process and has an effect on the declining of agricultural productivity, continuing of food insecurity and rural poverty.

The country today has strong initiations to undertake afforestation and reforestation activities to rehabilitate or restore degraded lands but the success have been hindered by low soil fertility and extreme environmental events i.e. seasonal frost and strong winds. Reports from survey of seedling survival in Amhara region reviled that frost is one of environmental stress listed as a major cause for seedling mortality in the highlands.

The international commitments that was made under the Bonn Challenge and reconfirmed under the UN Summit in New York in 2014, Ethiopia has committed to restoring 15 million hectares of forest landscapes by 2030 in addition to carrying out afforestation and reforestation and sustainable management of forests and woodlands on 7 million hectares. This indicates that arresting land degradation is the current crucial environmental issue seeking urgent solutions in the nation. Even though, complete restoration of degraded lands is rarely a realistic goal in the nation, bringing them back to an intermediate state to maintain biological diversity and restore some ecological and economic service is possible.

Therefore, this project is initiated to resolve land degradation problems basically through afforestation/reforestation strategies by improving seedling establishment and management techniques to withstand seasonal frost and strong wind interweaved with low soil fertility in frost affected highlands.

1.1 Objectives

1.1.1. General objective

The general objective of this project is enhancing the growth performance and survival of out planted seedling through improving seedling establishment and management techniques so as to restore degraded lands in frost affected highlands of Ethiopia.

1.1.2. Specific objectives

- To investigate appropriate frost management techniques that enhance the survival /frost hardiness of tree species on degraded frost affected highlands
- To screen adaptable and frost tolerant tree/shrubs species in the function of different seedling size and plating time
- To evaluate the effect of inorganic and organic fertilizer on growth performance and frost hardiness of selected tree/shrubs species

1.2. Research activities of the project

Table 2. List of research activities of the project

No_	Research Activities	Implementing centers, Location and study sites
1	***Assessment of farmers' tree needs and their traditional knowledge on seasonal frost management in selected frost affected highlands***	• Central Ethiopia-EFRC (Dessie zuria Legambo, Menez Mama and Menez Lalo districts) • Bahirdar-EFRC (Meket and Guna) • Deredewa-EFRC (Gurawa and Haromaya) • Hawassa-EFRC (
2	***Evaluating the appropriate frost management techniques that improve the survival and growth performance of tree species in degraded frost affected highlands***	• Central Ethiopia-EFRC (Dessie zuria and Menez Lalo districts) • Bahirdar-EFRC (Meket and Guna)
3	***Evaluation and selection of tree species in the function of different planting time in frost affected highlands***	• Central Ethiopia-EFRC (Dessie zuria and Menez Lalo districts) • Bahirdar-EFRC (Meket and Guna)
4	***Effect of inorganic and organic fertilizer on growth performance (frost hardiness) of selected tree species on frost affected areas***	• Central Ethiopia-EFRC (Dessie zuria Legambo, Menez Mama and Menez Lalo districts) • Bahirdar-EFRC (Meket and Guna)

2. Progress of research Activities

2.1 Activity 1. Assessment of farmers' tree needs and their traditional knowledge on seasonal frost management in selected frost affected highlands

2.1.1 Objective

- To assess and investigate farmers' tree needs and traditional seasonal frost management practices in frost affected degraded highlands of Northeastern Ethiopia.

2.1.2 Activities so far performed:

- Research areas; representative zones, districts, and even Kebeles were purposively selected with the consultation of experts and administration bodies of the respective zones and districts based on seasonal frost occurrence and severity of frost problems
- Check list and questionnaire were prepared and pretested on randomly selected inhabitants of Desie Zuria district
- FG and key informant discussion were held with different parts of the community
- Actual questionnaire survey were conducted in purposively selected eight districts, namely Dessie Zuria, Legambo, Menz Mama, Menz Lalo, by Central Ethiopia-EFRC: Guna and Meket by Bahirdar-EFRC, Haromaya and Gurawa by Deredewa-EFRC and Kombolcha wate and Tatesa Hancule by Hawassa-EFRC
- Even if the survey part have been conducted under four research centers, only two centers were benefited from the research grant, Central Ethiopia and Bahirdar Environment and forest research centers.
- The collected data have been encoded and analyzed at all respective research centers

