



THE UNITED REPUBLIC OF TANZANIA
MINISTRY OF NATURAL RESOURCES AND TOURISM



**National Forestry Research
Master Plan III (NAFORM III)**
2021 - 2031

Tanzania Forestry Research Institute
2021



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ABBREVIATIONS AND ACRONYMS

AF	Agroforestry
AFR100	African Forest Landscape Restoration Initiative
AIDS	Acquired Immunodeficiency Syndrome
CBD	Convention on Biological Diversity
CBFM	Community Based Forest Management
CFF	Community and Farm Forestry
CITES	Convention on International Trade in Endangered Species of Fauna and Flora
COSTECH	Tanzania Commission for Science and Technology
CPA	Certified Public Accountant
CPSP	Certified Procurement and Supplies Professional
EAMCEF	Eastern Arc Mountains Conservation Endowment Fund
FBD	Forestry and Beekeeping Division
FDT	Forest Development Trust
FITI	Forest Industries Training Institute
FYDP	Five Years Development Plan III
FOU	Forest Operations and Utilization
FRA	Forest Resources Assessment
GDP	Gross Domestic Product
KVTC	Kilombero Valley Teak Company
GRL	Green Resources Limited
ha	hectare
HIV	Human Immunodeficiency Virus
ICT	Information and Communication Technologies
IGAs	Income Generation Activities
LGA	Local Government Authority
LTPP	Long Term Perspective Plan
m³	cubic metre
MNFBC	Management of Natural Forests and Biodiversity Conservation
MNRT	Ministry of Natural Resources and Tourism
PFTI	Plantation Forests and Tree Improvement
NCDs	Non-Communicable Diseases

NFM	Natural Forest Management
NAFORMA	National Forest Resources Monitoring and Assessment
NAFORM	National Forestry Research Masterplan
NGOs	Non-Governmental Organisations
NTFPs	Non - Timber Forest Products
PFM	Participatory Forest Management
PFT	Plantation Forestry and Tree Improvement
REDD+	Reduced Emissions from Deforestation and Forest Degradation
SADC	Southern African Development Community
SDGs	Sustainable Development Goals
SEIA	Strategic Environmental Impact Assessment
SHUFPS	Sustainable Harvesting and Utilization of Forest Products
SPE	Socio-economics, Policy and Extension
SPFE	Socio-economics, Policy and Forestry Extension
SUA	Sokoine University of Agriculture
TaFF	Tanzania Forest Fund
TAFORI	Tanzania Forestry Research Institute
TDV	Tanzania Development Vision
TFS	Tanzania Forest Services Agency
ToF	Trees on Farm
TTSA	Tanzania Tree Seed Agency
TZS	Tanzania Shilling
UFF	Urban and Farm Forestry
UNCCD	United Nations Convention on Combatting Desertification
UNFCCC	United Nations Framework Convention on Climate Change
URT	United Republic of Tanzania
WMAs	Wildlife Management Areas
WWF	World Wide Fund for Nature

CURRENCY EQUIVALENTS

Tanzania Shilling (TZS) 2,309.12 = United States Dollar (USD) 1.00 (As of 2nd November, 2020).

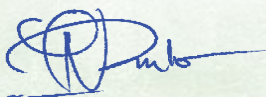
PREFACE

Development of the Third National Forestry Research Master Plan (NAFORM III) took into account changes in national, regional and global macroeconomic and environmental frameworks and obligations as well as emerging issues that have taken place since 2011. The changes have necessitated development of NAFORM III for the period 2021 to 2031. NAFORM III is an outcome of a consultative process that involved multiple stakeholders. Questionnaires and a stakeholders' workshop were used to solicit ideas for prioritisation research programmes and activities.

To ensure the necessary shift from supply to demand-driven research, all stakeholders connected directly or indirectly with forestry should be involved in the implementation of NAFORM III. This will lead to better research results and effective implementation of the Plan.

The NAFORM III has six research programmes and one support programme with four sub-programmes. The research programmes are indicated by forestry disciplines but multi-disciplinary research will be emphasised to ensure a more holistic approach. The Plan has spelled out the programme objectives, activities, indicative costs and implementation strategies. Sustainable financing, monitoring and coordination strategies have also been outlined.

The Plan which has the full support of the Government is envisaged to serve as a guiding document for all those involved or who will be involved in forestry research in Tanzania. The practical implication is that forestry research by individuals and institutions can now be pursued in focus areas that have been identified by stakeholders. It will ensure that the limited research resources are directed to the most important forestry challenges. It is therefore my sincere hope that TAFORI will ensure this document is available to all relevant stakeholders as well as instituting effective coordination of NAFORM III.



Dr. Aloyce K. Nzuki
Permanent Secretary
Ministry of Natural Resources and Tourism

ACKNOWLEDGEMENTS

Development of NAFORM III was a result of an initiative process by the Ministry of Natural Resources and Tourism (MNRT) through Forestry and Beekeeping Division (FBD) and the Tanzania Forestry Research Institute (TAFORI) Board of Directors. I wish to thank TAFORI Management for addressing gaps of the NAFORM II. I am indebted to the Task Force Team for leading the process of developing NAFORM III. The team consisted of Dr. Abel Masota, from Tanzania Forest Service Agency (TFS) who was Chairman; Dr. Chelestino Balama from TAFORI (Secretary), Prof. Wilbard Abeli from Sokoine University of Agriculture (SUA), Mr. Seleboni Mushi from FBD and Mr. Harun Makandi from the Tanzania Commission for Science and Technology (COSTECH) for developing this document based on stakeholder's inputs.

The Secretariat, constituting of Mr. Siwa Ernest and Mrs. Asha Raffy from TAFORI, and Ms. Elizabeth Musa from Tanzania Forest Fund (TaFF) is also acknowledged for logistical support and management of technical and financial records in the development of this document. Much appreciation is also extended to Prof. Said Iddi (SUA) for editing the draft NAFORM III document. Others stakeholders are as well acknowledged for their invaluable inputs to NAFORM III.

