



Ethiopian Environment and Forest Research Institute (EEFRI)



Strategic Plan
2016 - 2025



Ethiopian Environment and Forest Research Institute (EEFRI)

**ETHIOPIAN ENVIRONMENT AND
FOREST RESEARCH INSTITUTE
(EEFRI)**

STRATEGIC PLAN

2016–2025

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ACRONYMS

ABCDE	Assessment, Baseline, Components, Down to specifics and Evaluation
BEFRC	Bahir Dar Environment and Forest Research Centre
CEEFRC	Central Ethiopian Environment and Forest Research Centre
CRGE	Climate Resilient Green Economy
CO₂-e	Carbon Dioxide equivalent
DG	Director General
DDG	Deputy Director General
DEFRC	Dire Dawa Environment and Forest Research Centre
EEFRI	Ethiopian Environment and Forest Research Institute
GTP	Growth and Transformation Plan
MEFCC	Ministry of Environment, Forest and Climate Change
MEFRC	Mekelle Environment and Forest Research Centre
MoFEC	Ministry of Finance and Economic Cooperation
MoPSHR	Ministry of Public Service and Human Resource
HEFRC	Hawasa Environment and Forest Research Centre
JEFRC	Jimma Environment and Forest Research Centre
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RDPS	Rural Development Policy and Strategies
SPD	Strategic Plan Document
SWOT	Strength, Weakness, Opportunity and Threat
TD	Technical Directors

PREFACE

In the changing scenario today, the focus of research in environment and forestry must be in a position to bring quick and drastic changes and improve the economic and social wellbeing of the society through technology development and knowledge advancement. Through provision of technologies, knowledge, and information for the public and the government, research will contribute to: productivity enhancement, quality improvement, income generation, creation of employment opportunities, poverty alleviation, and realization of climate resilient green economy.

To this end, Ethiopian Environment and Forest Research Institute (EEFRI) was established by the Government of the Federal Democratic Republic of Ethiopia on December 26/2014. EEFRI is an autonomous nationally mandated governmental research institute whose mission is to adapt relevant local and exotic technologies, conduct prudent research projects, and disseminate technologies, skills and policy briefs; and also coordinate research projects that are carried out by higher learning and other research institutions and serve as a national repository where scientific data, reports, theses, dissertations, etc. in the areas of climate change, environment and forestry are stored, processed and used.

EEFRI has set a very clear goal right at its inception stage that it carries out research that should be in harmony with national development priorities in order to spawn socio-economic and ecological benefits for the people of Ethiopia. This strategic plan document paves the way what EEFRI aspires in order to be sustainable, accessible and, by 2025, to be one of the top five research hubs in Africa in the areas of environment, forestry and climate change. This strategic plan document has passed through several stages of thorough preparations: from setting up a committee, collecting as well as processing of data and information, writing up draft to editing and publishing. In each step of the preparation, professional and experienced people have made paramount contributions. They all deserve sincere appreciation. My heartfelt thankfulness and appreciation go to the Strategic plan preparation committee from the Ethiopian Environment and Forest Research Institute, particularly to Prof. Fassil Kebede, Dr. Teshome Tessema, Ato Berhane Kidane and Dr. Abayneh Dirrero, for their commitment to the preparation of this document. Besides, I am thankful to Dr. Aynalem Abebe, Ato

Getachew Desalegn and Ato Mindaye Teshome for their contribution to the preparation of the first draft document. I am also grateful to Dr. Agena Anjulo, Deputy Director General of EEFRI for his valuable comments. Finally, I am also beholden to thank all directors and staff of the various directorates of EEFRI for their worthwhile contributions. Conclusively, I wish you all the best and success as we all have toiled hard to put the strategic plan document into operations.

Wubalem Tadesse (PhD)

Director General

EEFRI

EXECUTIVE SUMMARY

The main purpose of this strategic document is to lay out a road map for the coming ten years for the newly established EEFRI. As a nationally mandated public research institution, EEFRI is expected to respond to the various demands and interests of the society related to environment, forestry and climate change. Presently, issues such as deforestation, forest degradation, environmental pollution, climate change, land degradation, decline of productivity, drought, and desertification need serious attention both from the government and the public sectors. In response, EEFRI, as an autonomous and authoritative federal institution, is commissioned and/or mandated to import and adapt relevant technologies; conduct rigorous research activities nationally; disseminate technologies, knowledge and solutions; and coordinate other research projects that are carried out by a non-EEFRI research and higher learning institutions in the areas of environment, forestry and climate change.

In order for EEFRI to serve its establishment purposes, preparation of a strategic plan document was found to be imperative and pragmatic. As a result, this strategic plan document was prepared for a period of ten years, which will commence as of July 1, 2016. The strategic plan document fundamentally is a road map of EEFRI to achieve its vision to be among the top five research institutions in Africa by 2025 in the fields of environment, forestry and climate change. The document embraces an introductory chapter where the national circumstances, research reviews, governance, vision, mission, values and guiding principles are presented succinctly. Then, in the subsequent chapters, issues akin to strategic context, strategic goals, objectives and activities are subsumed. Finally, in the last two chapters, the document presents, the strategic action plans and monitoring and evaluation highlights.

The strategic issues identified and formulated in this document are relevant, measurable and achievable. The milestones set will help to frame and streamline EEFRI to render better services to all stakeholders. In the document, it is underlined that in order to be able to move the institute forward, building institutional capacity through creating a superior infrastructure and trained human resource is of paramount importance. Induction of new skills through organizing training and exposure visits will help EEFRI's researchers to be kept abreast of latest scientific and technology developments. It is also underscored that periodic revision of the organizational structure, as deemed necessary and external conditions permit, will enormously help EEFRI to thrive in the world of challenges and dynamism. Currently, there is a need for partnership among research and policy makers, educational institutions, business

entrepreneurs, funding organizations, etc. more than ever before, and developing research-extension-industries partnership is an effective tool in order to achieve vision of the institute.

Thus, the strategic plan document commands to establish an entity or an office responsible for research- extension-industry linkages. The strategic plan document also underscores the need for automating all financial, human resource, and research systems of EEFRI. Enhancing IC and GIS technology at EEFRI can help transforming and modernizing services in data storage, acquisition, retrieval, processing, interpreting and presenting research results in environment, forestry, and climate change. In conclusion, the strategic plan document firmly dictates that a full-fledged office for strategy and institutional transformation must be established with mandates of leading, guiding and assisting the implementation of the issues outlined in the strategic plan document.

1. INTRODUCTION

1.1 National Circumstances of Environment and Forestry Sectors

Ethiopia is a country with high biodiversity and distinctive ecosystems. Located between 33° and 48° East longitude, and 3° and 15° North latitude, it comprises an area of 111.5 million hectares (ha). Out of this, 74 million ha or 66% of the total area is deemed suitable for agriculture. The country's population is estimated at 87 million and is expected to reach 120 million by the year 2030. Ethiopia can be characterized as having a rugged and mountainous topography with the altitude ranging from a height of 4,620m above sea level at Mount Ras Dashen in North Gondar to a low of 110m below sea level in the Dalol Depression of the Afar region. Mean annual rainfall distribution decreases from the southwestern areas, which have the highest rainfall, to the drier northern and eastern parts of the country. The environment in Ethiopia is endowed with farmlands, lakes, rivers, livestock, forests, woodlands, grasslands, wildlife and plenty of open spaces. Approximately 60% of Ethiopia's land surface is classified as arid and semi-arid, while the remaining 40% being sub-humid and humid, and thus, of high agricultural potential. Unlike the rural areas, the urban environment in Ethiopia is characterized by such variables as very high population, high density of housing, crowded market centres and contamination from industrial effluent. Of all the environmental problems, the country's most critical concern focuses on the management and utilization of its land resources.

Ethiopia's natural resources are critical to the economy and form the basis of the livelihoods of its people. The recent track record demonstrates that the country can achieve double-digit growth rates. Between 2005 and 2010, the country's real GDP grew by 11% with the service sector accounting for the highest growth (15%). Building on the positive development of recent years, Ethiopia intends to reach middle-income status (GDP per capita of around USD 1,000) within 15 years. In connection, forestry is one of the indispensable chain-links of the national economy that plays a vital role in the development of the country. To date, the contribution of the forestry sector to GDP, through the production of honey, forest coffee, and timber, is estimated to be 4%. However, considering the great untapped potential, the

forestry sector can contribute more to the overall growth of the GDP through increasing forest productivity and value addition.

Forests play an important role in environmental protection, including protection against soil erosion and sedimentation, and in controlling water flow, floods and water quality. The loss of forest cover due to unplanned harvesting or land use conversion will result in serious consequences. Forests are very important in reducing surface water flow and increasing infiltration. Watershed forests, especially natural forests with multi-layered canopies are very important in maintaining water flow rates during rainy seasons and in supplying water during dry seasons for local use, hydro-power generation and irrigation.

In spite of their economic and environmental value, Ethiopian forests are under threat. The growing population requires more fuel wood and more agricultural production, in effect creating needs for new farmland – both of which accelerate deforestation and forest degradation. Projections indicate that unless action is taken to change the traditional development path, an area of 9 million ha might be deforested between 2010 and 2030. Over the same period, annual fuel wood consumption will rise by 65% – leading to forest degradation of more than 22 million tons of woody biomass.

Environmental challenges, which include soil degradation, pollution of land, air and water, and climate change, are aggravated. Air and water pollution from domestic and industrial wastes is becoming a growing problem in Addis Ababa, as a result of the industrial expansion and social transformation processes taking place in the country.

As reported by various sources, human settlement, expansion of agricultural investment, high demand of forest products for fuel wood and construction purposes, climate change and forest fire are the natural and anthropogenic factors that contribute to the depletion and decline of forest resources.

With the growing economy, the demand for wood and wood products is also alarmingly increasing during the last few decades. As a result, there is a serious shortage of wood supply for the blooming industry and household consumption. The shortage has forced communities to resort to high exploitation of existing forest resources and the country to import wood products from abroad.

Hence, to tackle such intricate problems and to build a green and middle income nation by 2025, the government of Ethiopia has given much attention for the environment, forestry and climate change. Evident to this, it has established a ministry, the FDRE Ministry of Environment, Forest, and Climate Change, and an institute, the FDRE Environment and Forestry Research Institute, which will have a great role in bringing sustainable environmental and forest resources management into the picture and enabling the sector to properly contribute to the national economy.

In order to realize this aim, research must play a leading role in addressing current environment and forest related problems focusing on tasks emphasized below:

- 1** Various forest types must be sustainably established, managed, protected, utilized and developed. Existing natural forests should be well-managed; forest plantation areas should be expanded and their productivity should be improved; agro-forestry activities should be strengthened and industrialized; and bare lands should be used effectively and properly for forestry development. Timber and NTFP production and processing must be competitive and sustainable to satisfy the needs for domestic consumption, export of timber products, and utilization of other forest products.
- 2** Forestry in 5 million ha of forests and 2 million ha of woodlands alone represents around 50% of the total domestic abatement potential (or 130 Mt CO₂-e) and, as a sector, can even yield ‘negative emissions’ via sequestration, i.e., storage of carbon in the form of wood, at a level that surpasses emissions from deforestation and forest degradation. The single most important lever is to reduce demand for fuel wood through fuel wood efficient stoves, offering a potential of almost 35 Mt CO₂-e reduction, while other advanced cooking and baking technologies (electric, biogas, and LPG stoves) offer an additional combined potential of more than 15 Mt CO₂-e. Capturing this potential requires the switch of more than 20 million households to more efficient stoves. In addition, afforestation (2 million ha), reforestation (1 million ha), and forest management (2 million ha of forests and 2 million ha of woodlands) can help to increase sequestration by more than 40 Mt CO₂-e and hence even surpass any remaining emissions

from the forestry sector. Pressure from agriculture on forests can be reduced by agricultural intensification on existing land or by unlocking degraded land to irrigation, with the potential to lower deforestation and thus the associated emissions by nearly 40 Mt CO₂-e in 2030.

- 3 Livelihood improvement for tree farmers must be carried out through socialization and diversification of forestry activities. Employment opportunities should be created; capacity and awareness and livelihoods of people should be improved. Farmers must earn their livelihoods from forestry activities, and contribute to hunger alleviation, and poverty reduction.
- 4 Environmental protection should aim at effectively contributing to watershed management, urban protection, natural disaster mitigation, erosion control, protection of water sources and environmental protection; and at creating income sources from environmental services (environmental fees, CO₂ market, ecotourism, etc.) for increasing GDP of the country.

1.2 National and International policies, strategies and conventions

Ethiopia has developed policies, strategies, laws and regulations related to environmental protection and forest development with the aim of enhancing the socioeconomic and environmental contributions of the sector.

Forestry policy

The federal and regional governments of Ethiopia recognize the economic and social values of forests and support their conservation and management for sustainable use. Forestry sector policies include:

- ◆ the regulatory framework for the management and development of public forest lands and the utilization of public forests;
- ◆ policies governing the pricing and marketing of forest products;
- ◆ policies for public enterprise management and for private-sector development.

The Conservation Strategy of Ethiopia, the Ethiopian Forestry Action Plan and the National Action Plan to Combat Desertification are among the most relevant policy initiatives taken by the government to confront forest resources degradation.

Forestry legislation

The Legislations of Ethiopia, which impact the forestry sector directly, are Climate Resilient Green Economy Strategy; the Ethiopian Water Resources Management Policy; the National Population Policy of Ethiopia; the National Policy on Bio-diversity Conservation; the Energy Policy; Forestry Conservation, Development and Utilization Proclamation No. 94/1994; Forest and Wildlife Conservation and Development Proclamation (No. 192/1980); Exploitation of Private Forest Regulations (L. N. No. 346 of 1968); Rural Development Policy and Strategies and The Federal Forest Law.

Policy and legal regime on environment since 1994

Over the past few years, there has been a growing perception and commitment towards an improved natural resources management and environmental protection regime in the country. Consequently, in order to address the environmental problems and head towards achieving sustainable development, the mechanism of environmental protection adopted by Ethiopia since 1994 could be characterized by a three-stage approach.

i Constitutional Measures

The first stage marked incorporation of environmental issues into the supreme law of the land. In this regard, the current Constitution of Ethiopia has defined the environmental values to be preserved and protected. The 1994 Constitution of Ethiopia, under Articles 44 and 92, proclaims that all citizens shall have a right to live in a clean and healthy environment. Government and citizens shall have a duty to protect the environment. The design and implementation of programmes and projects shall not damage or destroy the environment.

ii Policy Measures

The second stage was formulation of national policy and strategy on environmental management and protection. The primary need in preparing national policy and strategy document on environmental matters was aiming at determining the objectives and strategies which should be used in order to ensure the respect for environmental imperatives, by taking into account the prevailing economic, social and cultural situations of the country. In this context, with a view to further amplifying the constitutional provisions on environmental protection, the Environmental Policy and the Conservation Strategy of Ethiopia have been prepared.

iii Legislative Measures

Incorporation of environmental rights under the constitution, adoption of Environmental Policy and the Conservation Strategy of Ethiopia; ratification of multilateral environmental conventions; establishment of the Environmental Protection Authority are some of the basic moves towards heading for environmental protection and sustainable development in Ethiopia.