2.1.3 Major findings

- The study was conducted in purposively selected frost-prone areas of Amhara, SNNP and Oromia regions. In Amhara region six woredas (districts) namely, Dessie Zuria and Legambo from south wollo, Menz Gera and Menz Mama from North Shewa, Guna from South Gonder and Meket from North Wollo were selected as study sites.
- Even if the study was conducted in different kebeles of Amhara, SNNP and Oromia regions, this report focuses on North Shewa and South Wollo zones of Amhara region. So

that, from four purposively selected kebeles of South Wollo and North Shewa zone, 202 households were sampled following simple random sampling technique by using the list of taxpayer households available in each site.

- Questionnaire survey and focus group discussions were used as primary data sources.
- The major tree species grown by farmers were E. globulus (55.0%), Cytisus proliferus (20.0%) and Cupressus lusitanica (9.4%).
- The major attributes and products of trees that were preferred by farmers were multipurpose use and fast growth nature (43.5%) and pole and construction material (68.5%) respectively.
- Seasonal frost is the major causes of seedling mortality for most of the farmers (59.4%) followed by drought (10.7%) and free grazing (8.5%).
- The farmers commonly practiced mulching (33.5%) followed by hoeing and watering (24.1%) and plant cover (21.5%) for frost management.
- Therefore, management practice of farmers should be optimized and new alternative management practices should be examined, introduced and scale out in different frost-prone areas.

2.1.4 Future plan

- Compiling all collected data and reports from all study sites as one report document and submission of the report for donners are the major remaining tasks.
- If it is possible, the one-day workshop will be organized to present the preliminary results of the project at district level.

2.2 Activity 2. Evaluating the appropriate frost management techniques that improve the survival and growth performance of tree species in degraded frost affected highlands

2.2.1 Objective

- To evaluate the appropriate frost management techniques that improve the survival and growth performance of tree species in degraded frost affected highlands

2.2.2 Materials and methods

2.2.2.1 Site description

This experiment was established in Menz-mama district, 06 kebele and Dessie Zuria district, 037 kebele (Tebasi) found in North Sowa and South wollo administrative zones respectively.

2.2.2.2 Experimental design

The experiment have seven frost management techniques including the local practice that obtained from the survey as treatments. The treatments are, 1) organic mulching, 2) soil plastic mulch /cover, 3) plant cover (shelter), 4) plant pipe (PVC), 5) local practice, 6) soil mound and 7) control and arranged in randomized complete block design (RCBD) with three replications. *Pinus patula* is considering as the candidate tree species for this study. Distance between planted seedlings, plots and blocks is 2m, one border row planting was framing as guard planting for the inner sample seedlings. In a plot, 16 individual trees will be established and taken as a sample for data collection.