I am grateful to all individuals who were in one way or another involved in the process of improving the document and securing funds to undertake this task. Specifically, I appreciate the efforts and inputs of Dr. Ezekiel Mwakalukwa, the Director of FBD and Dr. Revocatus Mushumbusi, the Acting Director General of TAFORI. I owe special thanks to the Government of the United Republic of Tanzania (URT) through the TaFF for financing the development of NAFORM III.

The TAFORI Board of Directors considers NAFORM III the latest milestone in the forestry research development in Tanzania. The implementation of the proposed activities will promote sustainable forest management by providing analytical information and technologies that can be used by stakeholders in the sector.



Dr. Felician B. Kilahama
Chairman, TAFORI Board of Directors

EXECUTIVE SUMMARY

Background to NAFORM III

The National Forestry Research Master Plan III builds on experience gained in the implementation of NAFORM II which covered the period 2011 to 2020. This document takes into account national, regional and global policy, socio-economic and environmental changes that have taken place over the years. At national level, reviews and consultations of stakeholders, key challenges in the forest sector were noted which used to formulate the objectives of this NAFORM III. This review also benefited from the ongoing process of reviewing the National Forest Policy of 1998.

Objectives of NAFORM III

The overall objective of NAFORM III is “*to ensure forests and tree resources are conserved and managed well and utilized in a sustainable manner to meet the current and future demands*”. The specific objectives are:

- (i) Forests and tree resources effectively developed and sustainably managed.
- (ii) Forest ecosystems effectively conserved;
- (iii) Production of forest and tree products enhanced and sustained;
- (iv) Investments in the development of forests, tree resources and industries enhanced;
- (v) Human and institutional capacity to deliver services in the forest sector enhanced;
- (vi) Regional and international cooperation enhanced;
- (vii) Impacts of HIV and AIDS infections in the forest sector reduced;
- (viii) Gender equity and equality in the forest sector enhanced;
- (ix) Good governance principles in the forest sector enhanced; and
- (x) Contribution of the forest sector to environmental conservation enhanced.

Methodology

Development of NAFORM III involved key stakeholders at various stages.

A Task Force of five people drawn from Public Institutions dealing with forest research, and management was appointed to lead the process. The Task Force consulted key stakeholders on the achievements and challenges encountered during the implementation of NAFORM II through questionnaires. The same stakeholders were also requested to indicate research priority areas to be considered under NAFORM III.

Questionnaire responses from the stakeholders were compiled and summarized before holding a stakeholders' workshop to discuss and improve the draft document. A total of 36 stakeholders from Research and Academic Institution, Government, Non-Governmental Organisations (NGOs) and Private Sector participated in this one-day workshop held on 5th December 2018 at TAFORI Headquarters, Morogoro. After incorporating stakeholder's views and comments, the improved draft document was submitted to TAFORI Management for further improvement. The final document was then submitted to MNRT through TAFORI Board of Directors.

Strategies

In order to realise the objectives of NAFORM III, the following strategies will be used:

- i. Develop competitive research proposal projects/programmes and submit them to various funding sources;
- ii. Enhance research capacities of researchers through short and long term trainings;
- iii. Strengthen collaboration with other local and international research institutions in preparing competitive proposals, implementing and monitoring of research projects;
- iv. Ensure use of basic, applied and adaptive research to solve the current and emerging issues or problems;
- v. Strengthen national, regional and international partnerships, networking and linkages to ensuring skills transfer and close expertise gap;

- vi. Promote contract research for clients with specific research issues or problems;
- vii. Develop user friendly means of communicating forestry research findings to stakeholders;
- viii. Develop forestry research infrastructure that will encourage development partners to provide research financial support; and
- ix. Ensure adequate research knowledge and skills in key areas e.g. tree breeding, entomology, pathology, botany, wood processing and marketing.

Research Programmes

The NAFORM III consists of six prioritised research programmes namely:

- (i) Natural Forests and Biodiversity Conservation;
- (ii) Urban and Farm Forestry;
- (iii) Forest Plantations and Tree Improvement;
- (iv) Forest Resources Assessment;
- (v) Socio-economics, Policy and Forestry Extension; and
- (vi) Sustainable Harvesting and Utilization of Forest Products.

For each research programme, information is provided on background and justification, objectives, research focus areas and indicative inputs.

Support Programme

Implementation of NAFORM III requires a support programme whose components are: Human resources, Infrastructure, Publications, Dissemination and Technology Transfer, and Financing of Research.

Inputs

Indicative financial inputs of TZS 141.45 billion have been given for all research and support programmes. Detailed research or support projects' write-ups will come up with more realistic cost estimates.

The NAFORM III entails substantial financial cost. Therefore, more commitment and support of the Government as well as assistance from Development Partners are important. Commitment and support from the government is envisaged to be through Tanzania Forest Fund (TaFF), TFS and COSTECH.

Other possible sources of funding NAFORM III include the Eastern Arc Mountain Conservation Endowment Fund (EAMCEF), Forest Development Trust (FDT), World Wide Fund for Nature (WWF).

Implementation Arrangements

Overall Coordination and Regulation of NAFORM III

As per Parliament Act No 5 of 1980 which established TAFORI, one of the Institute's mandates is to coordinate and regulate forestry research in Tanzania. To ensure effective gauging, monitoring and coordination of forestry research, '*Forestry Research Guidelines*' will be formulated to provide a framework for Government and private sector to report, among other things, on the research proposals and achievements attained. To ensure effective coordination of NAFORM III, a well-staffed and facilitated Coordination Unit hosted at TAFORI will be strengthened.

Monitoring, Evaluation and Impact Assessment

The Coordinating Unit will be responsible for monitoring and reporting to TAFORI Board of Directors through Research and Publications Committee on progress made during the implementation of NAFORM III. The Unit will issue guidelines and templates for preparing bi annual and annual progress reports to be used by all Researchers and Heads of Research Institutions.

In order to appraise NAFORM III in terms of relevance, effectiveness, efficiency and impact, there will be two types of evaluation: Mid-term evaluation and End of term evaluation. Mid-term evaluation will take place after five years. End of term evaluation will take place after 10 years and

will assess the extent of NAFORM III implementation and whether the planned objectives have been met.