Some key proclamations to enforce sensitive environmental issues are highlighted below:

- ◆ proclamation on the establishment of environmental protection organs
- ◆ environmental impact assessment proclamation, and
- ◆ environmental pollution control proclamation

In addition, in the course of three decades, i.e., from 1972 to 2002, a number of major multilateral environmental agreements have been adopted as a basis for state obligations with regard to sustainable development. In this context, Ethiopia has ratified the multilateral environmental agreements including the Convention on Biological Diversity; the Basal Convention on the Control of Trans-boundary Movements of Hazardous Wastes; the United Nations Framework Convention on Climate Change; the United Nations Convention to Combat Desertification; the Vienna Convention and the Montreal Protocol for the Protection of the Ozone Layer; the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade; and the Stockholm Convention on Persistent Organic Pollutants.

1.3 Research Synopsis in Environment, Forestry and Climate Change

Environmental research is cross cutting by its nature, and organized research was lacking in Ethiopia. So far some notable contributions come from different institutions and include both governmental and non-governmental institutions. The focus and objectives of each of the institutions varies based on the nature of projects and the mandate of the institutions. The main actor was Environmental Protection Authority (EPA) with objectives of formulating policies, strategies, laws and standards, which foster social and

economic development in a manner that enhances the welfare of humans and the safety of the environment sustainably, and to spearhead ensuring the effectiveness of the process of their implementation. Moreover, the authority has conducted various studies on water and air pollution, and on conflicts of land uses and economic benefits. Other institutions which were engaged in environmental issues have been focusing on policy, project studies, dry land management, and review of Ethiopian environment as part of the fulfilment of requirements for graduation.

Forestry research and flora studies in Ethiopia has passed through distinct historical milestones: 1) period before 1895 which was characterized by exploration expeditions, 2) period from 1895 to 1975 which marks period flora exploration; introduction of various tree species, namely *Eucalyptus*, *Acacia*, *Casuarina* and *Pinus* in 1895; and establishment of the Forestry Research Institute within the Addis Ababa University in 1961, 3) period from 1975 to 1997 marks the period in which the Forestry Research Centre (FRC) and the Wood Utilization and Research Centre (WUARC) were established. Both research centres were involved in conducting organized forestry research, and 4) the period from 1997 to 2013 marks the epoch where the mandate of forestry research and the two centres (FRC and WUARC) were transferred to the Ethiopian Institute of Agricultural Research (EIAR), the then Ethiopian Agricultural Research Organization (EARO) (Teketay, 2004), and 5) since 2013, a new era during which the forestry, environment and climate change sectors are brought together under an autonomous federal institute, EEFRI, to conduct multi-disciplinary and action-oriented research activities that can directly assist the nation in solving societal multifaceted predicaments.

Formal forestry research was possible after the establishment of the Forestry Research Centre and Wood Utilisation Research Centre. In addition to the two centres, several agricultural research centres of the Ethiopian Institute of Agricultural Research were also engaged in agro-forestry research. In addition, Addis Ababa University, Haramaya University, Wondo Genet College of Forestry and Natural Resources and Hawasa University, Ambo University, Jimma University, and the International Livestock Research Institute were active in forestry and agro-forestry related researches in Ethiopia. According to EARO (2000), the various forestry researches, which included silviculture, agro-forestry, forest management and economics, forest protection and tree seed researches, were conducted and completed throughout Ethiopia.

Besides, the various researches, a strong tree seed service was active and tree seed service was improved since the establishment of the Forestry Research Centre.

A number of research articles have been also published in environment and forestry by several academic and research institutions on relevant problems in Ethiopia. The expansion of research institutes and public universities and the continued engagement of international institutions on environment, forestry and climate change issues in Ethiopia have contributed to the proliferation of highly valuable publications.

2. MISSION, VISION, VALUES AND GOVERNANCE OF ETHIOPIAN ENVIRONMENT AND FOREST RESEARCH INSTITUTE

2.1 Mission

To import and adapt relevant technologies; and to conduct and coordinate research in the areas of environment, forestry and climate change, thereby generate and disseminate suitable technologies and information for end users to fulfil the high demand for forest products, safe environment and climate resilient green growth of the country.

2.2 Vision

To be one of the top five research institutions in environment, forestry and climate change research in Africa by 2025.

2.3 CORE VALUES

EEFRI adheres to core values of:

- ◆ Transparency
- ◆ Creativity
- ◆ Accountability
- ◆ Efficiency and effectiveness
- ◆ Team spirit

- ◆ Credibility
- ◆ Responsiveness
- ◆ Ethical research

2.4 Guiding Principles

EEFRI shall:

- ◆ Conduct demand driven and problem solving research without duplicating efforts
- ◆ Render quality services
- ◆ Promote cooperation among stakeholders and partnersSupport proposals that fulfils the strategic mission, vision and goals
- ◆ Solicit resources to compliment government's budget
- ◆ Practice transformational leadership

2.5 Governance

EEFRI is the highest governmental scientific body that focuses on planning, conducting, and coordinating research, and promoting and advancing technology, information and knowledge in the area of environment, forestry and climate change. EEFRI ensures scientific management of forestry, environmental and climate change research, technology development and dissemination. EEFRI carries out research under various research programmes through eight research directorates, twenty two divisions, two coordination offices and seven research centres, which are located in different bio-geographical regions of the country to cater to the environment, forestry and climate change research needs of the nation. Fig 1 depicts the existing institutional set up of EEFRI.

2.6 Directorates

- ☑ **Plantation and Agro-forestry Research Directorate**
 - ◆ Plantation Forest Research Division
 - ◆ Agro-forestry Research Division
 - ◆ Degraded Land Rehabilitation Research Division

- ☑ **Forest Resources Utilization Research Directorate**
 - ◆ Non-Timber Forest Product Research Division
 - ◆ Timber Characterization, Design and Utilization Research Division
 - ◆ Bio-Energy and Bio-chemical Research Division
- ☑ **Ecosystem Management Research Directorate**
 - ◆ Natural Forest Ecology and Management Research Division
 - ◆ Aquatic and Wetland Ecosystem Management Research Division
- ☑ **Forest Protection Research Directorate**
 - ◆ Forest Pathology and Entomology Research Division
 - ◆ Forest Fire and Parasitic Flowering Plants Research Division
- ☑ **Climate Science Research Directorate**
 - ◆ Climate Modeling and Risk Management Research Division
 - ◆ Climate Change Mitigation and Adaptation Research Division
- ☑ **Environmental Pollution Management Research Directorate**
 - ◆ Environmental Pollution Research Division
 - ◆ Waste Management Research Division
- ☑ **Environmental Laboratory Directorate**
 - ◆ Physico-chemical Laboratory Division
 - ◆ Biological Laboratory Division
- ☑ **Socio-economic, Policy, Extension and Gender Research Directorate**
 - ◆ Socio-Economics and Policy Research Division
 - ◆ Extension and Gender Research Division

2.7 Coordination Units

- ☑ **Tree seed Technology Coordination Unit**
 - ◆ Tree Seed Sources Management and Procurement Division
 - ◆ Tree Seed Biology Research Division

- ☑ **Biometrics, GIS, and Remote Sensing and Database Coordination Unit**
 - ◆ Biometrics and Data Base Division
 - ◆ GIS and Remote Sensing Division

2.8 Research Centres

EEFRI operates in 7 research centres that are located at distinct bio-geographical locations in the country (see Fig 2). These centres are:

- ☑ Central Ethiopia Environment and Forest Research Centre
- ☑ Wood Technology Research Centre
- ☑ Mekelle Environment and Forest Research Centre
- ☑ Bahir Dar Environment and Forest Research Centre
- ☑ Hawassa Environment and Forest Research Centre
- ☑ Jimma Environment and Forest Research Centre, and
- ☑ Dire Dawa Environment and Forest Research Centre

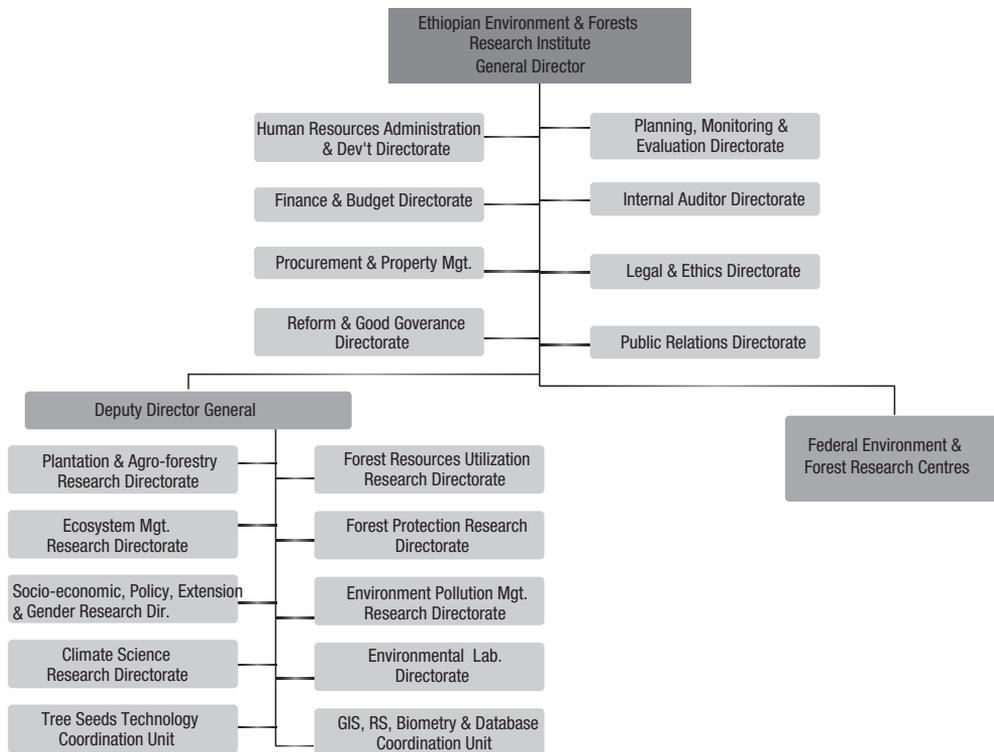


Fig 1: Organizational structure of EEFRI

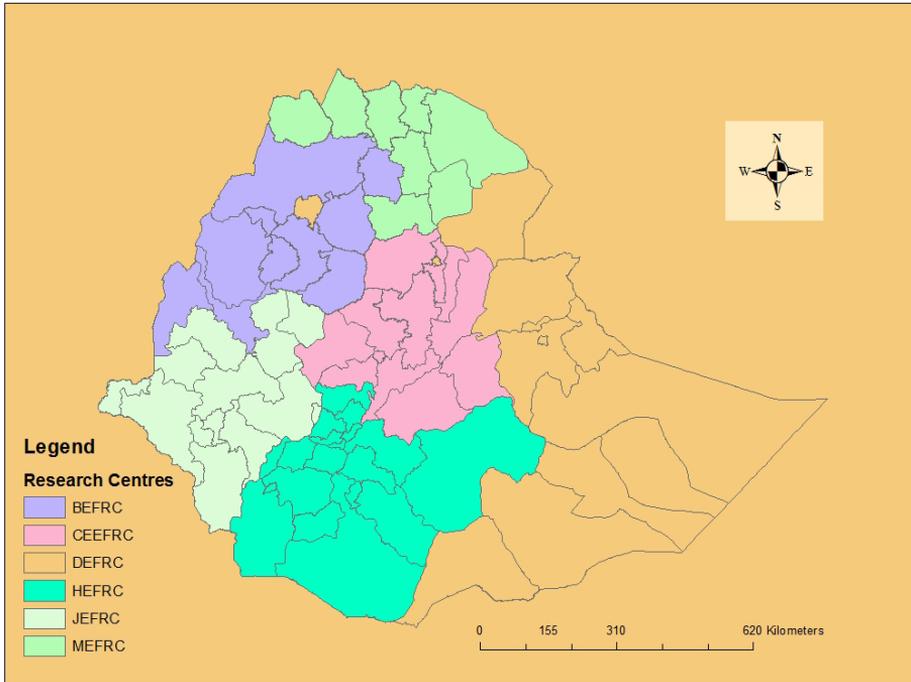


Fig 2: Location of EEFRI's research centres

3. STRATEGIC CONTEXT

3.1 Purposes of the Strategic Plan

The purpose of this strategic plan is to lay out a road map and mode of implementation and evaluation for EEFRI in order to discharge its duties and responsibilities for the years 2016 -2025.

This plan sets priorities to be accomplished in the coming ten years at the corporate level. It is meant towards becoming a centre of excellence in environment, forestry and climate change in Africa by the year 2025. The plan outlines the major areas of focus where both financial and other resources should be channelled into technology generation, research coordination, capacity building and system development and dissemination of technologies. It is hoped that high performance will be achieved if the plan is implemented properly and EEFRI will be in a position to significantly contribute to solve major forestry, environment and climate issues in Ethiopia. It is assumed that all directorates and sections will develop their own strategic plans based on this corporate strategic plan.

3.2 Approaches Used for Preparation of the Strategic Plan

Preparation of the strategic plan document followed three steps, namely gathering of baseline information and other relevant documents; draft SPD preparation and approval. In the preparatory phase, baseline information on environment, forestry and climate change in Ethiopia were collected and analyzed. Then the draft SP preparation was conducted using various tools such as ABCDE model (A= Assessment, B= Baseline, C= Components, D= Down to specifics and E= Evaluation) to guide the whole strategic planning process; SWOT (strength, weakness, opportunity, threat) tool to identify challenges and opportunities; and BSC (balanced score card) to set targets for finance, customer satisfaction, business process and learning and growth and monitoring progresses. The draft SPD was circulated and deliberated later on at three different workshops involving EEFRI researchers and stakeholders, and subsequently the draft was enriched incorporating comments from the workshops. Finally, the strategic plan document was approved by EEFRI management.

4. STRATEGIC ISSUES

4.1 Swot Analysis

EEFRI's strengths, weaknesses, opportunities and threats:

After assessing the internal environment of EEFRI critically against those criteria, such as rules and regulations, human resource, infrastructure, governance, linkage and networking, operations and systems, technology generation and extension; major strengths, weaknesses, opportunities and threats were identified.

Strength

- ◆ Experienced research staff in forestry
- ◆ New research staff attraction package
- ◆ Research experience in forest resources management and utilization
- ◆ Good experience on environmental monitoring

- ◆ Research review forum
- ◆ Experience in dissemination of forest technology, knowledge and information
- ◆ Experience in networking and collaboration in the field of forestry

Weakness

- ◆ Absence of directorate level research strategies
- ◆ Absence of state-of-the art research facilities (laboratories, cold storage, greenhouses, lath-houses, etc.)
- ◆ Limited technologies, knowledge and information in the area of forestry
- ◆ Lack of technologies, knowledge and information in environment and climate change disciplines
- ◆ Absence of a system for coordinating research projects
- ◆ Shortage of skilled researchers
- ◆ Absence of research-extension-industry linkage
- ◆ Absence of a system for international partnership and technology shopping
- ◆ Absence of a system for technology approval, registry and release
- ◆ Lack of a national repository and system for data storage, documentation, knowledge management and communications
- ◆ Inefficient system for research project review, approval and M&E
- ◆ Lack of budget-based human resource capacity development programme
- ◆ Poor staff attraction and retention benefit package for support staff
- ◆ Incomplete system for staff recognition
- ◆ Lack of full-fledged and multipurpose buildings for HQ, Research Centres, Sub-centres and Research Stations
- ◆ Insufficient number of vehicles and motor bikes
- ◆ Limited field equipment and absence of machines for forest mechanization

- ◆ Absence of system automation
- ◆ Absence of robust system for procurement and finance.