A. **Experimental Layout**

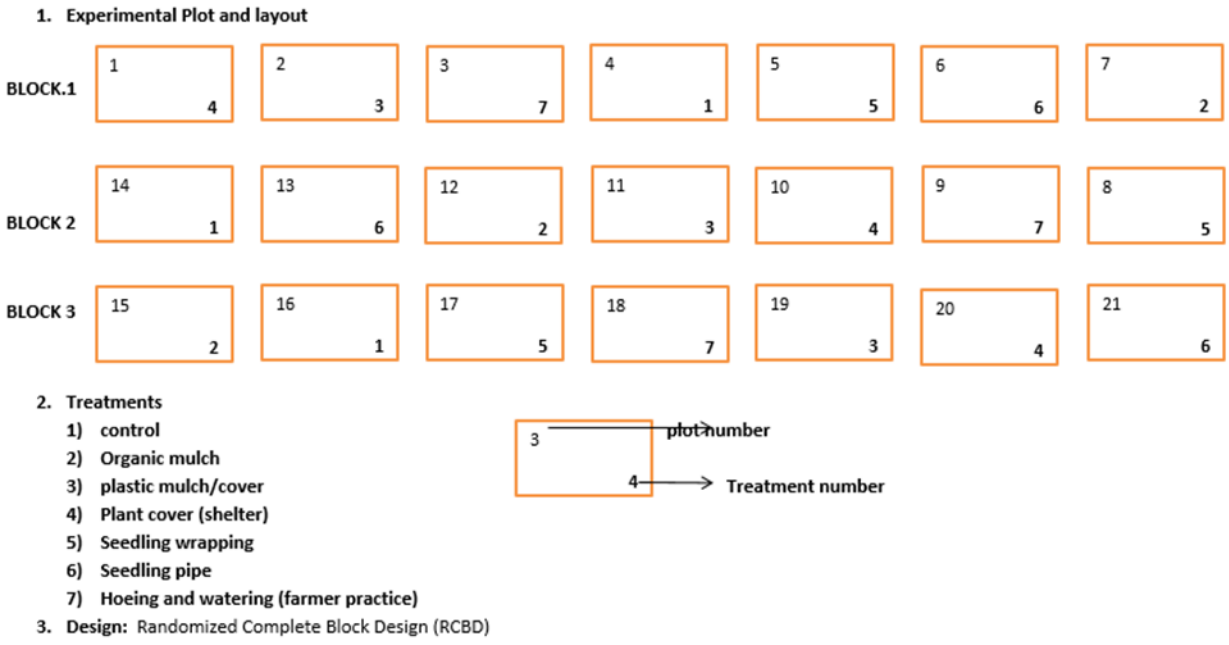


Figure 2Experimental layout and treatment arrangement of frost management methods at Tebasi and Menz site

B. **Detail of experimental layout and planting**

B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19	B20	B21	B22	B23	B24	B25	B26	B27	B28	B29	B30
B84	1	1	1	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	B31
B83	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	B32
B82	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	B33
B81	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	B34
B80	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	B35
B79	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	B36
B78	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	B37
B77	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	B38
B76	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	B39
B75	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	B40
B74	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	B41
B73	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	B42
B72	B71	B70	B69	B68	B67	B66	B65	B64	B63	B62	B61	B60	B59	B58	B57	B56	B55	B54	B53	B52	B51	B50	B49	B48	B47	B46	B45	B44	B43

Legend

treatment 4 | treatment 1 | treatment 2

treatment 3 | treatment 5 | B stands for border trees

treatment 7 | treatment 6

Figure 3/ detail view of experimental lay out for frost management methods at Tebasi and Menz sites

2.2.2.3 Establishment date

The establishment date of the experiment is August 5, 2020 at Menz and August 10, 2020 at Dessie Zuria sites.

2.2.3 Activity so far performed

- Awareness creation and office discussion were done with zonal, district and local (kebele) level about the project objective and the detail planed research activities to be done in their area
- Experimental sites were selected with collaboration of zonal and district level administrative officials and local community leaders
- The selected sites were fenced with barbed wire with wooden posts
- experimental sites were prepared and experimental plots are laid following an appropriate experimental design

- **Preparation of planting pit and planting of seedlings.**
- **Purchasing required inputs (polythene sheet, wood ashes, PPC and temperature logger etc.)**
- **installation of treatments prior to starting of frost season are done**
- **Collection of growth and survival data of the planted seedlings**

2.2.4 Major findings

As shown from the following graph, at Menz site the fourth month survival data shown as the seedling protected by PVC and organic mulch have shown a significant difference among other treatments followed by a seedling protected by plant shield with plastic sheet. However, untreated seedlings (control) shows the lowest survival rate in the area.