Concluding Remarks

NAFORM III has been developed to cover the period 2021 to 2031. Meaningful efforts must be made to ensure its successful implementation. This demands active participation of all stakeholders. Also, sustainable financing and proper coordination are vital for successful implementation of NAFORM III. During the implementation of NAFORM III, research demanded by stakeholders including emerging issues will be taken into consideration.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Forest resources in Tanzania Mainland cover about 48.1 million hectares (ha) which is equivalent to 55% of total land surface area. The main types of forests are Open woodlands (74.8%), Closed woodlands (18.2%), Lowland (3.4%), Montane (2.1%), Plantations (1.2%), and Mangroves (0.3%). The forests, particularly reserved ones are further divided into two main use categories, namely protection and production forests. Protection forests covering 28.09 million ha (58.4% of all forests) are located on fragile landscapes, water catchment areas or biodiversity hotspots. Production forests on the other hand, are natural forests or plantations that are managed to supply wood to meet the diverse needs of the nation and for export. These forests cover 20 million ha which is 41.6% of all forests (URT, 2015).

The existing forest tenure arrangements are Central Government (16.6 million ha or 34.5%), Local Government Authorities (3.1 million ha or 6.5%), Village Governments (21.9 million ha or 45.7%), Private (3.5 million ha or 7.3%), and General land (unreserved forest) (2.9 million ha or 6.0%) (URT, 2015).

In terms of the growing stock, it is estimated that there are 3.3 billion cubic metres (m³), of which closed forests account for 11.3% while woodlands account for 73.9% of the growing stock. The remaining 14.8% is contributed by trees on farm. For sustainable utilization, Tanzania may harvest up to 42.8 million m³ of wood per year. However, currently, the total annual supply of wood at national level is estimated at 83.7 million m³. In 2010 for example, the wood volume cut was 62.3 million m³ which is 19.5 million m³ above the allowable cut (URT, 2015).

The sector's contribution to national economy is estimated to be 3 – 4 % of Gross Domestic Product (GDP) (Ministry of Finance 2013; Tanzania Revenue Authority 2012, cited in the Tanzania Extractive Industries Transparency Initiative scoping study¹). Forests provide a range of products and ecosystem services, some of which such as timber and derivative products like paper are reflected in monetary terms but others are non-monetary such as the ability of forest soils to purify water, regulate run-off, sequester carbon, etc. However, due to difficulties in quantifying overall contribution of forests to the national economy, the real contribution of forest resources to national and local economies are probably underestimated. It is also notable that the national statistics on the contribution of the forestry sector to GDP do not reflect the illegal proportion of the forest products trade. For instance, Abdallah (2014) estimated a contribution of 4% based on royalties paid directly to the government upon harvesting forest products and exports but excludes illegally harvested and traded forest products. Forests on the other hand, provide about 90% of all the energy consumed in the country.

The forest sector conserves natural ecosystems which provide social, environmental, and cultural values. Further, forests provide habitats to wildlife and embrace fauna and flora biodiversity which in turn boosts up the country's economy through tourism. Forest management is experiencing a number of challenges including forest degradation and deforestation. The annual deforestation rate of 372,816 ha recorded in 2015 (URT, 2015) is now reported to have increased to 469,420 ha (URT, 2017).

The main drivers of deforestation and forest degradation are the growing energy needs of an expanding population coupled with agricultural expansion. Furthermore, the dominant vegetation types have low productivity and approximately half of the forest resources are found in

¹ Green Advocates International, Inc. 2014 Scoping Study of the Forestry Sector for the purpose of including the industry in Revenue Disclosure through the Tanzania Extractive Industries Transparency Initiative, December 2014

protected areas and therefore unavailable for harvesting. Deforestation and forest degradation have negative impacts in terms of loss of water retention capacity of forests, reduction of year round surface water, reduced rural livelihoods, reduced food security and loss of biodiversity, to mention a few. Other drivers include encroachment of forest areas for the expansion of agricultural areas and settlement, bush or forest fires, shortage of forestry staff, low budget allocation to the sector, high communities' dependency on forest resources as the major source of income, lack and low adoption of other sources of energy for both cooking and heating.

Despite the challenges facing research and the forest sector in general, research has to play a leading role in sustainable forest management. The challenges facing research include limited research funds, inadequate trained man power, inadequate infrastructure, and weak dissemination of research findings. NAFORM III uncovers issues, identifies priorities, and offer strategies to meet these challenges.

1.2 Rationale for the development of NAFORM III

NAFORM I was initiated in 1999. It created a base to ensure that all research undertaken were demand – driven. This was followed by NAFORM II which came into effect in 2011. NAFORM II had an overall objective of developing appropriate knowledge and technologies for the sustainable management of forest resources in the country. This Plan constituted six programmes and one support programme. The programmes were: Natural Forest Management, Community and Farm Forestry, Plantation Forestry and Tree Improvement, Forest Resources Assessment, Social Economics, Policy and Forestry Extension, Forest Operations and Utilizations. Since 2011, there have been remarkable changes in national, regional and global macroeconomic and environmental frameworks and obligations. Therefore, the need to develop NAFORM III is pertinent in order to comply with national, regional and global initiatives.

1.2.1 National Frameworks

The Tanzania Development Vision 2025 (TDV) outlines the economic framework that the country desires to achieve by 2025 (URT, 2005). The fundamental objective of the Vision is to transform Tanzania into a middle income country with a diversified and semi-industrialized economy. The Long Term Perspective Plan (LTPP) 2011/12- 2025/26 was developed as a means to implement Vision 2025 with the theme of “Nurturing an Industrial Economy”. The Second Five Year Development Plan: 2016/17- 2020/21 aims at economic transformation and human development (URT, 2016). It focuses to increase the interventions that halt and reverse the observed declining trends in productive capacity such as gross fixed capital formation and capital goods imports, poor quality in secondary and tertiary education as well as industrial research in forest and forest produce. In order to achieve these, the Second plan put emphasis on increasing research and development expenditure, public support to universities and research centres, increasing budget allocation for research development activities, reform links with Local Government Authorities (LGAs) and with research and training institutions as well. The Five Year Development Plan III (FYDP III (2021/22 - 2025/26), is anchored on the theme of “Attaining Export Growth and Competitiveness”.