Opportunities

- ◆ Increased demand for tree seeds, forest products and utilization both nationally and internationally
- ◆ Development of mega projects, such as GERD and other dams, large scale industries, urbanization, etc, calls for environmental research
- ◆ Encouraging plans, policies, strategies, multilateral agreements and conventions (CRGE, GTPNAMA, REDD+, ICBC, ICCD, IPCC, POPs, PCBs, obsolete pesticides and other organic and inorganic pollutants etc.)
- ◆ New Ministry of Environment, Forest and Climate Change
- ◆ Global technological advancement (software, GIS, IT, etc)
- ◆ Bio-geographic suitability of the country for forest enterprise development
- ◆ Current industrialization and urbanization in the country
- ◆ Cultural and ethnic diversity with magnificent indigenous knowledge and experience in NRM
- ◆ Availability of competitive grants in climate change research

Threats

- ◆ Absence of a national surveillance and control system for pest and disease outbreak
- ◆ Weak germplasm regulation system
- ◆ Shortage of forage and fodder
- ◆ Aggravated drought, land degradation, desertification, and loss of bio-diversity, encroachment of bushes, lake shrinkage and expansion.

4.2 Stakeholder Analysis

Analysis of stakeholders addresses expectations and potential impacts if their expectations are not met. Table 4.1 summarizes expectations of the stakeholders and the potential impacts.

Table 4.1: *A summary of stakeholder analysis*

Stakeholders	Expectations of stakeholders	Consequences if the expectations are not met
Tree farmers and pastoralists	Tree seeds, and technologies, knowledge, and information on forests and climate change	Diminishing of forest cover
Higher learning institutions	Access to scientific database, sponsorship of graduate students, supervision, lecturing, joint proposal development, joint publication, access to research sites and laboratories, assistance in curriculum development and revision, access to germplasm	Affects quality of graduates Limits research quality Reduces number of graduates Degrades reputation of the institute
Research institutes	Joint proposal development, joint publication, access to research sites and laboratories, organizing of joint scientific forums	Compromises research output Degrades reputation of the institute
Development actors (state and non-state)	Technologies, training, services	Vision of the institute would not be realized
Private sectors and industries	Technologies, training, services	Loses trust and acceptance Loses clients Reduces productivity / profitability of users
Development partners	Better capacity built, technologies, knowledge and information generated and delivered to end users	Loses trust Affects the services of partners Shortage of funds
MEFCC	Technologies, training, policy advice, services	Malfunctioning in discharging duties and responsibilities
MoFEC	Problem solving research projects and reports	Failure in implementing approved projects
Government/parliament	Fulfilling establishment objectives, which are technology generation, research coordination, capacity building and system development and technology dissemination to end users	Affects government goal May instigate legal action
CBOs and civic societies	Technologies, training and services	Knowledge and technology gap

4.3 Identified Strategic Issues

This strategic document highlights the following priority issues that need immediate attention in order to achieve EEFRI's strategic mission.

4.3.1 Environment, Forestry, and Climate Change Research

Issues, which require immediate attention in the strategic period, are presented here below:

- ◆ Preparation of research thematic areas by the respective research directorates
- ◆ Sustainable seed source development, quality seed supplies and tree seed system
- ◆ Improved pre- and post-plantation & nursery management
- ◆ Contributing to the preparation of national forest land use plan and national forest development plan
- ◆ Forest soils evaluation and management
- ◆ Maintaining and improving tree genetic diversity through conventional and modern breeding and genetic engineering
- ◆ Sustaining and improving traditional agro-forestry systems
- ◆ Enhancing commercial agro-forestry, industrial plantation and urban forestry
- ◆ Developing yield tables and silvicultural management tools
- ◆ Screening and availing sufficient and diverse fodder tree/shrub species
- ◆ Rehabilitation of degraded lands
- ◆ Restoration, conservation and management of woodland and degraded high forest
- ◆ Preserving and managing of aquatic and wetland ecosystem
- ◆ Standardizing and certification of tree seeds, timber and non-timber products
- ◆ Enhancing timber and non-timber production, characterization, utilization and products
- ◆ Improving biomass, bio-energy and biochemical processing and production
- ◆ Forest pest, fire and parasitic flowering plants management
- ◆ Contributing to the formulation and enforcement of environmental policy and criminology

- ◆ Benchmarking methodologies for environmental pollution studies; designing, developing and promoting case-specific environmental pollution management
- ◆ Developing capacities to solicit grants, networking and collaboration
- ◆ Creating a wide ranging awareness among the public on handling and disposal of wastes, obsolete pesticides and other pollutants
- ◆ Knowledge-based and research-lead protection of the environment around mega projects
- ◆ Working towards climate change adaptation and mitigation
- ◆ Increasing climate change financing and trading through proper quantifying of carbon stock
- ◆ Combating drought, land degradation, desertification, loss of tree bio-diversity, encroachment of bushes, lake shrinkage and expansion, etc.
- ◆ Documenting, protecting and using indigenous knowledge
- ◆ Institutionalizing a system for gender mainstreaming in research projects

4.3.2 Technology promotion, dissemination, communication and knowledge management system

In order for EEFRI to achieve its strategic vision, it is also imperative and pragmatic to pay due attention to the following identified key activities.

- ◆ Establishing a periodical extension forum with stakeholders at different levels
- ◆ Instilling a vibrant system for research outputs dissemination, such as production of technology manuals, brochures, extension package, etc.
- ◆ Building a capacity for staff on how to write winning project proposals and publish their pieces of works in peer reviewed and credible journals.
- ◆ Creating a national repository and a system for data storage, documentation, knowledge management and communications.
- ◆ Establishing a mechanism for technology shopping, technology approval, registry and release.
- ◆ Improving the system for research project review, approval and M&E.

4.3.3 Research Coordination and Networking

During the strategic period, improving the efficiency and efficacy of networking and coordination in research activities in the areas of environment, forestry and climate change with relevant national and international institutions is unequivocal. Hence, the strategic elements underlined below require due consideration.

- ◆ Creating a system for coordinating research activities at national level in environment, forestry and climate change which will be carried out by different research, development and higher learning institutions.
- ◆ Establishing an efficient system for regulating research activities that will be implemented outside EEFRI through designing a system for registry and reporting.
- ◆ Introducing a national council for environment, forestry and climate change research.

4.3.4 Human Resource Development

In order for EEFRI to fulfil its strategic mission, the human resource development endeavour of the institute will need:

- ◆ Training programmes in the local higher learning institutions.
- ◆ A system for recruiting competent professionals from the international labour market, when not available in the domestic market.
- ◆ Budget-based human resource capacity development programme.
- ◆ Staff attraction and retention benefit package for support staff.
- ◆ A system for staff recognition.

4.3.5 Infrastructure Development

Developing state-of-the-art infrastructure at EEFRI will boost its multi-dimensional engagements productively. Thus, the following strategic issues are identified as top priority:

- ◆ Multipurpose buildings including for HQ, research centres, sub-centres and research stations
- ◆ State-of-the-art laboratories
- ◆ Chemicals and reagents
- ◆ Cold storage
- ◆ Greenhouses and lath-houses

- ◆ Vehicles and motor bikes
- ◆ Field equipment and machines for forest mechanization
- ◆ Efficient automation system.

4.3.6 Governance, Strategy and Policy

Empowering and streamlining the leadership of EEFRI during the strategic period will be instrumental. Therefore, the following governance, strategy and policy issues should be given special emphasis.

- ◆ Producing Strategic Plan Document for the respective research directorates.
- ◆ Preparation of various working manuals, guidelines, rules and regulations.
- ◆ Institutionalizing a research-extension-industry coordination system.
- ◆ Development of a system for periodical leadership capacity building.
- ◆ Introducing an efficient procurement and financial system.

5. STRATEGIC GOALS AND OBJECTIVES

5.1 Summary of strategic goals and objectives

Goal 1: Importing relevant technologies, conducting research to develop suitable technologies, and generating knowledge and information

Strategic objective 1: Conducting demand driven and problem solving plantation forest research, developing 35 technologies, and generating 40 information packages

Strategic objective 2: Conducting demand driven and problem solving agro-forestry research activities, developing 37 technologies, and generating 43 information packages

Strategic objective 3: Conducting need based and problem solving rehabilitation of degraded land and developing 27 technologies and 35 information packages

Strategic objective 4: Conducting demand driven and problem solving research on natural forest ecology and management, developing 13 technologies, and generating 69 information packages

- Strategic objective 5: Conducting research on natural aquatic and wetland ecosystem management, developing 23 technologies, and generating 52 information packages.
- Strategic objective 6: Conducting demand driven and problem solving non-timber products and utilization research, developing 41 technologies, and generating 44 information packages.
- Strategic objective 7: Carrying out demand driven and problem solving timber characterization and utilization research, developing 71 technologies, and generating 31 information packages.
- Strategic objective 8: Carrying out problem solving bio-energy, biochemical and biomass research, developing 21 technologies, and generating 19 information packages.
- Strategic objective 9: Conducting demand driven and problem solving research on tree disease and insect pests, developing 16 technologies, and generating 17 information packages.
- Strategic objective 10: Conducting demand driven and problem solving research on forest fire, invasive species and other pests, developing 10 technologies, and generating 21 information packages.
- Strategic objective 11: Conducting demand driven and problem solving environmental pollution management research, developing 4 technologies, and generating 25 information packages.
- Strategic objective 12: Conducting demand driven and problem solving waste management research, developing 9 technologies, and generating 25 information packages.
- Strategic objective 13: Conducting demand driven and problem solving research on waste water, and generating 28 biotechnology based information packages.
- Strategic objective 14: Conducting demand driven and problem solving research on waste water, generating 5 biotechnology-based knowledge, and developing 1 technology.

Strategic objective 15: Conducting demand driven and problem solving research on climate change adaptation and mitigation, developing 12 technologies, and generating 19 pieces of information.

Strategic objective 16: Conducting demand driven and problem solving research on climate change modeling and risk management, developing 17 technologies, and generating 26 information packages.

Strategic objective 17: Generating 71 pieces of information for the understanding and protection of the country's natural resources and providing knowledge-based policy options to address major challenges and opportunities in the environment, forestry and climate change issues.

Strategic objective 18: Generating 28 pieces of information about the complex relationship between technological, biophysical environment, social, economic and political processes in the production, integration and use of scientific and other knowledge in environment, forestry and climate change.

Strategic objective 19: Supplying 97 tons of quality tree seed, and generating 86 quality seed sources.

Strategic objective 20: Generating 27 technologies and 31 pieces of information that can be used to improve the seed system of the country.

Goal 2: Formulating an efficient, cost effective and responsive system for technology promotion, dissemination, communication and knowledge management.

Strategic objective 1: Introducing systems to approve, register and disseminate technologies, knowledge and information.

Strategic objective 2: Improving communication skills for knowledge management.

Goal 3: Establishing a system for research coordination and networking

Strategic objective 1: Creating a system for linkage, networking and partnership.

Strategic objective 2: Designing a mechanism for coordinating research endeavours.

Goal 4: Creating an efficient system for human resource development

Strategic objective 1: Preparing a long-term human resource development plan

Strategic objective 2: Developing systems for human resource attraction and retention

Goal 5: Building a state-of-the-art infrastructure

Strategic objective 1: Constructing all season type building complexes for creating a conducive working environment.

Strategic objective 2: Creating state-of-the-art research facilities.

Goal 6: Devising and performing a responsive and proactive system for governance, strategy and policy

Strategic objective 1: Creating enabling leadership environment and improving institutional operational capacity.

Strategic objective 2: Introducing a system to increase institutional public visibility and influence.

5.2 Narrative of Goals, Objectives and Activities

Goal 1: Importing relevant technologies, conducting research to develop suitable technologies, generating knowledge and information

5.2.1 Plantation and Agro-forestry Research Directorate

Plantation Forest Research Division

As a result of the deterioration of natural forests caused by deforestation and forest degradation, the importance of embarking on plantation forests has been recognized to respond to huge demand of the society for wood and

wood products. However, the success so far is below expectation, and seeing seedlings grow up to sapling and tree levels becomes a rare case and the high mortality rate of planted seedlings has remained to be a challenge. Moreover, those planted seedlings which have managed to escape seedling mortality couldn't get proper management and have failed to achieve the objectives for which they have been planted. Technical and silvicultural failures are among the major pitfalls which have constrained the success of plantation forest development in the country. Therefore, targeted research is necessitated for developing technologies and generating knowledge and information that can turn around the existing problems and enhance plantation development and management. Research on development and management of plantation forests compel to embrace the different spheres and segments of the sub-sector and these have already been identified from the SWOT analysis.

Tree improvement research is compelling since there exists quantitative variation within and among species in terms of adaptation, growth performance, disease resistance, etc. Such differences that are of economic and ecological importance compel to explore the development of genetically improved varieties for use in afforestation and reforestation. Tree improvement involves application of genetic principles of good silviculture, and its ultimate goal is development of high yielding varieties for an industrial plantation programme, stress-resistant varieties for reclamation of marginal sites, improved nitrogen-fixing trees for agro-forestry systems or improved variety for fuel wood or bio-energy production.

Propagation research, especially macro and micro vegetative propagation techniques are essential for mass multiplication and for clonal orchard establishment. In addition, species-site matching; testing various silvicultural options for plantation development and management; developing various management tools for stand volume estimation; deciding optimum rotation period require various research endeavours. Supply of various afforestation and reforestation programmes with quality (certified, improved) seeds entails the development of strong tree seed programme, which caters for research on seeds and the tree seed service.

Research is also needed on urban forests with the aim of developing technologies that can improve the quality of urban life by providing tangible benefits as well as environmental services including food, freshwater, wood and pulp, medicines, climate regulation, water purification, pollinations, erosion control, tourism, recreation and scenery.

Strategic objective 1: Conducting demand driven and problem solving plantation forest research, developing 35 technologies and generating 40 information packages.

Activities

- ◆ Developing 9 technologies, generating 10 pieces of information and knowledge on tree improvement and domestication of industrial tree species.
- ◆ Developing 9 technologies, generating 10 pieces of information and knowledge on nursery management and propagation techniques.
- ◆ Developing 8 technologies, generating 10 pieces of information and knowledge on development and management of commercial and smallholder plantations.
- ◆ Developing 9 technologies, generating 10 pieces of information and knowledge on urban forest development and management.

Agro-forestry Research Division

Agro-forestry is a dynamic, ecologically-based natural resources management system that diversifies and increases production through the integration of trees into agricultural systems and landscapes, while simultaneously promoting social, economic and environmental benefits for land users.