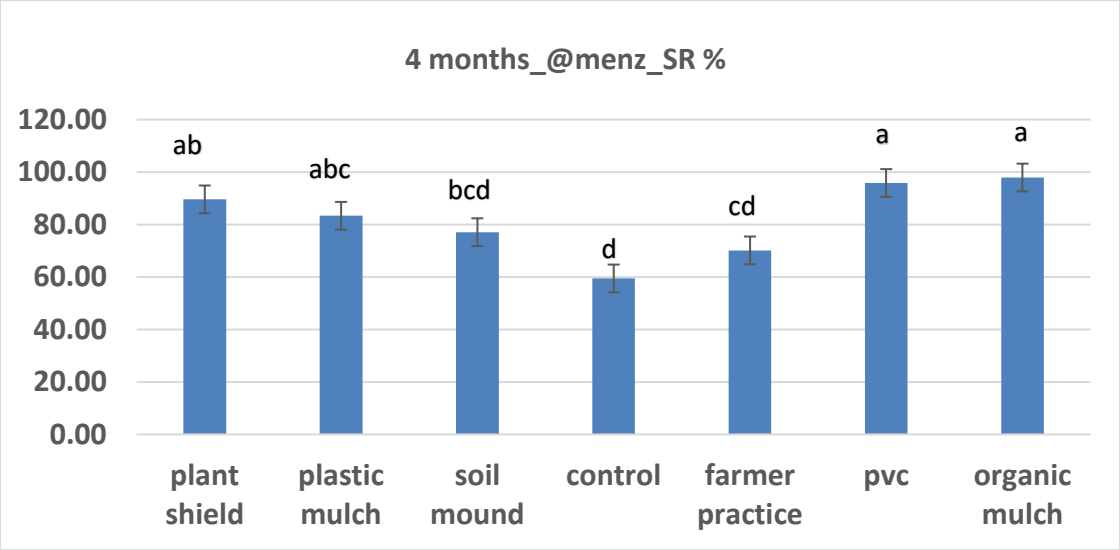


Figure 4/survival rate of seedlings among different frost management techniques at Menz site

At Dessie site (figure 2), the result of analysis of variance (ANOVA) indicated that there is a significance deference among treatments at 0.05 significant level. The highest seedling survival have been observed in seedlings that protected by PVC and Plastic sheet and similarly, the unprotected seedlings shows the lowest survival rate.

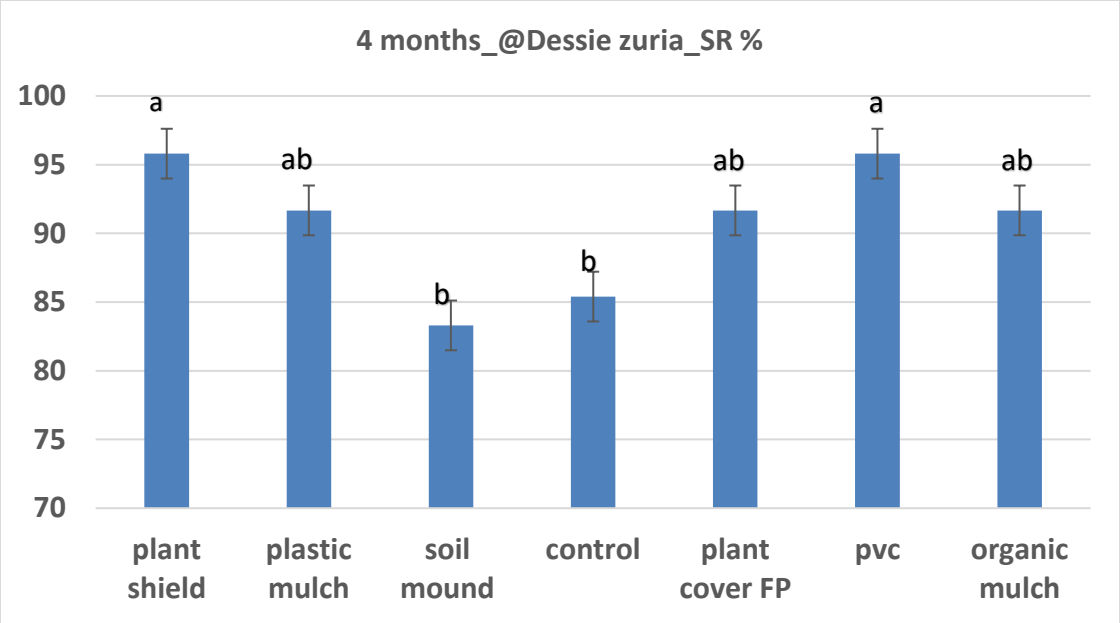


Figure 5/ survival rate of seedlings among different frost management techniques at Tebasi (Dessie Zuria) site

However, the combined analysis of variance indicated that PVC shows significant difference among treatments. The highest seedling survival rate obtained from seedling protected by PVC, 95.8 % followed by organic mulch, plant shield and plastic mulch with 94. 8, 92.7 and 87.5% respectively. Still, the control have shown the least survival rate (72.4). This indicated that by using seedling protection techniques we can increase the survival of planted seedling by 15.1-23.4%.