The National Forest Policy (1998) advocated for conservation and management of forest resources for the benefit of present and future generations which is in line with the emphasis on sustainable forest developments. Through extensive reviews and stakeholders’ consultations indicate several research issues which have to be addressed by NAFORM III. The development of NAFORM III is fully supported by the policy statement (32) and directions as stipulated in the National Forest Policy (1998) as well as the ongoing process of its review. The policy statement (32) states that *‘Forestry research and development will be promoted and strengthened as the basis for sustainable development and management of the forest sector. Financial resources for problem – oriented research*

and development programmes will be provided through cost-sharing mechanisms and establishment of research funds’.

Among the Directives under this policy statement insists on forest research and development priorities to be reviewed based on the demand-driven research principle. Also, the National Research Master Plan to be revised in collaboration with stakeholders by setting out priority areas for forest research.

On the other hand, the Medium Term Strategic Plan (2016 – 2021) is geared at achieving the aspirations of the policies, programmes and strategies aligned to natural and cultural resources and development of tourism. The plan identifies research areas, prioritization and coordination of research to be undertaken by various institutions and organizations.

1.2.2 Regional Obligation

Tanzania as a member of the East African Community (EAC) is party to the Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region and Related Protocols. The convention and related protocols aim at cooperation in the joint and efficient management and sustainable utilisation of natural resources including forests as well as prevention, reduction and combating pollution of the Convention area (EAC, 2016).

Tanzania is a member state of Southern African Development Community (SADC) and signatory to the SADC Protocol on Forestry. The Protocol focuses on promoting the development, conservation, sustainable management and utilisation of all types of forests and trees and trade in forest products (EAC, 2016).

1.2.3 Global Environmental Obligations

Tanzania has committed itself to a number of international obligations relating to environmental management. These include Sustainable

Development Goals (SDGs), Convention on Biological Diversity (CBD), United Nations Convention on Combating Desertification (UNCCD), United Nations Framework Convention on Climate Change (UNFCCC), Convention on International Trade in Endangered Species of Fauna and Flora (CITES), RAMSAR Convention and African Forest Landscape Restoration Initiative (AFR100). These Obligations in general focus on the importance of conservation and carbon sequestration by forests regionally and globally as measures to combat deforestation and forest degradation.

1.2.4 Global Economic Frameworks

1.2.4.1 Internal and external trade of forest products

The implementation of trade liberalization policies in Tanzania has been marked by both positive and negative social and environmental impacts. On the positive side, trade liberalization policies in the forestry sector have encouraged the expansion of production and trade in forest products, thereby accelerating the macroeconomic contribution to the sector. Other aspects of positive results of implementing trade liberalization are increased importation of inputs, growth in sectoral investment and increase in value addition, GDP and employment. Negative impacts include increased rate of forest products extraction (often illegally) thereby fuelling deforestation and increased atmospheric carbon dioxide. Tanzania is in the move to adopt a timber certification regime, a system which applies minimum standards and mechanisms for verification and certification in compliance with sustainable forest management.

1.2.4.2 Effects of Globalization

Globalization has led to greater movement of people, goods, capital and ideas due to increased economic integration which in turn is propelled by increased trade and investment. Globalization provides opportunities and challenges. One of the benefits of globalization is improved environmental awareness and accountability. On the other hand, globalization has harmed the environment through expansion of unsustainable agriculture, use of lesser known trees and mining activities.

1.2.5 Cross cutting issues

The cross cutting issues in forestry research are: prevalence of HIV and AIDS, Non-Communicable Diseases (NCDs), gender imbalance, governance, climate change and unemployment.

In efforts to combat HIV and AIDS, their respective policies have been mainstreamed in all Government strategic plans. The Government has been taking initiatives to reduce HIV infections and impacts of AIDS by conducting sensitization seminars on prevention and supporting people living with HIV and AIDS.

The NCDs includes strokes, heart diseases, most cancers, diabetes, and chronic kidney diseases. The Government has encouraged mainstreaming of NCDs in institutional strategic plans. Furthermore, it conducts awareness campaigns on lifestyles and improvement in healthy sector.

Gender balance aims at providing relatively equal opportunities to males, females and marginalized groups with similar qualifications to effectively manage forest resources and provide desirable services. Forest-related institutions and organizations in the sector consider gender balance in most aspects of institutional management and field operations. However, the gender proportion is skewed in favour of male staff due to disproportion in training institutions especially at the professional level. While males dominate the managerial cadre, females dominate the lower cadre. Marginalized groups are generally weakly represented. Furthermore, benefits accruing from forest sector are often not equitably gender shared.

In forest sector, good governance is reflected in reduction of corruption, stable property rights, and rule of law. It also ensures that positive policy contributions resulting from the implementation of sectoral action plans. The forest sector operates in an environment where scarce resources are managed in a participatory manner and necessitate benefit sharing.

Despite efforts to improve transparency, accountability and rule of law, some incidences of corruptions exist.

Adverse impacts of climate change such as extinction of flora and fauna, intensive fires during drought, high erosion and changes in phenology are reality in the country. To address impacts of climate change in the country, the Government has developed National Climate Change Strategy of 2012 as well as signing to different global protocols and conversions. Forests and trees are able to sequester carbon (and thereby reduce the release of carbon dioxide into the atmosphere). The loss of forests leads into weakening capacities of carbon sequestration hence increased greenhouse gases. Although there have been efforts to address the environmental challenges in the forest sector, trends show loss and degradation of forests, declining fresh water, soil degradation and erosion, biodiversity losses and accumulation of hazardous substances and pollutants. In its totality, climate change impacts on forest management resulting into declining availability of forest products and services. In order to reverse the trend, adaptation and mitigation measures need to be researched as well as develop capacity and knowledge to implement already laid down REDD+ commitments.

Employment is a source of personal dignity, family stability, peace at household, community and the nation at large. It is also a key in poverty reduction and a facility in achieving equitable, inclusive and sustainable development in the country. Youth employment situation remains one of the key challenges.