Organized research in agro-forestry globally was started some 35 years ago. Agro-forestry research is intended at drawing the attention of policy makers, and is being considered as determinant of the future land use. It is a remedy for the highly deforested and degraded Ethiopian highlands whose areas are above 1500 m that comprise about 44% of the landmass, about 88% of the agro-forestry community and about 67% of the total livestock (EFAP, 1994), for provisioning of multiple forest products and services. It is also highly needed in the lowland areas that comprise significant portion of the country and have highly degraded forest types and rangelands with low quality and quantity of forage for animals. The wind prone areas of these lowlands, in particular, are affected by extreme erosion, and demands intervention in wind breaks/shelterbelts, sand dune fixation, and sustainable feed development technologies. There are also specific agro-ecological zones seeking specific agro-forestry practices related to land reclamation. Such areas include degraded lands or wastelands that have been badly eroded or overgrazed or are highly saline or alkaline. It is estimated that there are 2 million hectares of land severely degraded, 6 million hectares of land moderately degraded,

and 14 million hectares of land degraded (FAO, 1986) seeking immediate attention. The traditional home gardens and other multi-species systems in fertile lowlands and areas with high perennial crop potentials of the south and south-west; the low perennial cereal crop potential of the mid-highlands and the high cereal livestock potentials of the Rift Valley, with various systems in between, at present indicate deterioration both in quality and size that necessitate intervention. In sharp contrast with mono-cropping practices, which threaten biodiversity, agro-forestry practices broaden genetic diversity and conserve the environment.

There are over 1000 tree (shrub) species in Ethiopia out of which over 300 are commercially valuable timber species. There are also high value fruit and timber species in the wild. The two high export earning tree genetic resources domesticated are *Coffea arabica* and *Catha edulis*; however, most of the tree species are neither utilized optimally nor domesticated. The tree domestication process entails identification and prioritization of high value trees for various agro-ecologies, products and services. Tree domestication is long-term in nature, and, in a broader sense, it may involve selection of superior tree varieties, propagation and planting; tree management, marketing and processing. The vast majority of tree species in their natural habitats are threatened due to deforestation and forest fragmentation. Hence, domestication is urgent and it gives great opportunity for the conservation of the *circa-situm* genetic resources, on top of realizing diversification and augmenting of tree products and services.

Therefore, a rigorous research is compelling to develop technologies and generate knowledge and information that can turn around the existing problems and enhance agro-forestry development and management. Research on development and management of agro-forestry is required to embrace the different aspects of the sub-sector and these aspects have already been identified from the SWOT analysis. Characterization and systems improvement, species selection and domestication, and introduction and expansion of different AF practices and models are some of the important areas that demand research.

Strategic objective 2: Conducting demand driven and problem solving agro-forestry research activities, developing 37 technologies, and generating 43 pieces of information.

Activities

- ◆ Developing 9 technologies, generating 12 pieces of information and knowledge on improvement of agro-forestry systems.

- ◆ Developing 8 technologies, generating 11 pieces of information and knowledge on species selection and domestication for agro-forestry practices.
- ◆ Developing 10 technologies, generating 10 pieces of information and knowledge on introduction and evaluation of traditional and improved AF practices,
- ◆ Developing 10 technologies, generating 10 pieces of information and knowledge on multiple use of agro-forestry systems,

Rehabilitation of Degraded Land Research Division

According to the United Nations Convention on Combating Desertification (UNCCD), land degradation is defined as the reduction or loss of the biological or economic productivity and complexity of rain fed cropland, irrigated cropland, range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns (FAO, 2011). The environmental degradation characterized by loss and deterioration of soil, water, forest and biodiversity is an unfolding crisis in Ethiopia and believed to be a root cause for poor quality of life and food insecurity (Esser et al.; 2002). A number of factors contribute to unsustainable land management in Ethiopia. With steady growth in population, clearing of woodland for agriculture has been a continuous process at an estimated rate of 62,000 ha a year; methods of cereal production are aggravating factors to soil loss, and dung and crop residues are used as fuel, reducing their fertilizing effects. The impact of land degradation is a drain on economic growth in rural areas and has an effect on national economic growth patterns. Without the proper management of its land resources, it becomes very challenging for Ethiopia to feed the increasing population. Though there is reasonable knowledge on the impacts of land degradation, research based investments on remedial actions (rehabilitation technologies) to mitigate the problem are still very limited. Comprehensive knowledge on economic returns from already done investments on land degradation is also lacking. Thus, bridging these major gaps through research would be a priority agenda to circumvent the current complex issues of land degradation in Ethiopia and would contribute a lot to gear future endeavours in the right track.

Dams provide all-around purposes to the socio-economic development of a nation through irrigation and generation of hydro-electric power. Even

though the construction of dams was recognized by the country since the drought of early 1980s, there are major threats, like heavy silt-laden flows that make lifespan of the reservoirs shorter. Hence, there is a compelling need for watershed management approaches, requiring more research as to how to tackle such level of degradation of catchments and size of reservoirs, formulate silt mitigation measures, etc. Ethiopia is undertaking a huge project on construction of dams for the purpose of electric power generation and integrated irrigation development. However, due to environmental phenomena happening and persistent human action in the country, our dams are facing problems in relation to siltation, landslides and degradation, and nutrient accumulation. Besides the soil erosion, agricultural run-off as well as domestic and industrial effluents cause serious negative effects, such as pollution in downstream environments. Thus, it is crucial to undertake studies to recommend possible solutions for such problems as sedimentation, landslides and water pollution in major dams.

Therefore, a rigorous research is mandatory to develop technologies and generate knowledge and information that can enhance the rehabilitation, reclamation, and restoration of degraded lands. Research on rehabilitation, reclamation, and restoration of degraded lands is compelling to embrace different aspects which have already been identified from the SWOT analysis. Evaluation of already rehabilitated sites, rehabilitation and restoration of degraded lands using watershed management approaches, management and improvement of enclosures and exclosures, and tree solutions for management of problematic soils are some of the most important thematic areas of the research on rehabilitation of degraded lands.

Strategic objective 3: Conducting demand driven and problem solving rehabilitation of degraded land research, and developing 27 technologies and 35 information packages.

Activities

- ◆ Developing 5 technologies, and generating 5 pieces of information on the evaluation of the effectiveness of knowledge and technology on previously rehabilitated sites.
- ◆ Developing 6 technologies, and generating 6 pieces of information and knowledge on watershed scale rehabilitation and restoration of degraded lands.

- ◆ Developing 5 technologies, and generating 7 pieces of information and knowledge on management and improvement of exclosures.
- ◆ Developing 6 technologies, and generating 8 pieces of information and knowledge on management of degraded soils.
- ◆ Developing 5 technologies, and generating 9 pieces of information and knowledge on protection of mega dams for various uses.

5.2.2 Ecosystem Management Research Directorate

Natural Forest Ecology and Management Research Division

There are eight officially recognized natural ecosystems in Ethiopia: Afroalpine and sub-Afroalpine, dry evergreen montane forest and grassland complex, moist evergreen montane forest, *Acacia-Commiphora* woodland, *Combretum-Terminalia* woodland, lowland semi-evergreen forest, desert and semi-desert scrubland and aquatic ecosystems (IBC, 2005). The ecosystems exhibit various types and levels of threats to biodiversity due to human and animal population pressure, the level of resource consumption, and market and policy related issues (IBC, 2005). Specific threats to the various ecosystems require to be dealt differently, and prioritization of ecosystems for intervention is not an option given the sense of urgency. Rather, it will be necessary to include the often neglected ecosystems, such as the wetlands and the rangelands, in environment and forestry researches.

It will be imperative to embark on generating up-to-date database on land use/land cover (LULC) dynamics and the driving forces of change in all the ecosystems (Reid et al., 2000). LULC dataset provides critical inputs to evaluate complex causes and responses in order to project future trends better, ranging from local to national scales. For instance, to assess land resource abundance and environmental impacts; to study changes that: affect biological diversity, contribute to forest fragmentation, lead to soil erosion, alter ecosystem services, disrupt socio-cultural practices, and increase natural disasters; and to set up a reference level of degradation for reducing emissions from deforestation and forest degradation (REDD) and REDD+ negotiations. Remote sensing and GIS techniques can provide accurate and objective LULC information depending on the time period being examined and on their location (e.g. Bewket, 2002; Dessie and Kleman, 2007; Wondie et al., 2011; Kindu et al., 2013). Thus, an inclusive national database of monitoring the LULC system of the country backed with research is necessary.

In addition, in-depth understanding of woody plants/floral diversity, structure and natural processes (pollination, phenology, natural regeneration, microbial

associations, etc) undergone in forest ecosystems is essential to managing the resources sustainably. In this regard, a lot of scholarly articles exist but it will be necessary to have comprehensive reviews and meta-analysis on some of the widely covered topics, such as species diversity and regeneration, and try to cover the less covered aspects in new research projects.

Strategic objective 4: Conducting demand driven and problem solving research on natural forest ecology and management, developing 13 technologies, and generating 69 information packages.

Activities

- ◆ Developing 4 technologies, and generating 25 pieces of information on restoration of degraded high forests and woodlands.
- ◆ Developing 5 technologies, and generating 28 pieces of information on conservation and management of high forests and woodlands.
- ◆ Developing 4 technologies, and generating 16 pieces of information on riverine vegetation.

Aquatic and Wetland Ecosystem Management Research

Ethiopia is endowed with rich aquatic and wetland resources that include lakes, marshes/swamps, rivers, flood plains, reservoirs, manmade ponds and dams. The wetlands are estimated to cover a total area of 18587 km² or about 1.5 percent of the country's total area (EPA, 2002) and are distributed in different altitudes all over the country. The major ones are found in SNNP, Oromia, Amhara, Gambella and Tigray National Regional States. Some of the major wetlands and aquatic bodies in Ethiopia include, Chew Bahir, Chamo, Abbaya, Awassa, Yergachefe, Boyo, and Small Abbaya in the SNNP; Abiata-Shalla, Langano, Ziway, Fincha-Comen, Dabus, Beseka, and Ardibo in Oromia; Tana-fogera, Chefa, Lugo (Haik), Alatish Valley in Amhara; Baro Akobo River Basin in Gambella; and Waja Tmuga, and Ashange in Tigray (Mekiso, 2004). Those located in the Rift Valley basin are Ziway, Abjatata, Shalla, Langano, Hawassa, Abaya, Chamo and Chew Bahir, and drain an area of about 52,000 Km². These lakes are widely varied in their area, colour, physical and chemical parameters, diversity and composition of flora and fauna. For example, Lake Beseka, Abijata and Shalla lakes are highly saline. The largest and relatively the shallowest are Abaya and Chew Bahir. The majority of these lakes have great socioeconomic values. They are very important in terms of biological and terrestrial biodiversity; serve as

wintering ground and maintain station for a large number of terrestrial and aquatic birds. Especially Lake Abiyatta and Shalla are providing paramount services to the wetland birds. Over 50% of wetland birds are concentrated in these two lakes and they are using the lakes as their nesting/breeding and feeding centre. Moreover, the migratory birds from other continents are using the lakes during winter times. Indigenous knowledge on various ecosystems is an important tool to develop ecologically and economically friendly ecosystem management and planning for maintaining sustainable resource utilization and conservation. In addition, identifying major driving forces of land use change plays a significant role to establish evidence based decision-making processes.

However, due to growing human population, industrialization and urbanization around rift valley lakes resulted in reckless cutting of trees for fuel wood, charcoal, construction and conversion into agriculture. This resulted in soil erosion, loss of biodiversity and depletion of water availability. Aquatic and wetlands are highly threatened by severe siltation and soil deposition due to the conversion of forest to other land use on the surrounding watershed. In addition, different chemicals (fertilizers) from the surrounding agricultural practices are assumed to increase the level of eutrophication in the water. Aquatic and wetlands are showing a pattern of spatial change over time, some of these lakes (e.g. Beseka Lake) are expanding while others are shrinking. Different natural and human made activities can be mentioned as a cause to the spatial change. However, research investigations are limited in this regard. Thus, the floristic composition and structure of the vegetation and soil conditions around the lakes should be known. The socioeconomic and environmental significance of aquatic and wetlands should be also explored thoroughly. Reversing this situation and developing restoration, conservation and sustainable management options is very important to increase the sustainability of the ecosystem.

Strategic objective 5: Conducting demand driven and problem solving natural aquatic and wetland ecosystem management research, developing 23 technologies, and generating 52 information packages.

Activities

- ◆ Developing 10 technologies, and generating 20 pieces of information for controlling water hyacinth and eutrophication in lakes.

- ◆ Developing 10 technologies, and generating 20 pieces of information on restoration of rift valley lakes.
- ◆ Developing 3 technologies, and generating 12 pieces of information on conservation and management of swampy and marshy areas.

5.2.3 Forest Resource Utilization Research Directorate

Non-timber Forest Products Research Division

The worldwide role of Non-Timber Forest Products (NTFPs) has increased in the last three decades due to their contribution to conservation of biological diversity, to household economies and food security, and also to the national economies (Neumann and Hirsch, 2000). Ethiopia is endowed with a variety of non-timber forest species that are found at different bio-geographical areas and have many uses. Despite the enormous socio-economic and ecological contribution that can be gained from the proper management and utilization of non-timber forest products of the country, the resources are reported to be in a big threat due to several interrelated factors (Eshete, 2002; Tadesse *et al.*, 2002; Lemineh, 2005). Among the factors, the technology related constraints that attributed mainly for improper and unsustainable product harvesting, collection, processing and storage of non-timber forest products are mentioned as the main factors that contribute more for the degradation of these resources in the country. Therefore, non-timber research should focus on addressing the above indicated issues by considering the following objectives.

Strategic objective 6: Conducting demand driven and problem solving non-timber products and utilization research, developing 41 technologies, and generating 44 information packages.

Activities

- ◆ Adapting and developing 25 technologies, and generating 17 pieces of information on non-timber species products and utilization.
- ◆ Introducing and developing 16 technologies, and generating 9 pieces of information for collection, harvesting and processing of non-timber forest products.
- ◆ Adapting and developing 3 pieces of information on non-timber products standards, and getting them certified.
- ◆ Generating 15 pieces of information on ethno-botany of non-timber forest products and utilization.

Timber Characterization, Design and Utilization Research

The Ethiopian GTP targets to transform the living conditions of citizens dramatically and to elevate the status to that of middle income level within a short period of time. The fulfilment of this plan should be primarily reflected in the improvement of citizens' living conditions which will directly cause a drastic increase in the demand for improved housing and interior furnishings or value added wood products since they are intimately linked to the living environment of human being. In line with the countries growth and transformation strategy of CRGE, wood furniture and construction materials should be manufactured competitively having the three cornerstones/fundamental bases of sustainability attributes (environmentally friendly, socially acceptable and economically affordable). However, the Ethiopian wood manufacturing sector is not competitive in all dimensions of sustainability. Therefore, upgrading the Ethiopian entire wood products manufacturing in all the cornerstone attributes of sustainability is very urgent and the most feasible research and development strategy to follow is recommended as follows: Timber characterization; Raw material innovations (remanufacturing and modification) with TBL; Innovations in products design and development with TBL; Certification of products for assurance of TBL; Improvement of productivity and efficiency in products manufacturing. Therefore, the research focus considers four major areas.

Strategic objective 7: Conducting demand driven and problem solving timber characterization and utilization research, developing 71 technologies, and generating 31 pieces of information.

Activities

- ◆ Adapting and developing 48 technologies, and generating 24 pieces of information on timber characterization.
- ◆ Adapting and developing 11 technologies and generating 2 pieces of information on composite products production and utilization.
- ◆ Adapting and developing 12 technologies on timber products design and production.
- ◆ Generating 5 pieces of information on timber products and production standards and get certified.