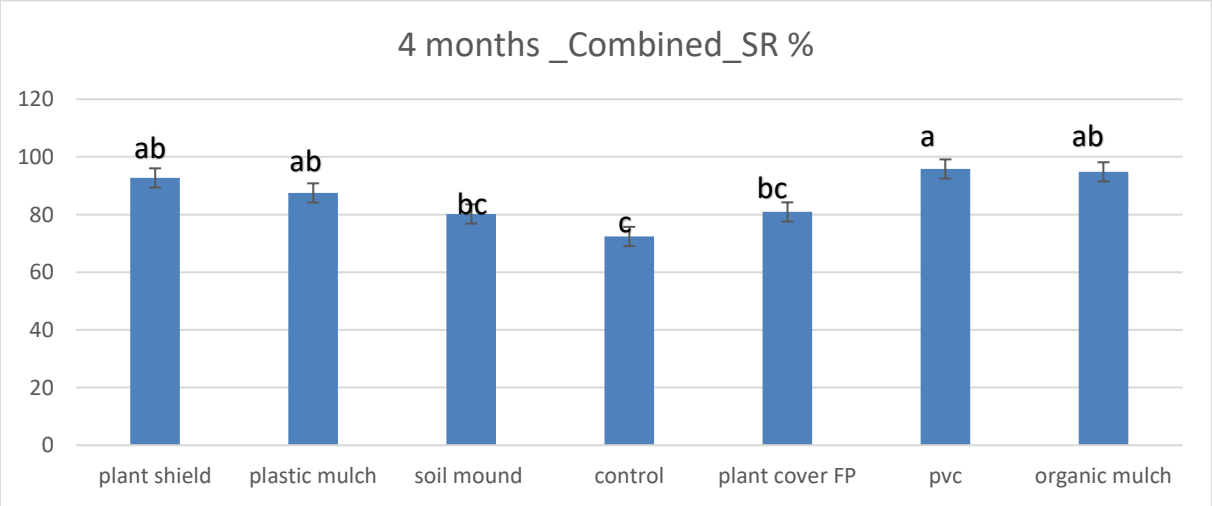


Figure 6/ survival rate of seedlings among different frost management techniques, combined by sites

2.2.5 Future Plan

A. **Site management**

The site have been guarded and as much as possible it is fenced by barbed wire with wooden posts. While, monthly follow up, management practices (hoeing, weeding and tending) and fence maintenance will be done as per plan.

B. **Data collection**

Survival rate, height and root collar diameter of planted seedlings will be taken once every three months. In addition, to strengthen the data the daily minimum temperature will be requested from Ethiopian meteorology agency.

2.2.6 Expected outputs

Appropriate frost management methods having paramount importance on tree growth and survival in degraded frost prone areas, will be identified and recommended.

2.3 Activity 3. Evaluation and selection of tree species in the function of different planting time in frost affected highlands

2.3.1 Objectives

- To screen adaptable and frost tolerant tree/shrubs species on degraded frost affected highlands
- To determine appropriate seedling size and planting time for better growth performance and survival in frost affected highlands

2.3.2 Experimental Design

After collecting and assuring seeds; seedlings of selected trees and shrubs will be raised at a representative nursery site of the selected experimental site. The experiment will have three factors, such as tree species, seedling size (normal and larger (seedling staying in nursery more than one year) and planting time (main and short rainy season). The candidate tree species are *E.viminalis, E. globlus, Dombeya torrida, Hagenea abyssinica Chamaecytisus palmensis, Juniperus procera, Acacia decurrence, Olea africana Acacia melanoxylon, Acacia abyssinica and, Ekbergia capensis* and will be considered as treatments on the basis of their ecological niche compatibility and potential to rehabilitate degraded land. The species will be planted in to

two different planting times (at main and short rainy season) with recommended establishment techniques depending on the site condition. The experiment will be laid out in randomized complete block design (RCBD) with three replications. The space between trees in a plot will be 2 m. Plot size will be 6 m X 6 m. In a plot, 25 trees will be established. The nine inner individual trees will be taken as a sample for data collection. Since it will be implemented in different research centers, the researchers can customize the candidate species, the space between plant, plots, blocks even as per the experimental area and the resource they have.