Unemployment is due to the fact that most youth have no employable skills. Skills requirement in the labour market are not compatible with skills supply and as a result, we have a mismatch of skills. Secondly, the existing global labour market competitiveness demands use of advanced technology and Information, Communication and Technology (ICT). This replaces unskilled labour and requires labour with specialized skills only.

Other drawbacks include poor attitude of youth towards work; insufficient business and entrepreneurship development services. To address issues of unemployment, the Government has mainstreamed entrepreneurship course into all vocational training curricula. Specifically, the Government needs to promote access to employment opportunities and resources to the vulnerable and marginalized groups (youth, women and people with disability).

1.3 Specific Objectives of NAFORM II

The specific objectives of NAFORM II were as follows:

- i. Develop management and conservation systems of natural forests;
- ii. Scale up appropriate tree planting/management, agroforestry and land rehabilitation technologies for subsistence farmers and other land users;
- iii. Improve productivity of plantations by identifying and improving suitable species and their nursery, establishment, management and protection techniques;
- iv. Develop efficient and environmentally sound forest harvesting techniques;
- v. Improve technologies for better utilization and marketing of forest products;
- vi. Establish linkages between socio – economics, policy, forest extension and natural resources;
- vii. Develop research expertise, infrastructure and appropriate environment to respond to forest research needs of Tanzania;
- viii. Enhance cost- effective dissemination mechanism and
- ix. Generate and enhance a reliable database and information to guide decisions on forest issues at all levels.

CHAPTER TWO

2.0 KEY ACHIEVEMENTS, CHALLENGES AND LESSONS LEARNT DURING THE IMPLEMENTATION OF NAFORM II (2011-2020)

2.1 Key Achievements

2.1.1 Research Programmes

2.1.1.1 Natural Forests Management

Key achievements under this programme included:

- (i) Successful domestication of *Albizia gummifera*, *Cordia africana*, *Entendophragma holtsii*, *Newtonia buchananii* and *Prunus africana* for conservation purposes;
- (ii) Capacity building to communities in Bagamoyo, Handeni Districts and Dodoma City on conservation of *Terminalia sericea*;
- (iii) 87 botanical specimens collected from National Forestry Resources Monitoring and Assessment (NAFORMA) and Rufiji Hydropower Projects and identified.
- (iv) One species namely *Dialium angolense Welw. Ex Oliv* recorded for the first time in Tanzania and Floral of Tropical East Africa region;
- (v) PFM Database for 16 Southern African Development Community (SADC) member states developed;
- (vi) Fire occurrences and intensity in Tanzania Forests were mapped;
- (vii) Climate Change Adaptation Options and their implications on Mangrove Resources in Bagamoyo District assessed;
- (viii) Seed dispersal by bats studied;
- (ix) Pollination of *Mesogyne insignis* (Moraceae) in Amani Nature Forest Reserve studied;
- (x) Isolation and development of 13 new, polymorphic microsatellite loci for a threatened, understory tree, *Mesogyne insignis*, (Moraceae) from the Eastern Arc Mountains carried out;

- (xi) Livestock grazing impacts on plant species composition in montane forests on the northern slope of Mount Kilimanjaro studied;
- (xii) Plant species response to variation in soil nutrient saturation gradients in Zaraninge Forest studied; and
- (xiii) Anthropogenic disturbances effect on population structure and regeneration of *Scorodophloeus fischeri* and *Manilkara sulcata* in coastal forests studied.

2.1.1.2 Community and Farm Forestry

Key achievements under this programme included:

- (i) Norms for indigenous systems used for forest management and beekeeping practices in Mzoghoti Village Forest Reserve in Usambara Mountain, identified;
- (ii) Benefit sharing on revenues generated from sustainable forest management in village land forest reserves in Lushoto District documented;
- (iii) *Paranaleptes reticulate* threatening survival of Eucalypt clones in community woodlots in Tanga Region identified;
- (iv) Impacts of woody invasive plants on rural livelihood, ecosystem services and biodiversity in Eastern Africa for mitigation in Tanga and Kilimanjaro regions assessed; and
- (v) 50 ha of fuelwood plantation established in Lushoto Prison;
- (vi) Economic and ecological benefits in Coffee Agroforestry Systems studied;
- (vii) Agroforestry options to enhance food security and climate change resilience for rural communities in Eastern Arc Mountains in Tanzania, studied; and
- (viii) Exploration of the potentials of Forest Stewardship Council Group Certification Scheme, studied in 16 community forests.

2.1.1.3 Plantation Forestry and Tree Improvement

Key achievements under this programme included:

- (i) Trial plots for assessing survival rate and planting spacing on

- growth performance of various indigenous tree species (*Milicia excelsa*, *Khaya anthotheca*, *Azelia quanzensis*, *Albizia lebeck*, *Tamarindus indica*, *Acacia nilotica*, *A. polyacantha*, *A. tortilis*, and *Melia azedarach* established in eight ecological zones;
- (ii) Trial plots for assessing survival rate and planting spacing on growth performance of various exotics (*Cedrela odorata*, *Acacia mangium*, *Gmelina arborea*, *Pinus patula*, *P. maximinoi*, *P. oocarpa*, *P. caribaea* and Eucalypt clones, *Eucalyptus tereticornis*, *E. pellita*) established in eight ecological zones;
 - (iii) Water use by Eucalypt clones in the country studied;
 - (iv) Effect of weeding and spacing on growth of bamboo - *Dendrocalamus membranaceae* CV *grandis* established;
 - (v) 10 priority medicinal tree species in Miombo ecological zone domesticated;
 - (vi) Forest health in Pines and *Grevillea robusta* in six government plantations assessed;
 - (vii) Resistance of *Cupressus lusitanica* to Aphid attack in Lushoto assessed;
 - (viii) Effect of fertilizer application on *Eucalyptus saligna* and *Pinus patula* in Lushoto established;
 - (ix) Seed orchards to supply high-quality *Pinus patula*, *Grevillea robusta*, *Eucalyptus saligna* and *E. grandis* tree seeds in Lushoto and Mufindi districts established;
 - (x) 76 genetic trials for *Eucalyptus* species, *Corymbia*, Pines and their hybrids in 23 trial sites covering four climatic zones namely tropical, sub-tropical, warm temperate and cool temperate in the Southern Highlands, along the Coast and Lake Zone establishment and managed;
 - (xi) Six trials for breeding population for *Pinus patula* and *Eucalyptus grandis* in Mufindi and Njombe districts in the Southern Highlands of Tanzania, established; and
 - (xii) Four trials for seed orchards of *Pinus patula* and *Eucalyptus grandis*

in Mufindi and Njombe district in the Southern Highlands of Tanzania established.