Bio-energy, Bio-chemical and Biomass Research

Biomaterials and bio-energy have long been produced from plants. The development of oil from fossil fuel replaced many of these traditional uses during the twentieth century. The growing concern on the use of fossil fuel and its impact on the atmosphere through addition of carbon has resulted in renewed interest in the use of plants as direct sources of bio-energy and biomaterials (Henry, 2009). The use of renewable energy is becoming increasingly necessary to achieve the changes required to address the impacts of global warming (McKendry, 2002). Woody biomass is an important provider of renewable energy currently and is anticipated to be an important component of any future renewable energy portfolio. Thus, bio-energy research fills a void in the rapidly growing area of feedstock biology research related to biomass, biofuels, and bio-energy. Therefore, focusing and conducting research on key renewable energy and raw materials to develop alternative, renewable fuels and chemicals from cellulosic biomass to reduce fossil fuel dependence and preserve the environment is crucial.

There are also a number of indigenous timber and non-timber resources that could be important for the production of juice, jam, oil, pulp and paper, etc. production. However, little research has been done so far to utilize these valuable resources. Thus, biochemical research will focus and address the issues related to pulp and paper production, chemical characterization, wood derivatives and suitability of less-known and less-utilized indigenous and home-grown timber, bamboo and other species in Ethiopia.

Forest biomass and its change over time are key characteristics of forest ecosystems. Forest inventory information and biomass factors, or equations, which transform diameter, height or volume data into biomass estimates, are widely used for stock change estimates for large forest areas. For use in forest biomass estimation and for transparent and consistent reporting of carbon inventories, it is necessary to select, develop and apply proper biomass factors or equations (Somogyi et al., 2007).

Strategic objective 8: Conducting demand driven and problem solving bio-energy, biochemical and biomass research, developing 21 technologies, and generating 19 information packages.

Activities

- ◆ Adapting and developing 12 bio-energy technologies, and generating 4 pieces of information for timber and non-timber species utilization.
- ◆ Adapting and developing 9 technologies, and generating 5 pieces of information on biochemical utilization of timber and non-timber species.
- ◆ Generating 10 pieces of information on holistic use of timber and non-timber biomasses.

5.2.4 Forest Protection Research Directorate

Forest Pathology and Entomology Research Division

Land and forest degradation, due to over exploitation of forest, recurrent drought, death of planted seedlings and trees, has been considered to be the main factor for the depletion of forest and its low level production. On the other hand, the demand for forest product has increased through time with increasing human population. This has necessitated a proper management and utilization of natural forests and commencement of plantation of exotic trees. On the contrary, in recent years it has been common to observe death of trees in natural forest plantation, trees on farm, in a plantation and seedlings in nursery. It is well known that both biotic and abiotic agents could lead to death of trees. In Ethiopia, however, it has been commonly assumed that poor tending practice, drought and poor species-site matching as causes of tree death. The role of biotic agents in causing tree death is not well studied. Biotic agents including pathogens, insect pests and rodents can cause abnormal growth on trees. It is, therefore, essential to note that the losses due to disease, insect pests, parasitic plants and rodents have major impact in reducing forest growth and yield. Similarly, both native and exotic sources entering into the country through seeds or other propagation materials may be diseased or infested and can be main roots for the introduction of insect pests. Through movement of these materials, humans have facilitated transcontinental spread of many destructive pests and diseases.

Strategic objective 9: Conducting demand driven and problem solving research on tree disease and insect pests, developing 16 technologies, and generating 17 information packages.

Activities

- ◆ Developing 3 technologies, and generating 6 pieces of information on the identity, characteristics of the pathogen and insect pests that affect the growth performance and yield of trees.
- ◆ Identifying mycorrhizae fungi and rhizobium bacteria, developing 3 technologies, and generating 6 pieces of information for rehabilitating degraded lands.
- ◆ Adapting and developing 10 technologies, knowledge and 5 pieces of information on pests, diseases and parasitic plants control and management.

Forest Fire and Parasitic Flowering Plants Research Division

A number of factors can affect the forest cover situation, composition and diversity. Fire is one of the factors that can positively or negatively influence the forest resources in particular and the landscape in general. In some forest ecosystems the occurrence of forest fire is considered to be an essential phenomenon that can assist to shape the life form and diversity of the forest ecosystem. On the other hand, it also could have different effect on the energy flow including the cycle of carbon. Different factors can be the cause for the forest fire to start. According to some studies conducted in Ethiopia, fire started by people is mainly responsible for the destruction of most forests. Forest fire can cause change not only to the structure and composition of the forest mainly in most dry tropical forests but also has an adverse effect on the soil and its biology as well. The physiological makeup of the trees in the forest is responsible to determine the susceptibility and/or the resistance of individual trees to fire. Different factors can influence the occurrence, intensity and frequency of the fire. In many cases, it is necessary to come up with adequate measures that minimize the damage forest fire inflicts.

Ethiopia is known to have diverse vegetation zones that comprise different vegetation cover. Over time, these vegetation covers have undergone through different kinds of natural and anthropogenic changes. Some of the changes lead to adoption of different land use practice, which might have led to changing vegetation composition and structure. The changing land management, together with the growing sophistication and affluence in external travel and trade, the danger of entry of alien organisms through commercial, private shipment of plant materials and travelers, has become a more pressing problem to resource managers in all parts of the world. Movement of different wood products, seed and other vegetative propagation materials is assumed to be the major means of introduction and expansion

of foreign or alien invasive species. Ethiopia has been exposed to invasion from a number of alien invasive species and native encroaching tree and shrub species. These invasive and encroaching species have brought about a number of socio-economic and ecological effects. Hence, there is a need to devise a means to contain, manage and control the introduction and spread of invasive and encroaching species into the forest and woodlands.

Strategic objective 10: Conducting demand driven and problem solving research on forest fire, invasive species and other pests, developing 10 technologies, and generating 21 pieces of information.

Activities

- ◆ Adapting and developing 3 technologies, and generating 8 pieces of information on fire protection and management.
- ◆ Adapting and developing 3 technologies, and generating 8 pieces of information on the control and management of invasive plant species.
- ◆ Adapting and developing 4 technologies, and generating 5 pieces of information on invasive plant species control and management.

5.2.5 Environmental Pollution Management Research

Environmental Pollution Research Division

Environmental Pollution Research Division focusing on conducting researches on issues of water pollution, soil pollution, air pollution, noise pollution and invasive species management, specifically: greenhouse gas emissions reduction, persistent organic pollutants (POPs) management as well as ecotoxicology and risk assessment. Developing and testing remediation options for contaminated soil and water bodies are the major concern of this research division.

Pollutants and contaminants that get into the natural environment can affect non-target plants and animals. For example, pesticides, herbicides and pharmaceutical desecrate can damage individuals, natural communities and eco-systems. Therefore, tasks to deal with the fate and transport of pesticides and the effect on biological processes of the target and non-target plant and animals will also be undertaken by this research division so that the consequences of the contaminant on the receiving environment can be estimated.

Strategic objective 11: Conducting demand driven and problem solving environmental pollution management research, developing 4 technologies, and generating 25 pieces of information.

Activities

- ◆ Generating 7 baseline information packages on sources, types and severity of pollutants/contaminants in air, soil and water quality and water pollution.
- ◆ Adapting and developing 4 technologies, and generating 5 information packages and technologies for managing and controlling of air, soil and water pollution.
- ◆ Generating 5 baseline information packages on the fate and transport of pesticides, fertilizers, POPs and the effect on biological processes of the target and non-target plants and animals.
- ◆ Generating 4 information packages on interaction between people and the biosphere.
- ◆ Developing 4 research-based tools, guideline, standards for auditing and monitoring of the environment.

Waste Management Research Division

Waste Management Research Division focuses on conducting researches on issues of handling of solid, liquid and gaseous wastes that, if not properly handled, pose threat to the environment. Hence, developing management options for wastes from both non-anthropogenic and anthropogenic sources were the major concern of this research division. The research division focuses on conducting researches in areas of innovative integrated waste management methods for hazardous and non-hazardous wastes. Since environmental technology has a leading position, particularly in the fields of recycling and enhancing waste to wealth options, research-based implementation of them will address the dilemma between balanced economic growth and environmental impact. In addition, this division adopts and generates cleaner and resource efficient environmental technologies which can reduce inputs, energy consumption and emissions as well as recover valuable commodities from byproducts and minimize waste disposal problems.

Strategic objective 12: Conducting demand driven and problem solving waste management research, developing 9 technologies, and generating 25 information packages.

Activities

- ◆ Developing 4 technologies, and generating 5 pieces of information for managing and controlling waste generated from different sources.
- ◆ Developing 5 technologies, and generating 5 pieces of information on hazardous and non-hazardous waste management options.
- ◆ Generating 5 baseline data on sources, types and severity of wastes.
- ◆ Developing 5 research-based tools, guideline, standards for auditing and monitoring waste management options.
- ◆ Generating 5 pieces of information on environmental disaster risks and developing management options for those problems coming due to hazardous wastes.

5.2.6 Environmental Laboratories Directorate

Physico-Chemical Lab Division

The physico-chemical analysis of the environment (water) started in a fragmented way at the former EPA and the different chemistry departments of universities in Ethiopia. With increasing pressure from inside and outside of the research and development, aspects of the environmental research are getting attention. However, these pieces of information generated so far were not collected into a data banking system.

The division will start to collect the information on polluted water and soil resources generated by different institutions. Based on the available data, the division also continues to generating monitoring information on Awash River (where the population is growing from time to time and reaching 3.5 million inhabitants in 2010) and industries of Addis Ababa (which are the major pollution causes of Awash River through Akaki River Basin). The polluted river water is used by downstream communities to cultivate vegetables, which are sold and consumed by inhabitants of the city. Therefore, to reduce the level of pollution of the Awash River and other water bodies due attention will be given to lower the pollution level. Besides the division will work with other directorates' research divisions on generation of technologies related to analytical laboratory works.

The air pollution, particularly in Addis Ababa where the release from industries, car exhausts and wood burning is contributing to the smog formation and other toxic chemicals, like SO₂, NO₂, is at an alarming stage.

Therefore, a rigorous data generation is compelling to develop technologies and generate knowledge and information that can reduce the emission and finally enhance the environmental problem management capacity.

Strategic objective 13: Conducting demand driven and problem solving research on waste water, and generating 28 biotechnology based information packages.

Activities

- ◆ Generating 10 pieces of information on chemical pollution around water bodies.
- ◆ Generating 10 pieces of information on soil chemical pollution.
- ◆ Generating 8 pieces of information on POPs.

Biological Lab Division

The biological material analysis of the water bodies started in a fragmented way at the former EPA and the different chemistry departments of universities in Ethiopia. With the climate change concern growing, the research and development aspects on environmental science are getting attention.

The division will start to collect the information generated by different institutions with regard to biological oxygen presence in polluted water on Addis Ababa (whose population is growing from time to time and reaching 3.5 million inhabitants in 2010) and industries around Addis Ababa (polluting the Awash River through its tributary, the Akaki River). Therefore, to reduce the level of pollution on the Awash River, the Akaki river and its tributaries will be given due attention with regard to the reduction of effluent release through awareness creation. Besides, the division will work with other directorates' research divisions on generation of technologies related to biological research works.

Strategic objective 14: Conducting demand driven and problem solving research on waste water, generating 5 pieces of biotechnology-based knowledge, and developing 1 technology.

Activities

- ◆ Developing 1 technology, and generating 1 piece of information on genetically modified, drought tolerant tree species.
- ◆ Generating 2 pieces of information on pollution resistant tree species.
- ◆ Generating 2 pieces of information on pollution tolerant microorganisms.

5.2.7 Climate Science Research Directorate

Climate Change Mitigation and Adaptation Research Division

In United Nations Framework Convention in Climate Change (UNFCCC), climate change refers to a change in climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods. The ultimate aim of the UNFCCC is to stabilize greenhouse gas concentrations ‘at a level that would prevent dangerous anthropogenic interference with the climate system’. This stabilization should be achieved within a time frame that: (1) allows ecosystems to adapt naturally to climate change, (2) ensures that food production is not threatened, and (3) enables sustainable economic development to proceed.

Developing countries like Ethiopia are more vulnerable to the adverse impacts of climate variability and change. Due to Ethiopia’s location in tropics and dependence on natural resources (water, forest and soil), it has low adaptive capacity and is highly sensitive to climate variability and change. Sensitivity and adaptive capacity also vary between sectors and geographic locations, time and social, economic and environmental considerations within a country. Current climate variability is already imposing a significant challenge to Ethiopia by affecting food security, water and energy supply, poverty reduction and sustainable development efforts, and by causing natural resource degradation and natural disasters.

Strategic objective 15: Conducting demand driven and problem solving research, developing 12 technologies, and generating 19 pieces of information on climate change adaptation and mitigation.

Activities

- ◆ Developing 8 technologies, and generating 10 pieces of information on climate change adaptation.
- ◆ Developing 4 technologies, and generating 9 pieces of information on climate change mitigation.

Climate Modeling and Risk Management Research Division

Climate change also presents the necessity and opportunity to switch to a new, sustainable development model. If Ethiopia were to pursue a conventional

economic development path to achieve its ambition of reaching middle income status before 2025, the resulting greenhouse gas (GHG) emissions would be more than double from 150 Mt CO₂-e in 2010 to 400 Mt CO₂e in 2030. The Government has, therefore, initiated the Climate-Resilient Green Economy (CRGE) initiative to protect the country from the adverse effects of climate change and to build a green economy that will help realize its stretched goals. Achieving these goals would unquestionably require scientific information and technology regarding the characteristics of climate change in the past and future, its risks, alternative adaptation and mitigation options to fill the gaps in the processes of developing policies, strategies and development plans.

Strategic objective 16: Conducting demand driven and problem solving research, developing 17 technologies, and generating 26 information packages on climate change modeling and risk management.

Activities

- ◆ Characterizing past, current, future climatic parameters, developing 10 technologies and generating 14 information packages on climate variability and change patterns of the country.
- ◆ Assessing the risks of climate change and variability on environment and forestry resources of the country, developing 7 technologies, and generating 11 pieces of information on alternative risk management options.

5.2.8 Socio-economics, Policy, Extension and Gender Research Directorate

Socio-economics and Policy Research Division

Ethiopia's population is growing at unprecedented rate, making it the second most populous country in Africa. The consequence is increased pressure on natural resources and conversion of marginal and forest land to agricultural land due to increased demand for food. On top of this, climate change is posing a serious challenge to the country's agricultural production system. As such, smallholder farmers that account for more than 85% of the population are highly vulnerable to climate change due to unpredictable weather condition. Therefore, policies and strategies to mitigate and adapt to climate change are imperative to build a resilient economy. Accordingly, Ethiopia is pursuing a new development model, green growth approach.

There has been efforts and intervention in reforestation, rehabilitations of degraded natural resources, diversifying and promoting alternative energy sources, and watershed development throughout the country. In spite of the fact that the country is making efforts to build a resilient economy, scientific information for policy makers are lacking. A due attention to research in environment, forestry and climate change is a very recent phenomenon. Particularly, research in economics of environmental resources and climate change are very scant. However, a sound policy for sustainable use of natural resources and building resilient economy needs rigorous scientific information. Therefore, over the coming years the socioeconomic division will conduct researches in areas of environmental economics, energy economics, forestry and climate change to contribute to the gaps in knowledge. We believe, the research outputs will help in making informed policy that learn from past and design future strategies based on scientific information.