2.3.3 Activities so far performed:

- Awareness creation and office discussion were done with zonal, district and local (kebele) level about the project objective and the detail planed research activities to be done in their area
- Experimental sites were selected with collaboration of zonal and district level administrative officials and local community leaders
- The selected sites were measured and fenced with frost wire with wooden posts
- However, the selected site was destroyed and the fence materials were stolen by surrounding inhabitants so that, in this year selection of alternative sites were assessed but still not secured.
- Seedlings of *J. procera, A. de3currence, A. melanoxilon, H. abyssinica and E. globules* with different sizes have been preparing since last year.

2.3.4 Future plan

- **Selection of alternative planting sites**
- **Preparation of experimental site and lay outing the experimental plots**
- **Preparation of planting pit and planting seedlings**
- **Collection of growth and survival data of the planted seedlings**

2.4 Activity 4. Effect of inorganic and organic fertilizer on growth performance (frost hardiness) of selected tree species on frost affected areas

2.4.1 Objectives

- To evaluate inorganic and organic fertilizer in improving growth performance of selected tree/shrubs species on frost affected areas

2.4.2 Materials and methods

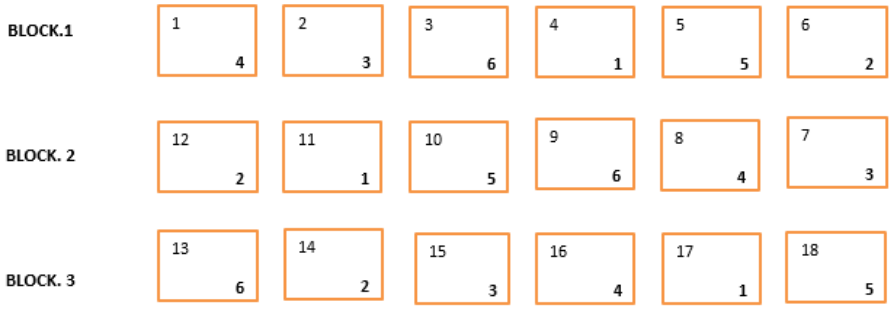
2.4.2.1 Site description

This experiment was established in Menz Gera district, 06 kebele and Dessie Zuria district, 037 kebele (Tebasi) found in North Sowa and South wollo administrative zones respectively.

2.4.2.2 Experimental design

The experiment have six options of soil fertility management including one control and considered as treatments such as: 1) control, 2) complete NPK fertilizer (2:1:2 ratio), 3) decomposed farmyard manure, 4) Vermi-compost, 5/ Forest soil and 6) mixture of 0.5 of T1, T2, T3, and T4. The experiment arranged in randomized complete block design with three replications. Distance between planted seedlings, plots and blocks is 2m, one border row planting was framing as guard planting for the inner sample seedlings. In a plot there are 16 and 12 individual trees were plant at Menz and Tebassi site respectively and taken as a sample during data collection. During planting time, 60 gm of complete NPK fertilizer (3:1:2 ratios by weight) and 1 kg of each decomposed farmyard manure, Vermi-compost and mix of compost were added to the planting pit. Additional 100 gm and 150 gm complete NPK fertilizer and 2 kg compost and manure will be added at one and two years' age of planted seedling respectively.

A. **Experimental Layout**



2. Treatments
   1) Control
   2) Complete fertilizer(NPK)
   3) Decomposed farmyard manure
   4) Vermi-compost
   5) Forest soil
   6) Mixture of 0.5 of T2, T3, T4 and T5
3. **Design:** Randomized Complete Block Design (RCBD)