2.1.1.4 Forest Resource Assessment

Key achievements under this programme included:

- (i) National Forest Resources Monitoring and Assessment of Tanzania Mainland (NAFORMA) undertaken;
- (ii) Permanent sample plots for assessing forest resource conditions in Bukombe-Mbogwe Forest Reserve in Shinyanga region established;
- (iii) Baseline information on Carbon storage potential of natural forest in the Eastern Arc Mountains obtained;
- (iv) Distribution and abundance of endangered plant species *Saintpaulia* and *Streptocarpus* in Eastern Arc Mountains studied for conservation purposes;
- (v) Models for estimation of tree volume and biomass in different vegetation types including Miombo woodlands, Teak, *Pinus patula*, Baobab, Cashew nut, Coconut, Itigi thickets, *Acacia-commiphora*, lowland and tropical rainforest in Tanzania were developed;
- (vi) Land use/cover of Selous Game Reserve and surrounding Wildlife Management Areas (WMAs) mapped;
- (vii) Bio-physical resource inventory in the Ruvu and Zigi catchment forests conducted;
- (viii) Biodiversity and natural resources assessment and economic valuation of Mount Hanang' Forest Reserve conducted;
- (ix) Natural resources (biodiversity assets) assessment in five WMAs in Ruvuma landscape conducted;
- (x) Composition and size class structure of tree species in Ihang'ana Forest Reserve in Mufindi district studied; and
- (xi) Diversity and distribution pattern of riparian plant species in the Wami River system studied.

2.1.1.5 Socio-Economics, Policy and Extension

Key achievements under this programme included:

- (i) Appropriate Institutional arrangement in forests and woodlands under Community-Based Forest Management (CBFM) developed;
- (ii) Factors affecting land allocation in semi-improved and traditional irrigation Schemes (land ownership, market access, and government policies) identified;
- (iii) Rules for accessing Non-Timber Forest Products (NTFPs) in forest nature reserves for adaptation to climate change by forest adjacent communities formulated;
- (iv) Appropriate water management institutions for farmer-managed irrigation schemes studied;
- (v) Appropriate selling system (auction system) of wood from national forest reserves developed;
- (vi) Environmental friendly Income Generating Activities (IGAs) such as beekeeping practice, livestock keeping (chicken and ducks), and horticultural activities (vegetable and fruit production) to enhance conservation of forest reserves identified and promoted;
- (vii) Five appropriate agroforestry practices for hill farming communities around Uluguru Mountains developed and disseminated;
- (viii) Efficient charcoal production technology (Cassamance Basic Earth Mound Kiln) and use of improved cooking stoves for sustainable utilisation of forest resources developed;
- (ix) Two guidelines for wood energy woodlots establishment and management techniques developed;
- (x) Demonstration plots for Pines, *Eucalyptus* species and Eucalypt clonal hybrid materials to determine impact of different level of silvicultural practices on survival, tree growth, stem form and wood quality established at Kisolanza site (Iringa Rural);
- (xi) Guideline for production of Eucalypt clones developed;
- (xii) Dynamics and impact of private forests on village land studied;
- (xiii) Balancing rural livelihoods and conservation, studied;

- (xiv) Incentives, constraints and institutions shaping resource use studied;
- (xv) Forest plantation and woodlot technical guidelines developed;
- (xvi) Tree improvement strategies for Southern Highlands of Tanzania developed;
- (xvii) Standard operating procedures (SOPs) for implementing tree breeding operations of the Tree Improvement Research Working Group (TIRWG) in Tanzania developed;
- (xviii) Integrated fire management: Guidelines for commercial forestry developed; and
- (xix) Tanzania wood product market study studied.

2.1.1.6 Forest Operations and Utilisation

Key achievements under this programme included:

- (i) Physical and strength properties of immature *Pinus patula* (5 - 15 years old) suitable for woodfuel, veneer and pulp production determined;
- (ii) Optimal rotation age of *Tectona grandis*, *Pinus patula*, *P. caribaea*, *P. tecunumanii* and *P. kesiya* in plantation forests for timber production determined;
- (iii) Minimum age of *Pinus patula* suitable for pulp and paper production determined;
- (iv) 20 indigenous tree species from Miombo woodlands qualified to be included into the Fourteenth Schedule of the Forest Act;
- (v) Wood properties of nine-year-old Eucalypt clones for pulp and paper production, woodfuel and for structural use determined;
- (vi) Nutrient contents of dried leaves of *Zanthoxylum chalybeum* Engl. for food consumption determined;
- (vii) Nicotine contents in honey from tobacco and non-tobacco growing areas determined;
- (viii) Household annual charcoal consumption in Dar es Salaam, Arusha, Morogoro and Mwanza regions determined;
- (ix) Assessment of sustainable utilization of forest products and

economic valuation of timber and non-timber forest products in Mbarang'andu WMA within the Ruvuma Landscape conducted; and

- (x) Sustainable timber harvesting in agroforestry and tree farms developed.

2.1.2 Support Programme

2.1.2.1 Human Resources

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Table 1: Qualifications of TAFORI of staff in 2011 and 2018

Education level	Total number of staff	
	2011	2018
PhD	1	7
Masters	16	23
Post Graduate Diploma	0	0
Bachelor's Degree	24	19
Advanced Diploma	5	4
Diploma	20	27
Certificates	28	13
Certified Public Accountant (CPA)	2	5
Certified Procurement and Supplies Professional (CPSP)	1	2
Other	63	26
Total	160	126

**Observed decline in number of staff with certificates, advanced diploma and bachelor's degree (between 2011 and 2018) is due to staff undergoing further trainings, retirement and lack of new employment during this period.*

2.1.2.2 Infrastructure

Forestry research institutions continued to improve research infrastructure which involved rehabilitation, construction of laboratories and offices, provision of furniture, field and laboratory facilities. Specifically, construction of a modern Library and wood science Laboratory at Forest Industries Training Institute (FITI), furnishing forest seeds laboratory at the then Tanzania Tree Seed Agency (TTSA) and purchase of equipment

for measuring water uptakes by various trees at TAFORI. Despite these improvements, there are still some infrastructure gaps in various institutions.