Strategic objective 17: Generating 71 pieces of information for the understanding and protection of the country's natural resources, and providing knowledge-based policy options to address major challenges and opportunities in the environment, forestry and climate change issues.

Activities

- ◆ Evaluating existing policies of environment, forestry and climate change and their impacts, and generating 4 information packages.
- ◆ Assessing timber and non-timber forest products' value chains, and generating 20 pieces of information.
- ◆ Studying the economics of forest and environment and households' behavior towards climate change, and generating 23 pieces of information.
- ◆ Assessing the economic values of environmental services and household preferences for environment, forestry and climate change technologies, and generating 14 pieces of information.

Extension and Gender Research Division

Ethiopia faces the challenges of attaining national food security and inclusive economic growth, whilst sustaining key environmental systems' functionality, particularly under increasing climatic variability. Since the 1970s, researchers have recommended various technological solutions, such as improved soil

and water construction practices, and improved agro-forestry trees and better forest management practices for natural resource conservation and re-vegetation of degraded hillsides in Ethiopia. Implementation of these technologies would allow higher production from limited land and water resources and improved natural resource conservation. Despite numerous attempts to disseminate environmental and forestry technologies in the past few decades, the technologies have not been implemented by majority of smallholders. The failure of the majority of smallholder farmers to take advantage of technological opportunities in environment and forest management remains to be an unresolved puzzle: What barriers prevent the most promising technologies from spreading to a large number of smallholder farmers in the country? Which technologies, policies, institutions, and investments improve the productivity of natural resources while conserving water, land and energy resources and enhancing environmental services?

Given the scale and interconnected nature of the issues we face, tentative and piecemeal solutions will not suffice. Technology adoption involves a complicated web of science and technology, biophysical environment, economics and institutions. To fully understand the scope of the problem, we must also examine the array of laws and policies that lie beneath the surface—the regulatory and legal frameworks that determine the balance of power between government and private businesses, farmers, private businesses and other interest groups; competition policies and labor relations that make up the current economy of the country. Eventually we seek to identify potential policy solutions, rules and investments that make the use of natural resources more efficient, equitable and environmentally benign. Through research and outreach, the extension and gender division aims to address these issues and contribute to several EEFRI-wide research areas, such as sustainable food production, increasing resilience, strengthening governance and gender.

Strategic objective 18: Generating 28 pieces of information on the complex relationship between technological, biophysical environment, social, economic and political processes in the production, integration and use of scientific and other knowledge in environment, forestry and climate change.

Activities

- ◆ Conducting 8 technology adoption and impact studies on environment, forestry and climate change
- ◆ Analyzing and mainstreaming 10 gender issues on forestry, environment and climate change
- ◆ Developing and testing 4 extension approaches and methodologies for dissemination of technologies in environment, forestry and climate change
- ◆ Designing and implementing 6 knowledge management and communication strategies in forestry, environment and climate change

5.2.9 Tree Seed Technology Coordination Unit

Tree Seed Procurement and Tree Seed Source Management

Many efforts are underway for implementing the stretched afforestation/reforestation and restoration targets that have been set by Ethiopian Government to carry out: forestation (2 million ha), reforestation (1 million ha), forest management (4 million ha) and enormous land restoration activities until 2025 (CRGE, 2011). Success in these afforestation/reforestation programmes is highly dependent on the availability and use of quality seed/germplasm.

Poor quality seeds result in poor survival and growth and incur costly plantation processes as they can't be easily corrected and the effect continues throughout the life of the stand. A poor quality seedling will always grow into a poor quality tree even if planted on a well-prepared, good site. Poor quality seedlings waste spaces and resources leading to low site productivity. Thus, seed quality is the basis and most important factor for the success of plantations in growth performance and it is responsible for higher economic and ecological returns.

The success on afforestation/reforestation programmes is also dependent on the amount of seed supply for the required species that fits the intended target/end use. Very important species that should be promoted by the forest extension are needed to be supplied so that the afforestation programme attains its desired objectives.

Thus, the Tree Seed Procurement and Tree Seed Source Management Division of the Tree Seed Technology Coordination Unit of EEFRI will work on supplying quality trees seeds of sufficient amount, 8 to 10 tons of seeds

per annum, which are collected from mother trees of diverse agro-ecology of the country. The division will also manage quality seed sources and develop more seed sources of improved genetic quality and intensive management.

Strategic objective 19: Supplying 97 tones of quality tree seeds and generating 86 quality seed sources.

Activities

- ◆ Procuring 97 tons of quality germplasm (seed and clonal materials).
- ◆ Establishing 86 different types of seed sources with different genetic quality and management intensity (including provenances and progeny trials, seed orchards).

Tree Seed Biology Research

There have been massive afforestation/reforestation programmes in Ethiopia, during the past few years. During the coming planning periods (time for implementing GTP II and CRGE strategy), the government also continues to conduct massive afforestation/reforestation. From previous experiences, such programmes were commented to have limitations in quality aspects mainly the quality of seed/germplasms and species used.

Seed quality has a direct impact on tree growth and the success of tree planting activities. Quality aspects are ensured during the identification of seed sources, phenology surveys, collection and handling of seeds and during storage time and dispatch. Quality tree seed does not only comprise external qualities like purity, freedom from insects and pathogens, but also qualities, such as the physiological and genetic aspects of viability, vigor and genetic variation. Moreover, the suitability of the site (provenance) is considered as another factor of quality when it comes to provision of seeds. The limitation in germplasm quality and quantity is mainly because of lack of knowledge, technologies and scientific information.

For the past few decades, it was the National Tree Seed Project (NTSP) of the then Forestry Research Centre and afterwards the Tree Seed Service of the then Forestry Research Centre that have been supplying tree seeds at national level. However, associated with the escalating demand for germplasm supply, three other government owned seed centres were established in different regions about two years ago. Besides, a number of private seed collectors and distributors are involved in the seed business. Moreover, with the advancement of science, many opportunities need to be evaluated and scientific decisions should be made, for instance, the use of seeds of Genetically Modified Organisms (GMO). Success in supplying quality germplasm by the government and non-government actors also depends on research support.

Strategic objective 20: Generating 18 pieces of information that can be used to improve the seed system of the country.

Activities

- ◆ Conducting research on seed biology, seed handling and storage conditions, and generating 9 pieces of information.
- ◆ Conducting research on seed functional genomics, genetic diversity of populations and biotechnology, and generating 9 pieces of information.

5.2.10 Biometry and GIS and Remote Sensing and Data Base Coordination Unit

GIS and Remote Sensing Research Division

The term ‘remote sensing’ is broadly defined as the technique(s) for collecting images or other data about an object from measurements made at a distance from the object, and can refer, for instance, to satellite imagery, to aerial photographs or to ocean bathymetry explored from a ship using radar data. However, in the present context, only optical images acquired by space-borne or air-borne sensors are considered. Over the past few decades, remote sensing technology has been used increasingly by the scientific community to describe and monitor a variety of systems on a local or global scale. This technology has evolved from pure visual imagery (e.g. panchromatic aerial photographs) to multi-spectral imagery (e.g. Thematic Mapper).

GISs are widely used as tools to forest resource management, inventory, environmental vulnerability evaluation, and suitability analysis, SWOT analysis, etc., but in the case of our country GIS and Remote Sensing-based research skills is very limited.

Well organized GIS and remote sensing database and research based on GIS and remote sensing technology is mandatory to improve the quality and the reliability of our research outputs especially on the area of land use/land cover, carbon sequestration, suitability analysis, ecosystem management, pollution estimation, etc.

Strategic objective 21: Creating 7 GIS and remote sensing database to EEFRI centres, conducting 20 GIS/remote sensing based researches, and developing 20 models and 20 pieces of information.

Activities

- ◆ Developing 5 GIS and remote sensing based research outcomes and models to forest resources management.
- ◆ Developing 5 GIS and remote sensing based research outcomes and models to forest suitability analysis.
- ◆ Developing 5 GIS and remote sensing-based research outcomes and models to environmental management and climate change.
- ◆ Developing 5 GIS and remote sensing based research outcomes and models to ecosystem management.
- ◆ Developing 5 GIS and remote sensing based research outcomes and models to pollution estimation.
- ◆ Developing 7 GIS and remote sensing database to EEFRI regional centres (Hawasa, Central Ethiopia, Bahir Dar, Jimma, Dire-Dawa, Mekele and Head Office).

Goal 2: Formulating an efficient, cost effective and responsive system for technology promotion, dissemination, communication and knowledge management

One of the shortfalls of research systems is lack of a proper publicizing and promotion of research outputs. There are a number of research outputs simply shelved in offices without being transferred to end users. Technology development and knowledge generation is not the end of the story by itself and without promotion it will be meaningless and has no use for societal development. Research results should be brought to the end users and popularized through different means like demonstrations, field days, pre-scaling up, publications, exhibitions, etc. Publications include journals, proceedings, manuals, leaflets, booklets, brochures, etc. In addition to popularization, there is also a compelling need to multiply technology outputs to deliver to our customers.

Research findings can be widely spread and scaled up to end users (farmers, forest investors, etc.) when we connect them to the forestry extension. There should be a very strong research-extension linkage at all levels (federal, regional, zonal, woreda, and kebele). The major source of research agenda and also the final destination of research output is always the forestry extension. Therefore, closely working with forestry extensionists is not an option, but mandatory. Our research outputs will be credible if they secure acceptance

by the extension and relevant stakeholders. Therefore, workable strategies should be put in place with the aim to strengthen the technology promotion, dissemination and knowledge management system.

Strategic objective 1: Introducing systems to approve, register and disseminate technologies, knowledge and information.

Activities

- ◆ Introducing 1 system for technology approval, registry and release.
- ◆ Arranging 5 extension forums with stakeholders at different levels.
- ◆ Developing 1 viable research outputs dissemination system.

Strategic objective 2: Improving communication skills for knowledge management.

Activities

- ◆ Organizing 5 training sessions to fill knowledge and skill gaps in write up and publishing in reputable journals and to increase the availability of technology manuals and extension packages.
- ◆ Producing 1 strategy for public relations and communication.
- ◆ Establishing one system for efficient information, knowledge management and documentation.

Goal 3: Establishing a vibrant system for research coordination and networking

EEFRI will establish five new research centres at various parts of the country, maintaining the Forestry Research Centre to cater for central Ethiopia and upgrading the Forest Products Research sub-centre to a centre level. There are a number of other actors engaged directly or indirectly in environment and forestry research activities in Ethiopia. These include the Ethiopian Development Research Institute (EDRI), federal and regional agricultural research institutes and centres, and higher education institutes. Hence, the following actions are needed for creation of synergy, alignment and complementarities among actors, and rational and effective resource mobilization.

Strategic objective 1: Creating a system for linkage, networking and partnership.

Activities

- ◆ Designing a system for linkage, networking and partnership with national and international organizations.
- ◆ Instilling and implementing a system for gender mainstreaming in the research projects.

Strategic objective 2: Designing a mechanism for coordinating research endeavours.

Activities

- ◆ Developing a system for coordinating research activities in environment, forestry and climate change which are carried out by different research and higher learning institutions.
- ◆ Establishing a national research council for environment, forestry and climate change.
- ◆ Framing a legal ground for enforcing researchers outside EEFRI to submit research proposals and outputs.

Goal 4: Creating an efficient system for human resource development

Institute is not a building. It is people, and for people to be productive, the operating environment should be convenient. Hence, it is imperative to work towards developing the human capital, infrastructure and operating environment and systems for efficient, effective and development-based technology.

Strategic objective 1: Planning for long-term human resource development

Activities

- ◆ Empowering EEFRI with B.Sc., M.Sc., and PhD holders, as per the human resource development plan.
- ◆ Preparing a project proposal for human capacity building.
- ◆ Signing 10 MoU and MoA with higher learning, research and other related institutions for tailor-made training.
- ◆ Developing a competitive package for research staff attraction in some critical fields of specialization.
- ◆ Establishing a system for recruitment of international staff.

Strategic objective 2: Developing systems for human resource attraction and retention.

Activities

- ◆ Introducing a system for researcher recognition.
- ◆ Preparing a proposal for support staff attraction and retention, and negotiating as well as following up the implementation.
- ◆ Prepare a proposal for recruitment of international staff, and negotiating as well as following up the implementation.
- ◆ Designing a system for staff insurances.

Goal 5: Building a state-of-the-art infrastructure

Strategic objective 1: Constructing all-season-type buildings so as to create a favourable working environment.

Activities

- ◆ Building offices at the headquarters, research centres and sub-centres.
- ◆ Building multipurpose complexes such as laboratories, cold storage, etc.

Strategic objective 2: Creating state-of-the-art research facilities.

Activities

- ◆ Setting up laboratories, greenhouses, lathouses, arboretum and nursery sites.
- ◆ Establishing research stations.
- ◆ Equipping with field equipments, vehicles and machineries.
- ◆ Setting up system automation.
- ◆ Building a national database system.

Goal 6: Devising and performing a responsive and proactive system for governance, strategy and policy

The concept of governance encompass topics relating to how resources are managed, ranging from how decisions are made and who is involved in the decision-making process, to the enforcement of policies, strategies, rules and regulations. Governance has been also defined as a set of institutions, mechanisms and processes, through which clients can articulate their interests and mediate their differences and exercise their rights and obligations. Participation, accountability, transparency, responsiveness, the rule of the law, and equity are some of the basic dimensions of good governance.

Bringing good governance into the picture requires assessing the position of the above mentioned pillars in EEFRI and strengthening and consolidating them accordingly. Problems related to policies and strategies could be either related to the deficiency of the already existing ones in containing the most important policy instruments or to the total absence of them. Therefore, the current situation should be assessed accordingly and viable strategies should be devised to fix problems.

Strategic objective 1: Creating enabling leadership environment and improving institutional operational systems.

Activities

- ◆ Designing 20 capacity building programmes in leadership.
- ◆ Developing 15 working manuals, guidelines, rules and regulations.
- ◆ Creating an office for tripartite coordination (of research-extension-industry).
- ◆ Establishing an office for strategy & institutional transformation.
- ◆ Developing 16 directorate level research strategies.
- ◆ Producing 1 anti-corruption strategy.

Strategic objective 2: Introducing a system to increase institutional public visibility and influence.

Activities

- ◆ Devising a system that connects and integrates all dissemination, communication and public relations efforts.
- ◆ Introducing 30 national calendar events for forestry/environment/climate change dialogues
- ◆ Establishing 5 EEFRI-NGOs forums.
- ◆ Sponsoring 18 events and programmes for obtaining mass media publicity opportunities.