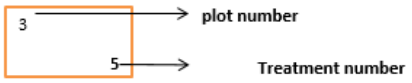


Figure 7/ Experimental layout and treatment arrangement at Tebasi and Menz site

B. **Detail of experimental layout and planting**

B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19	B20	B21	B22	B23	B24	B25	B26
B76	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	B27
B75	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	B28
B74	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	B29
B73	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	B30
B72	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	B31
B71	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	B32
B70	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	B33
B69	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	B34
B68	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	B35
B67	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	8	7	6	5	B36
B66	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	9	10	11	12	B37
B65	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	16	15	14	13	B38
B64	B63	B62	B61	B60	B59	B58	B57	B56	B55	B54	B53	B52	B51	B50	B49	B48	B47	B46	B45	B44	B43	B42	B41	B40	B39

B stands for border tree

Legend

treatment 4

treatment 1

treatment 3

treatment 5

treatment 6

treatment 2

Figure 8/ detail view of experimental lay out at Tebasi and Menz sites

2.4.2.3 Establishment date

The establishment date of the experiment is August 5, 2020 at Menz and August 10, 2020 at Dessie Zuria sites.

2.4.3 Activity so far performed

- **Preparation of experimental site and lay outing the experimental plots**
- **Purchasing and preparing required inputs (forest soil, compost, vermi-compost, KCL fertilizer etc.)**
- **Preparation of planting pit and planting of seedlings**
- **Incorporation of in organic and organic treatments in to the soil**
- **Collection of growth and survival data of the planted seedlings**

2.4.4 Major findings

As shown the following figure ( ), relatively the overall survival rate of planted seedling are poor (68.9%). Even if the time of observation is too early, the result indicated that the highest survival rate is observed by untreated control followed by the seedling treated by forest soil, farm yard manure and vermi-compost with 80.5, 74;8, 72.2 and 69.4 % survival respectively. From this result the conclusion can be drown as in this specific experimental site addition of soil amendments have no impact on seedling survival in frost prone area and it is not economically feasible as compared to sole planting (control).

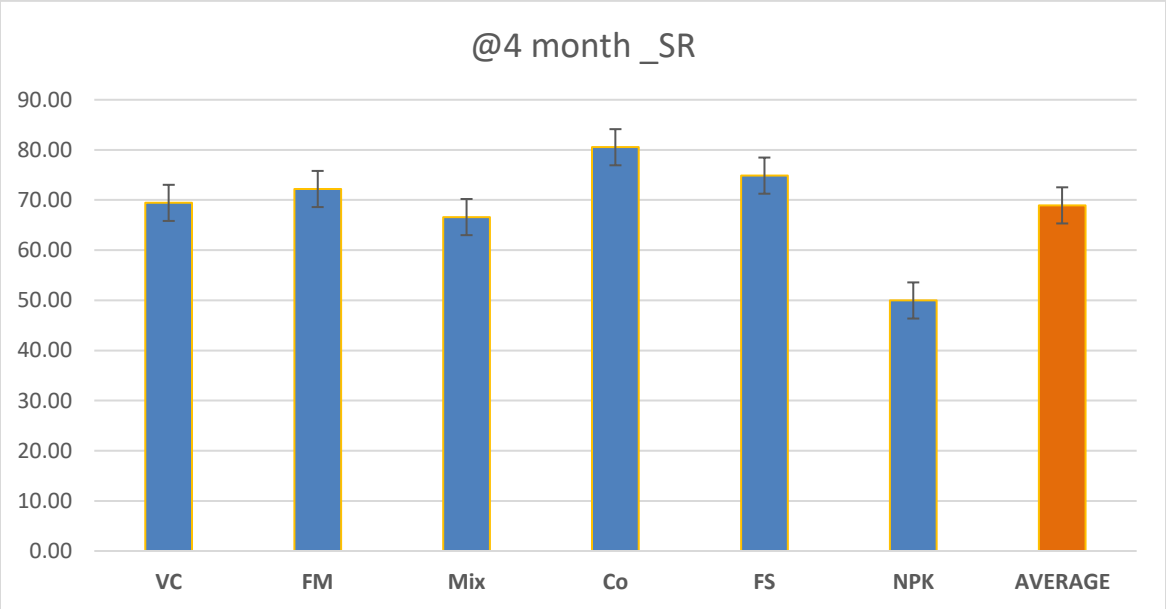


Figure 9/ seedling survival among six treatments of organic and inorganic soil amendments'

Unfortunately, the experiment established at Menz Gera is completely fall due to the waterlogging nature of the selected site.