2.1.2.3 Publications and Dissemination

During the implementation of NAFORM II, institutions involved in forestry research published various documents including books (10), journals (76), proceedings (6) and newsletters (8). There was also dissemination of different proven technologies such as Agroforestry, production of planting materials through cloning and improved charcoal production kilns “the Cassamance model”.

Research Institutions also conducted workshops e.g. the Insect Pests, Diseases and Soil Problems in Forest Plantations Workshop in 2011; the Second Participatory Forest Management (PFM) Research Workshop in 2013; and several Conferences including the one on Forestry Research for Sustainable Industrial Economy in Tanzania, conducted in 2018, in Morogoro. Institutions also participated in the Dar- es -Salaam International Trade Fairs and Nane Nane Agricultural exhibitions held in different agricultural zones.

2.2 Challenges

The main challenges encountered during the implementation of NAFORM II were:

- (i) Shortage of human resources;
- (ii) Inadequate research knowledge and skills in some areas e.g. wood processing, botany and tree breeding;
- (iii) Inadequate funding;
- (iv) Old and inadequate infrastructure;
- (v) Lack of research materials (manual books, guidelines) and equipment (calliper, hypsometer, compass, tensiometer);
- (vi) Lack of proper coordination of NAFORM II; and
- (vii) Lack of action plan/strategy to guide implementation of NAFORM II.

2.3 Lessons Learnt

The main lessons learnt from NAFORM II that need to be considered during the implementation of NAFORM III are the following:

- (i) To implement Research master plan effectively and efficiently; research institutions need qualified human resources;
- (i) Reliable research facilities and infrastructure are needed;
- (ii) The Master plan needs to be properly coordinated and regulated;
- (iii) Research needs sustainable and diversified source of funding;
- (iv) Development partners and other stakeholders are ready to provide support so long as proper research plan is in place;
- (v) Research findings have significant impacts on the country's industrialisation as it increases raw materials;
- (vi) Institutional linkages or collaboration with other institutions is one of the strategies for capacity building of staff particularly scientists/research officers; and
- (vii) Implementation of any Research master plan needs action plan/strategy.

CHAPTER THREE

3.0 NAFORM III: OBJECTIVES, PRIORITY SETTING AND STRATEGIES

3.1 Objectives

The objective of NAFORM III is to operationalise the National Forest Policy (URT, 1998). The overall goal of the National Forest Policy (1998) is *‘to enhance the contribution of the forest sector to the sustainable development of Tanzania and the conservation and management of her natural resources for the benefit of present and future generations’*.

Based on the goal of the National Forest Policy (1998), the overall objective of the NAFORM III is *“to ensure forest and tree resources are well conserved, managed and utilized in a sustainable manner to meet the current and future demands”*. In order to achieve this objective, accurate and researched information is needed to guide in decision making. Thus, the specific objectives of NAFORM III are:

- (i) Forest and tree resources effectively developed and sustainably managed.
- (ii) Forest ecosystems effectively conserved;
- (iii) Production and marketing of forest and tree products enhanced and sustained;
- (iv) Investments in the development of forests, tree resources and industries enhanced;
- (v) Human and institution capacity to deliver services in forest sector enhanced;
- (vi) Regional and international cooperation enhanced;
- (vii) Impacts of HIV and AIDS infections in the forest sector reduced;
- (viii) Gender equity and equality in the forest sector enhanced;
- (ix) Good governance principles in the forest sector enhanced; and
- (x) Contribution of the forest sector to environmental conservation enhanced.

The NAFORM III will also contribute to the achievement of TDV 2025 through the main priority research areas: natural resource management, environment, climate change, and human and infrastructure development. Others include strong and competitive economy, nature, tourism, cultural heritage, cross cutting issues such as governance, HIV and AIDS, gender, and NCDs.

3.2 Priorities

The development of NAFORM III was through a consultative process that involved relevant stakeholders. Various national, regional and global macro-economic and environmental framework changes and obligations that have taken place since the approval of NAFORM II were reviewed. Research objectives of NAFORM II were evaluated on the basis of their relevance before being adopted in NAFORM III. As far as possible, emphasis was given to objectives not accomplished under NAFORM II and on new emerging issues.

As part of consultation process, a questionnaire survey (Appendix I) was administered to key stakeholders to provide information on research achievements of NAFORM II, forestry research priority areas, challenges and ways and means used to address those challenges. The key stakeholders involved Forestry Research and Academic/Training Institutions, Institutions dealing with the Management of natural and plantation forests, Forestry associations, Non-Governmental Organizations (NGOs) and Forestry Funding agencies. Responses of stakeholders were analysed/evaluated and new ideas or inputs were incorporated in the relevant sections of the document. The prepared draft NAFORM III document was presented in a Stakeholders' workshop in order to cross check and validate the information collected or provided. A total of 36 stakeholders from Research Institutions (17), Academic Institutions (8), Private Organizations (3), Government (4) and Non-Governmental Organizations (4) attended this meeting/workshop. Relevant comments raised during stakeholders' workshop were further

incorporated before presenting the improved draft document to TAFORI Management. The improved draft document was tabled to the TAFORI Board of Directors before the final report was submitted to MNRT.

3.3 Strategies

In order to achieve the objectives of NAFORM III stated in Section 3.1, Forestry Research institutions and other stakeholders involved in forestry research will develop strategies aimed at soliciting and acquiring research funds. Some of the strategies that will be used include:

- i. Develop competitive research proposal projects/programmes and submit them to various funding sources for funding;
- ii. Enhance research capacities of Researchers through short and long term trainings;
- iii. Strengthen collaboration with other local and international research institutions in preparing competitive proposals, implementing and monitoring of research projects;
- iv. Ensure use of basic, applied and adaptive research to solve the current and emerging issues or problems;
- v. Strengthen national, regional and international partnerships, networking and linkages to ensuring skills transfer and close expertise gap;
- vi. Promote contract research for clients with specific research issues or problems;
- vii. Develop user friendly means of communicating forestry research findings to stakeholders;
- viii. Develop forestry research infrastructure that will encourage development partners to provide research financial support; and
- ix. Ensure adequate research knowledge and skills in key areas e.g. tree breeding, entomology, pathology, botany and wood processing.