6. STRATEGIC ACTION PLAN

Goal 1: Importing relevant technologies, conduct research to develop suitable technologies, generate knowledge and information

Strategic objectives	Activity	Measure	Target (Research outputs)	Implementation Timetable										Responsible bodies
				'16	'17	'18	'19	'20	'21	'22	'23	'24	'25	
i. Plantation and Agro-forestry Research Directorate														
Strategic objective 1: Conducting demand driven and problem solving plantation forest research, developing 35 technologies, and generating 40 pieces of information	Developing technologies and generating information on tree improvement and domestication of industrial tree species	Technologies	9	2		2	1	1		2			1	PAF Research Directorate
		Information	10	1	2	1		1	2		1	1	1	
	Developing technologies and generating information on nursery management and propagation techniques	Technologies	9	1		3		1		2	1		1	
		Information	10	1	2	1	1		1	2	1	1		
	Developing technologies and generating information on development and management of commercial and smallholder plantations	Technologies	8		1		1	2	1	1	1		1	
		Information	10	1	2	1	2		3		1		1	
	Developing technologies and generating information on urban forest development and management	Technologies	9			2	1	1	2				2	1
		Information	10	1		3	1		1	1	1	1	1	

Strategic objective 2: Conducting demand driven and problem solving agro- forestry research activities, developing 37 technologies, and generating 43 pieces of information	Developing technologies and generating information on improvement of agro forestry systems	Technologies	9	2				3		2	1		1	
		Information	12	2		2	1	1	3		1	1	1	
	Developing technologies and generating information on species selection and domestication for agro-forestry practices	Technologies	8	1	1	1		1	2			1	1	
		Information	11	1	1	2	1	1	1	2	2		1	
	Developing technologies and generating information on introduction and evaluation of traditional and improved AF practices	Technologies	10		1	1		3	1	2		1	1	
		Information	10		2		3		1	1	1	1	1	
	Developing technologies and generating information on multiple use of agro-forestry systems	Technologies	10	1	2	1	1		1	2		1	1	
		Information	10	1	1			3	1		1	2	1	
Strategic objective 3: Conducting demand driven and problem solving degraded land rehabilitation research, and developing 27 technologies and 35 pieces of information	Developing technologies and generating information on the effectiveness of the previously rehabilitated sites	Technologies	5		1		1		1		1		1	
		Information	5	1		1		1		1		1		
	Developing technologies and generating information on watershed scale rehabilitation and restoration of degraded lands	Technologies	6		1		1		1		1	1	1	
		Information	6	1		1		1	1	1		1		
	Developing technologies and generating information on management and improvement of exclosures	Technologies	5		1		1		1		1		1	
		Information	7	1		1		1	1		1	1	1	
	Developing technologies and generating information on management of degraded soils	Technologies	6		1	1		1		1	1		1	
		Information	8		1	1	1		2	1	1		1	
	Developing technologies and generating information on protection of mega dams for various uses	Technologies	5	1		1		1		1	1			
		Information	9		1	1	1	1	1	1	1	1	1	

ii. Ecosystem Management Research Directorate													
Strategic objective 4: Conducting demand driven and problem solving research on natural forest ecology and management, developing 13 technologies, and generating 69 information packages	Developing technologies, and generating information on restoration of degraded high forests and woodlands	Technologies	4			1			2				1
		Information	25	1	1	4	1	2	4	4	3	3	2
	Developing technologies, and generating information on conservation and management of high forests and woodlands	Technologies	5			2		1		1			1
		Information	28	2	2	3	1	4	2	3	6	3	2
	Developing technologies, and generating information on riverine vegetation	Technologies	4				1			1		1	1
		Information	16		1	2	1	2	2	1	3	2	2
Strategic objective 5: Conducting demand driven and problem solving natural aquatic and wetland ecosystem management research, developing 23 technologies, and generating 52 information packages	Generating information and technology for controlling water hyacinth and eutrophication in lakes	Technologies	10	1	1	1	1	1	1	1	1	1	1
		Information	20	3	2	2	2	2	2	2	2	2	1
	Developing technologies and generating information on restoration of rift valley lakes	Technologies	10		0	1	1	1	1	1	1	2	2
		Information	20		1	2	2	2	2	2	3	3	3
	Developing technologies, and generating information on conservation and management of swampy and marshy areas	Technologies	3		0	0	1	0	1	0	0	1	0
		Information	12		0	2	1	1	1	1	2	2	2

iii. Forest Resources Utilization Research Directorate															
Strategic objective 6: Conducting demand driven and problem solving non-timber products and utilization research, developing 41 technologies and generating 44 information packages	Adapting and developing technologies, and generating information on non-timber species products and utilization	Technologies	25	1	2	4	6	4	2	1	2	2	1		
		Information	17	3	6	1			1	3		2	1		
	Introducing and developing technologies, and generating information for collection, harvesting and processing of non-timber forest products	Technologies	16		2	2	5	3	1	2	1				
		Information	9	2	2	1			2		1	1			
	Adapting and developing non-timber products standards and getting certified	Technologies	NA	NA											
		Information	3				3								
	Generating information on ethno-botany of non-timber forest products and utilization	Technologies													
		Information	15	3	1	1	2	1	2	2	1	1	1		
	Strategic objective 7 : Conducting demand driven and problem solving timber characterization, design and utilization research, developing 71 technologies, and generating 31 information packages	Adapting and developing technologies and information on timber characterization	Technologies	48	5	6	7	5	6	3	3	5	3	5	
			Information	24	2	6	6	6	4						
Adapting and developing technologies and information on composite products production and utilization		Technologies	11				3	1		3		2	2		
		Information	2				1	1							
Adapting and developing technologies and information on timber products design and production		Technologies	12				2	2		2	2	2	2		
		Information													
Adapting and developing knowledge and information on timber products and production standards and getting certified		Technologies													
		Information	5					5							

Strategic objective 8: Conducting demand driven and problem solving bio-energy, biochemical and biomass research, developing 21 technologies, and generating 19 information packages	Adapting and developing bio- energy technologies, information for timber and non-timber species utilization	Technologies	12		1	2		3	1	2	1		2		
		Information	4		1	1			1	1					
	Adapting and developing technologies and information on biochemical utilization of timber and non-timber species	Technologies	9					2	2	1			2	2	
		Information	5				2	1			1		1		
	Adapting and generating information on holistic use of timber and non-timber biomasses	Technologies													
		Information	10		2		1	1	2			2		2	
	iv. Forest Protection Research Directorate														
	Strategic objective 9: Conducting demand driven and problem solving research on tree disease and insect pests, developing 16 technologies, and generating 17 information	Developing technologies and generating information on the identity, characteristics of the pathogen and insect pests that affect the growth performance and yield of trees	Technologies	3				1			1		1		
Information			6		1	1	-	1	1			1	1		
Identifying mycorrhizae fungi and rhizobium bacteria, developing technologies and generating information for rehabilitating degraded lands		Technologies	3						1	1	1				
		Information	6			1	1	1	1			1		1	
Adapting and developing technologies, knowledge and information on pests and diseases control and management		Technologies	10			1	1	1			1	2	2	2	
		Information	5		1		2					2			
Strategic objective 10: Conducting demand driven and problem solving research on forest fire and parasitic flowering plants, developing 10 technologies, and generating 21 pieces of information		Adapting and developing technologies and generating information on fire protection and management	Technologies	3					1		1		1		
			Information	8				2		2		2		2	
	Adapting and developing technologies, and generating information on the control and management of parasitic flowering plants	Technologies	3				1		1				1		
		Information	8				1	1	1	1			2	2	
	Adapting and developing technologies and generating information on invasive plant species control and management	Technologies	4				1					1	1	1	
		Information	5				1		1	1		1	1		

v. Environmental Pollution Management Research Directorate													
Strategic objective 11: Conducting demand driven and problem solving environmental pollution management research, developing 4 technologies, and generating 25 pieces of information	Generating baseline data on sources, types and severity of pollutants/contaminants in air, soil and water quality and water pollution	Technologies											
		Information	7	2	1		2		1			1	
	Generating, adapting and testing information and technologies for managing and controlling of air, soil and water pollution	Technologies	4		1	1	1					1	
		Information	5		1		1		1		1	1	
	Generating baseline data on the fate and transport of pesticides, fertilizers, POPs and the effect on biological processes of the target and non target plant and animals	Technologies											
		Information	5	1			1		1	1		1	
	Generating information on interaction between humans and the biosphere	Technologies											
		Information	4			1			1	1		1	
	Setting up research-based tools, guideline, standards for auditing and monitoring of the environment	Technologies											
		Information	4			1		1		1		1	

<p>Strategic objective 12: Conducting demand driven and problem solving waste management research, developing 9 technologies, and generating 25 pieces of information</p>	<p>Generating, adapting and testing information and technologies for managing and controlling waste generated from different sources</p>	Technologies	4					1		1		1	1	
		Information	5				1	1		1		1	1	
	<p>Generating, adapting and testing information and technologies on hazardous and non-hazardous waste management options</p>	Technologies	5			1	1		1		1		1	
		Information	5			1	1		1			1	1	
	<p>Generating baseline data on sources, types and severity of wastes</p>	Technologies												
		Information	5	1			1		1		1	1		
	<p>Setting up research-based tools, guideline, standards for auditing and monitoring waste management options</p>	Technologies												
		Information	5			1	1		1		1		1	
	<p>Generating and adapting information and technology on environmental disaster risks, and developing management options for those problems emerging due to hazardous wastes</p>	Technologies												
		Information	5				1		1		1	1	1	

vi. Environmental Laboratories Directorate															
Strategic objective 13: Conducting demand driven and problem solving on physico-chemical research on waste water, and generating 28 biotechnology based information packages	Generating information on chemical pollution around water bodies	Information	10	1	1	1	1	1	1	1	1	1	1		
	Generating information on soil chemical pollution	Information	10	1	1	1	1	1	1	1	1	1	1		
	Generating information on POPs	Information	8			1	1	1	1	1	1	1	1		
Strategic objective 14: Conducting demand driven and problem solving biological research, generating 5 biotechnology based knowledge, and developing 1 technology	Developing technologies, and generating information on genetically modified drought tolerant tree species	Technologies	1					1							
		Information	1					1							
	Generating information on pollution resistant tree species	Information	2						1				1		
	Generating information on pollution tolerant microorganisms	Information	2					1					1		
vii Climate Science Research Directorate															
Strategic objective 15: Conducting demand driven and problem solving research, developing 12 technologies, generating 19 pieces of information on climate change adaptation and mitigation	Generating information and developing technologies on climate change adaptation	Technologies	8			1	1	1	2		1	1	1		
		Information	10			1	1	1	1	1	2	1	1	1	
	Generating information and developing technologies on climate change mitigation	Technologies	4				1	1				1	1		
		Information	9			1	1		1	2	1		1	2	

Strategic objective 16: Conducting demand driven and problem solving research, developing 17 technologies, and generating 26 pieces of information in climate change modeling and risk management.	Characterizing past, current and future climate parameters; and modeling climate variability and change patterns of the country	Technologies	10			1	2	1	1	2	2		1		
		Information	14		1	2	1	1	2	1	1	2	2		
	Assessing the risks of climate change and variability to environment and forestry resources of the country, and developing alternative risk management options	Technologies	7			1	2		2	1				1	
		Information	12		1	1	1	2	1	1	2	2	1		
viii. Socio-economics, Policy, Extension and Gender Research Directorate															
Strategic objective 17: Generating 71 pieces of information for the understanding and protection of the country's natural resources and providing knowledge-based policy options to address major challenges and opportunities in the environment, forestry and climate change issues.	Evaluating existing policies of environment, forestry and climate change and their impacts	Information	4		1		1			1			1		
	Assessing timber and non-timber forest product value chains	Information	20		1	3	2	2	3	3	2	2	2		
	Studying the economics of forest and environment, and households' behavior towards climate change	Information	23		2	3	3	2	3	2	3	3	2		
	Assessing economic values of environmental services and household preferences for environment, forest and climate change technologies	Information	14		1	1	1	2	2	2	2	1	2		

Strategic objective 18 Generating 28 pieces of information on the complex relationship between technological, biophysical environment, social, economic and political processes in the production, integration and use of scientific and other sets of knowledge in environment, forestry and climate change.	Understanding the complex relationship between technological, biophysical environment, social, economic and political processes in the production, integration and use of scientific and other sets of knowledge in environment, forestry and climate change.	Information	10		2	2	2	2	2	2			
	Understanding the complex relationship between technological, biophysical environment, social, economic and political processes in the production, integration and use of scientific and other knowledge in environment, forestry and climate change.	Information	5		1	1	1	1	1	1			
	Understanding the complex relationship between technological, biophysical environment, social, economic and political processes in the production, integration and use of scientific and other knowledge in environment, forestry and climate change.	Information	10		2	2	2	2	2	2			
ix. Tree Seed Technology Coordination													
Strategic objective 19:	Procuring quality germplasm (seed and clonal materials)	Ton	97	10	11	12	12	13	10	8	8	7	6
Supplying 97 tons of quality tree seed, and generating 86 quality seed sources	Developing different types of seed sources by selecting from natural forests and plantation and also by establishing plantation, with different genetic quality and management intensity (including provenances and progeny trials, seed orchards)	hectare	86	5	8	9	9	10	10	9	9	9	8

Strategic objective 20: Generating 27 technologies and 31 pieces of information on seed biology and biotechnology	Conducting research on seed biology, seed handling and storage conditions	technologies	10	1	1	1	1	1	1	1	1	1	1		
		Information	10	1	1	1	1	1	1	1	1	1	1	1	
	Conducting research on seed functional genomics, genetic diversity of populations and biotechnology	technologies	7		1		1		1	1	1	1	1		
		Information	9		1	1	1	1	1	1	1	1	1	1	
	Conducting research on clonal propagation techniques and biotechnology	technologies	10	1	1	1	1	1	1	1	1	1	1	1	
		Information	5		1		1		1		1		1		
	Generating information on quality assurance aspects and the seed system in general	Information	5		1		1		1		1		1		
	Developing seed standards and establish get certified	Information	2			1				1					

Goal 2: Formulating an efficient, cost effective and responsive system for technology promotion, dissemination, communication and knowledge management

Strategic objectives	Activity	Measure	Target	Implementation Timetable										Responsible bodies	
				'16	'17	'18	'19	'20	'21	'22	'23	'24	'25		
Strategic objective 1: Introducing systems to approve, register and disseminate technologies, knowledge and information (2 systems and 5 forums)	Introducing a system for technology approval, registry and release	No.	1				1								DDG and Technical Directors
	Arranging extension forums with stakeholders at different levels	No.	5		1		1		1		1		1		DDG and Technical Directors
	Developing viable research outputs dissemination system	No.	1		1										DDG and Director of SEPEG
Strategic objective 2: Improving communication skills for knowledge management (5 training, 1 system, 18 manuals and packages and 1 strategy document)	Organizing training to fill knowledge and skill gaps in write up and publishing in any credible journals	No.	5	1		1		1		1		1		DDG and Technical Directors	
	Producing technology manuals and extension packages	No.	18		2	2	2	2	2	2	2	2	2	Directors	
	Producing a strategy planning document for public relations and communication	No.	1		1									DDG and Director of Public Relation	
	Establishing efficient information, knowledge management and documentation system	No.	1											DDG and Director of SEPEG	

Goal 3: Establishing a vibrant system for research coordination and networking

Strategic objectives	Activity	Measure	Target	Implementation Timetable										Responsible bodies	
				'16	'17	'18	'19	'20	'21	'22	'23	'24	'25		
Strategic objective 1: Creating 2 systems for linkage, networking and partnership	Designing & implementing a system for linkage, networking and partnership with national and international organization	No.	1		1										DG, DDG and Technical Directors
	Instilling and implementing a system for gender mainstreaming in the research projects	No.	1	1											DDG and SEPEG Director
Strategic objective 2: Designing a mechanism for coordinating research endeavours (1 system, 1 council and 1 legal framework)	Developing and implementing a system for coordinating research activities in environment, forestry and climate change which are carried out by different research and higher learning institutions	No.	1		1										DG, DDG and Technical Directors
	Establishing a national environment, forestry and climate change research council and making it function well	No.	1	1											DG
	Framing and implementing a legal ground for enabling researchers outside of EEFRI submit research proposals and outputs	No.	1		1										DG