2.4.5 Future Plan

A. Site management

The site have been guarded and as much as possible it is fenced by barbed wire with wooden posts. While, monthly follow up, management practices (hoeing, weeding and tending) and fence maintenance will be done as per plan.

B. Data collection

Survival rate, height and root collar diameter of planted seedlings will be taken once every three months. In addition, to strengthen the data the daily minimum temperature will be requested from Ethiopian meteorology agency.

N.B: However, during field observation work we have observed that the survival of planted seedling becoming significantly decreased from time to time. Therefore, to deliver strong recommendation about the impact of soil amendment on frost withstand of planted seedling, the experiment may require reestablished. In this regard, we prepared seedlings of *J. procera* in CEEFRC nursery site.

2.4.6 Expected outputs

The outsmarted organic and in organic soil amendments having paramount importance on tree growth and survival in degraded frost prone areas, will be identified and recommended.

3. Summary of Utilized Budget

For implementation of this project, we received a grant of 1,003,360.00 Ethiopian Birr. About 27.6 % of the grant (277,080 ETB) had released in two rounds. Ten percent of the released budget (27,708 ETB) had been deduct for the overhead cost by the institute and the rest 249,372 ETB allotted for operational costs. Even if the institute will report our financial performance separately, the following table shows short summary of our performance.

Table 3/ summary of our financial performance

allocated budget	**Released budget**	**Utilized budget /ETB**	**Utilized budget /%**
1,003,360.00	277, 080.00 (27.6%)	263,562.46	From released: **95.1%**

			From allocated: **26.3%**

4. **Future action plan and budget requirement**

4.1 Action plan and budget requirement

Table 4. Action plan of the remaining works and their budget requirement of the year 2021

No_	Activities	2021 fiscal year		Budget plan		Remark
		July-September	October - December	Budget description	Total Amount	
.	**Developing frost risk map for frost affected highlands of Ethiopia**					
	Collected required information (climate and topographic data)			Purchase	15000	
	Developing and publishing the map			Per-dime	25000	
				Transport/fuel/Rent	15000	
.	**Evaluating the appropriate frost management techniques that improve the survival and growth performance of tree species in degraded frost affected highlands**					
	• Site preparation, layout, and strengthening the fence • Seedling planting and replanting • follow up and tending operations			Purchase	20000	Not yet established other centers and replanting is needed at CEEFRC
				Per-dime	21000	
				Labor	20600	
				Transport/fuel/Rent	15000	
	• Experimentation and seedling preparation (procuring material inputs and quality seedling)			Purchase	25000	
				Per-dime	22000	
				Labor	25000	
				Transport/fuel/Rent	18000	
.	**Evaluation and selection of tree species in the function of different planting time and seedling size in frost affected highlands**					
	• Site preparation, layout, and strengthening the fence • seedling planting and follow up			Purchase	20000	Not yet stablished
				Per-dime	21000	
				Labor	35000	
				Transport/fuel/Rent	25000	
	• Experimentation and seedling preparation (procuring material inputs and quality seedling)			Purchase	35000	
				Per-dime	22000	
				Labor	30000	
				Transport/fuel	18000	
. .	**Effect of inorganic and organic fertilizer on growth performance (frost hardiness) of selected tree species on frost affected areas**					
	• Site preparation, layout, and strengthening the fence • Seedling planting and replanting • follow up and tending operations			Purchase	15320	Reestablish at CEEFRC and will be establish at Hawassa and Bahirdar centers
				Per-dime	21000	
				Labor	25600	
				Transport/fuel/Rent	25000	
	• Experimentation and seedling preparation (procuring material inputs and quality seedling)			Purchase	20000	
				Per-dime	22000	
				Labor	30000	
				Transport/fuel/Rent	18600	
.	**Workshop and field visit**			Per-dime	50000	

No_	Activities	2021 fiscal year		Budget plan		Remark
		July-September	October - December	Budget description	Total Amount	
				Refreshment	49000	Presenting preliminary result at district level
				Purchase	8000	
				Transport/fuel/ Rent	14160	
TOTAL					**726,280.00**	