Goal 4: Creating an efficient system for human resource development

Strategic objectives	Activity	Measure	Target	Implementation Timetable										Responsible bodies	
				'16	'17	'18	'19	'20	'21	'22	'23	'24	'25		
Strategic objective 1: Planning for long-term human resource development	Empowering EEFRI with qualified and experienced research staff as per the human resource development plan	No. of BSc holders	125	28	45	58	69	81	89	96	109	116	125	DG and HR Directorate	
		MSc. Holders	260	64	84	103	120	140	169	189	210	237	260		
		PhD holders	169	20	34	53	68	88	107	128	143	157	169		
	Preparing a project proposal for human capacity building	No.	1		1										DG and HRD
	Signing MoU and MoA with higher learning, research and other related institutions for tailor-made training	No.	10	1	1	1	1	1	1	1	1	1	1	1	DG and DDG
	Developing a competitive package for research staff attraction in critical field of specialization	No.	1				1								DG, DDG and human resource
	Establishing a recruitment system for international staff	No.	1		1										DG and Technical Directors

Strategic objective 2: Developing systems for human resource attraction and retention (2 proposals and 2 systems)	Introducing and implementing of researcher recognition system	No.	1	1											DG, DDG and HRD
	Preparing a proposal for support staff attraction and retention, and negotiating and following up the implementation	No.	1	1											DDG and HRD
	Preparing a proposal for recruitment of international staff, and negotiating and following up the implementation	No.	1		1										DDG
	Designing a system for staff insurance	No.	1		1										DG

Goal 5: Building a state-of-the-art infrastructure

Strategic objectives	Activity	Measure	Target	Implementation Timetable											Responsible bodies
				'16	'17	'18	'19	'20	'21	'22	'23	'24	'25		
Strategic objective 1: Constructing all season type conducive working environment	Building offices at head quarter, research and sub-centres														
	Building versatile building complexes, such as laboratories, cold storage, etc.														
Strategic objective 2: Creating state-of-the-art research facilities	Setting up laboratories, greenhouses, lathhouses, arboretums and nursery sites	No.	1	1											DG, DDG and TD
	Establishing research stations	No.	15	3	3	3	3	3							DG and Technical Directors
	Automating systems	%	Automate All services	30	30	20	20								DG and ICT Director
	Equipping with field equipment, vehicles and machineries	%	Equip Technical Directorates	25	25	20	20	10							DG and Technical Directorates
	Building a national data base system	%	-	10	10	10	10	10	10	10	10	10	10	10	DG and TD

Goal-6: Devising and performing a responsive and proactive system for governance, strategy and policy

Strategic objectives	Activity	Measure	Target	Implementation Timetable										Responsible bodies
				'16	'17	'18	'19	'20	'21	'22	'23	'24	'25	
Strategic objective 1: Creating enabling leadership environment and improving institutional operational systems (20 capacity building programmes, 15 working manuals, 2 offices , 17 strategic plan documents)	Designing a periodic capacity building programmes in leadership	No.	20	2	2	2	2	2	2	2	2	2	2	DG and HR
	Developing working manuals, guidelines, rules and regulations	No	15	2	1	1	1	1	2	2	2	1	2	DG and Support Directorates
	Creating an Office for research-extension-industry coordination	No.	1		1									Director General
	Establishing an office for strategy & institutional transformation	No.	1		1									DG
	Developing directorate level strategies	No.	16	16										All Directors
	Formulating an anti-corruption strategy	No.	1	1										DG
Strategic objective 2: Introducing a system to increase institutional public visibility and influence (1 system, 30 calendar events, 5 forums and 18 event sponsors)	Devising a system that connects and integrates all dissemination, communication and public relations efforts	No.	1	1										DG
	Introducing national calendar of events for forestry/ environment/climate change	No	30	3	3	3	3	3	3	3	3	3	3	DG and Planning
	Establishing an EEFRI-NGOs forum	No	5		1		1		1		1		1	DG
	Sponsoring events for seeking publicity opportunities programmes on mass media	No	18	1	1	2	2	2	2	2	2	2	2	DG and PR

7. MONITORING AND EVALUATION

Effective monitoring and evaluation plan will help EEFRI to gauge the accomplishment of every action as per the framed timetable stringently as stipulated in this strategic plan document. Cognizant of this, the strategic plan has assigned monitoring indicators at objective levels (see Tables 7.1-7.6), which will be used for verifying the implementation during the strategic plan period.

Monitoring and evaluation of the strategic plan will be carried out by a team assigned by the Director General of EEFRI.

Finally, significant risks affecting the implementation of this strategic plan were identified. The top risks identified in the process were the willingness of development partners to accept the project proposals to be submitted for financing our major capacity building programmes. Secondly, persuasiveness of EEFRI's leadership to persuade and win MoFEC's and MoPSHR's support for our strategic plan taking our aspiration of becoming a premier research institute by a year 2025 into consideration. Thirdly, the commitment of staff of EEFRI, particularly, in accepting the assignments to work in ad-hoc- committees. These risks will be addressed through the implementation of the strategic objectives and the priority programmes.

Table 7.1 Monitoring and evaluation matrix for Goal-1

Objectives/outcomes	Verifiable Indicator	Means of Verification	Risks and assumptions	Frequency of measurement	Frequency of reporting
Strategic objective 1: Plantation forest research conducted and 35 technologies and 40 pieces of information generated	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual
Strategic objective 2: Agro-forestry research undertaken, 37 technologies developed, and 43 information generated	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual
Strategic objective 3: Research on rehabilitation of degraded land conducted, 27 technologies and 35 pieces of information generated	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual
Strategic objective 4: Natural forest ecology and management research conducted, and 13 technologies and 69 pieces of information generated	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual
Strategic objective 5: Natural aquatic and wetland ecosystem management research conducted, and 23 technologies and 52 pieces of information generated	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual

Strategic objective 6: Non-timber products and utilization research conducted, and 41 technologies and 44 pieces of information generated	No. of technologies and pieces of information generated	Meeting reports, annual review forum and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual
Strategic objective 7 : Timber characterization and utilization research conducted, and 71 technologies and 31 pieces of information generated	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual
Strategic objective 8: Bio-energy, biochemical and biomass research conducted, and 21 technologies and 19 pieces of information generated	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual
Strategic objective 9: Research on tree disease and insect pests conducted, and 16 technologies and 17 pieces of information generated	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual
Strategic objective 10: Forest fire and parasitic plants conducted and 10 technologies and 21 pieces of information generated	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual

Strategic objective 11: Environmental pollution management research conducted, and 4 technologies and 25 pieces of information generated	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual
Strategic objective 12: Research on waste management conducted, and 9 technologies and 25 pieces of information generated	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual
Strategic objective 13 : Physical chemistry research on waste water treatment conducted and 28 pieces of information generated	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual
Strategic objective 14 : Biological research on waste water treatment conducted, and 5 biotechnology knowledge and 1 technology generated	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual
Strategic objective 15 : Climate change adaptation and mitigation research conducted, and 12 technologies and 19 pieces of information generated	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual

Strategic objective 16 : Climate change modeling and risk management research conducted, and 17 technologies and 26 information generated.	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual
Strategic objective 17: Socio-economic and policy research conducted, and 71 pieces of information generated.	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual
Strategic objective 18 : Extension and gender research conducted, and 28 pieces information generated.	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual
Strategic objective 19 : 97 tons of quality tree seeds supplied and 86 quality seed sources generated.	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual
Strategic objective 20 : Seed system improvement research conducted and 27 technologies and 31 pieces of information generated.	No. of technologies and pieces of information generated	Meeting reports, annual review forum, and field day	Staff commitment and turnover; funding; weather related problems, and peace and security	Quarterly	Biannual

Table 7.2 Monitoring and evaluation matrix for Goal 2

Objectives/outcomes	Verifiable Indicator	Means of Verification	Risks and assumptions	Frequency of measurement	Frequency of reporting
<p>Strategic objective 1:</p> <p>Two systems introduced to approve and register research; and 5 extension forums implemented to disseminate technologies, knowledge and information</p>	<p>No. of systems introduced;</p> <p>No. of forums</p>	<p>Meeting reports, annual forum, published documents, and field day</p>	<p>Leadership commitment; funding/resource availability</p>	<p>Bimonthly</p>	<p>Quarterly</p>
<p>Strategic objective 2:</p> <p>5 training sessions conducted; a system introduced; 18 manuals/packages prepared and a strategic plan document prepared in order to improve communication skills for knowledge management</p>	<p>No. of training sessions conducted;</p> <p>No. of systems introduced;</p> <p>No. of packages developed</p> <p>No. of strategic plan document prepared</p>	<p>Meeting reports, annual forum, published documents, and field day</p>	<p>Leadership commitment; funding/resource availability</p>	<p>Bimonthly</p>	<p>Quarterly</p>

Table 7.3 Monitoring and evaluation matrix for Goal-3

Objectives/outcomes	Verifiable Indicator	Means of Verification	Risks and assumptions	Frequency of measurement	Frequency of reporting
Strategic objective 1: Two systems created for linkage, networking and partnership	No. of systems introduced	Meeting reports, published documents, and visits to the respective directorates	Leadership commitment; funding/resource availability	Bimonthly	Quarterly
Strategic objective 2: A system for research coordination implemented; a national council for environment, forestry and climate change established and a legal framework formulated and reinforced	No. of system introduced; No. of councils formed; No. of legal frameworks formulated and reinforced	Meeting reports, published documents, and visits to the respective directorates	Leadership commitment; funding/resource availability	Bimonthly	Quarterly

Table 7.4 Monitoring and evaluation matrix for Goal-4

Objectives/outcomes	Verifiable Indicator	Means of Verification	Risks and assumptions	Frequency of measurement	Frequency of reporting
Strategic objective-1: Training of qualified and relevant professional personnel (at B.Sc., M.Sc. and PhD levels), 125, 260 and 169, respectively, through the long-term human resource development plan	No. of B.Sc., M.Sc. and PhD holders	Human resource database report; payroll	Leadership commitment; funding/resource availability	Annually	Annually
Strategic objective 2: 2 projects and 2 systems developed and implemented in order to attract and retain staff	No. of project proposals written, No. of systems introduced	Meeting reports, published materials, granted project documents and visits to the respective directorates	Leadership commitment; funding/resource availability	Quarterly	Biannual

Table 7.5 Monitoring and evaluation matrix for Goal-5

Objectives/outcomes	Verifiable Indicator	Means of Verification	Risks and assumptions	Frequency of measurement	Frequency of reporting
Strategic objective 1: 20 different multi-storey building complexes constructed	No. of buildings constructed	On site supervision, meetings, reports, and visit to the concerned directorates	Leadership commitment ; funding/resource availability	Bimonthly	Quarterly
Strategic objective 2: State-of-the-art research facilities built	No. of labs, cold storage facilities; equipment, vehicles, etc.	On site supervisions, meetings, reports, and visit to labs, etc.	Leadership commitment; funding/resource availability	Bimonthly	Quarterly

Table 7.6 Monitoring and evaluation matrix for Goal-6

Objectives/outcomes	Verifiable Indicator	Means of Verification	Risks and assumptions	Frequency of measurement	Frequency of reporting
Strategic objective 1: 20 capacity building programmes effected; 15 working manuals prepared and applied, and 17 strategic plan documents prepared in order to create leadership competence and improve institutional operational systems	No. of capacity building programmes; No. of working manuals; No. of strategic plan documents	Meeting reports; published documents; and no. of trained leaders	Leadership commitment; funding/resource availability	Bimonthly	Quarterly
Strategic objective 2: A system designed and introduced; 30 events performed; 5 EEFRI-NGO forums realized and 18 national events sponsored in order to increase institutional public visibility and influence	No. of systems introduced; No. of EEFRI-NGO forums organized; No. of national events performed and sponsored	Meeting reports; published documents; No. of recognitions; No. of promotions via EBC or other media	Leadership commitment; funding/resource availability	Bimonthly	Quarterly

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Annex -1: EEFRI's 10 Year Human Resources Development Plan

Qualification	'16	'17	'18	'19	'20	'21	'22	'23	'24	'25
Plantation and Agro-forestry Research Directorate										
B.Sc.	14	16	18	20	22	24	26	28	30	32
M.Sc.	7	10	13	17	20	25	30	33	35	37
PhD	3	5	8	12	17	23	28	31	33	35
Total	24	31	39	49	59	72	84	92	98	104
Ecosystem Management Research Directorate										
B.Sc.	2	4	5	5	6	6	6	6	6	6
M.Sc.	10	12	12	13	15	15	17	18	19	20
PhD	3	4	8	8	10	10	12	12	12	14
Total	15	20	25	26	31	31	35	36	37	40
Forest Resources Utilization Research Directorate										
B.Sc.	18	20	22	24	26	26	28	28	28	30
M.Sc.	14	18	21	24	27	36	40	42	48	54
PhD	3	6	8	10	12	14	16	18	20	22
Total	35	44	51	58	65	76	84	88	96	106

Forest Protection Research Directorate										
B.Sc.		2	2	3	4	4	5	5	6	6
M.Sc.	3	4	6	6	8	10	10	12	12	14
PhD	2	3	4	5	6	6	7	7	8	8
Total	5	9	12	14	18	20	22	24	26	28
Environmental Pollution Management Research Directorate										
B.Sc.	5	8	10	11	13	14	16	17	18	19
M.Sc.	6	9	11	14	17	20	23	26	29	31
PhD	2	4	6	8	10	12	13	15	16	17
Total	13	21	27	33	40	46	52	58	63	67
Environmental Laboratory Directorate										
B.Sc.	1	3	4	5	6	7	7	9	10	10
M.Sc.	3	6	8	8	10	10	12	12	14	14
PhD	1	2	2	4	6	6	8	8	9	10
Total	5	11	14	17	22	23	27	29	33	34

Climate Change										
B.Sc.		2	4	6	8	8	10	12	14	14
M.Sc.	8	10	12	14	16	18	18	20	22	22
PhD	1	2	3	4	5	6	7	8	8	9
Total	9	14	19	24	29	32	35	40	44	45
Socio-economic, Policy , Extension and Gender Research Directorate										
B.Sc.	6	8	12	14	16	18	18	20	20	22
M.Sc.	7	8	10	11	13	16	18	21	25	29
PhD	3	5	7	8	12	15	19	22	25	25
Total	16	21	29	33	41	49	55	63	70	76
Tree seed Technologies Coordination Unit										
B.Sc.	2	4	6	8	8	10	10	12	12	14
M.Sc.	2	3	4	5	6	9	11	14	19	23
PhD	1	2	5	7	8	12	15	19	22	25
Total	5	9	15	20	22	31	36	45	53	62
GIS and Bio-metrics Coordination Unit										
B.Sc.		2	2	2	4	4	4	6	6	8
M.Sc.	4	4	6	8	8	10	10	12	14	16
PhD	1	1	2	2	2	3	3	3	4	4
Total	5	7	10	12	14	17	17	21	24	28

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