CHAPTER FOUR

4.0 RESEARCH PROGRAMMES

The National Forestry Research Master Plan III (NAFORM III) which covers the period 2021 to 2031 has six Research programmes and one Support programme. The Research Programmes are: Management of Natural Forests and Biodiversity Conservation (MNFBC), Urban and Farm Forestry (UFF), Forest Plantations and Tree Improvement (FPTI), Forest Resources Assessment (FRA), Socio-economics, Policy and Forestry Extension (SPFE), and Sustainable Harvesting and Utilization of Forest Products (SHUFPS).

The Support Programme has four sub programmes namely Human resources, Infrastructure, Publications and Dissemination and Financing strategies as detailed in Chapter 5.

Sustainable Forest Management as pointed out earlier can be achieved through application of researched information/ data which is generated from properly planned and conducted forestry research. Therefore, implementation of research programmes presented in the following sections will contribute to generation of appropriate information which will contribute to the achievement of goals of various policies, programmes, strategies, and global obligations as stated in various conventions. The linkages between policies, strategies and global conventions to NAFORM III are discussed under Chapter 1.

4.1 Management of Natural Forests and Biodiversity Conservation

Background and Justification

About one third of the country's area is managed as protected area in the form of Forest Reserves, Forest Nature Reserves, Marine Parks,

National Parks, Game Reserves and wetland areas. These forests besides providing ecosystem goods and services have enormous biological, economic, scientific and recreational values. In addition, they serve as biodiversity reserves of flora and fauna and a carbon sequestration pool for mitigation of climate change (URT, 2017). However, the values are mostly threatened by deforestation and forest degradation caused by anthropogenic activities.

Attempts to reduce extents of anthropogenic activities have been undertaken at all levels. For instance, there have been global efforts through UNFCCC COP 18 (Doha Conference held in 2012) aimed at reducing the effects of deforestation and forest degradation on climate change. Increased pressure due to uses of natural resources including forests has resulted in biodiversity and ecosystem resilience loss. Resilience in this context is the capacity of these forests to absorb disturbances - habitat degradation, drought, overgrazing, wildfires, and reorganize while undergoing anthropogenic changes so as to retain essentially the same structure and functions.

Illegal trafficking and transformation of forests for quick economic gains also contribute to the mentioned unsustainable practices. Another important threat is the continued trends of fragmentation of natural forests, outbreaks of invasive species, forest fires, pests and diseases. In order to make informed decisions on what is taking place in natural forests and for their sustainability, researched information is highly needed. These include forest establishment and or sustenance methods taking into account that traditional plantation establishment and tending techniques are not readily applicable to some natural forest tree species and silvicultural systems. Most fundamental, is the fact that regeneration in most natural forests is not always of seed origin. Furthermore, existing information on different aspects of ecology, silviculture, biological and hydrological processes, growth and yield, and biodiversity is either inadequate, and not sufficiently tailor made to support sound management and conservation of natural

forests. Forestry research on forest management will guide in informed decision making for sustainable management of natural forests.

A global focus on carbon sequestration by natural forests has placed Tanzania's natural forests among the key global natural forests. This is due to area covered, plant species diversity and implied assimilation efficiencies. Other functions of these natural forests include conservation of biodiversity and gene pools, production of food and fibres, water catchment, control of soil erosion, soil conservation, minimization of downstream sedimentation and flooding and provision of habitats for wildlife and other fauna. Also, they contribute to maintenance of air quality and reduction of air pollution. One of the challenges facing the management of natural forests is trade-off between production and environmental services. In this context, decision makers need reliable data/ information to enable them to develop and reach best management options. In addition, researches are needed on environmental accounting with special reference to natural forests.

It is important to capitalise on the green value of the forests. Effective management of forests through various forms of administrations have positioned many forests in the environmentally appropriate, socially beneficial, and economically viable forests. Some of these have been certified for carbon stocking and their products are highly valued because of the certification. Examples of certified forests in Tanzania include; Namajongoo, Mwembendawile, Kijawa A, Kijawa B, Namatuli, Mbumbila A, Mbumbila B, Lung'ou, Likonde, Uchungwa, Magongo, Mbarale, Nyamkongo, Tawi, Chihuruka, and Chiumbe Village Lands Forest Reserves in Kilwa District. Others are Kilombero Valley Teak Company (KVTC) in Kilombero and Green Resources Limited (GRL) in Mufindi District. The addition of an additional layer of green value thus could be one of the aims of forest management to benefit the environment and the people.

Programme Objective

To develop sustainable management of natural forests and conservation systems for biodiversity, ecological and hydrological benefits in Tanzania.

Research Focus Areas

- (i) Surveys and monitoring of biodiversity and ecological processes in various natural forest types,
- (ii) Identification, collection, listing and characterization of endemic, rare and threatened species which need conservation;
- (iii) Identification and analysis of impacts/effects of potential invasive/aliens' species, lianas, pathogens, pests, diseases and vermin in various natural forest types;
- (iv) Establishment and evaluation of suitable *ex-situ/in-situ* conservation methods;
- (v) Monitoring forest regeneration and factors influencing it;
- (vi) Studies on Evaluation of different propagation techniques;
- (vii) Phenological and ecological studies of indigenous tree species in various ecosystems;
- (viii) Monitoring the effects of fire, pathogens, pests, grazing, logging, shifting cultivation, and wildlife on seedling recruitment, species diversity, and soil properties;
- (ix) Monitoring hydrological processes and anthropogenic impacts on the hydrological cycle, including water use by different tree species and their respective implications to climate change;
- (x) Identification and improvement of growth characteristics of fast-growing indigenous tree species for enrichment and restoration of degraded forests;
- (xi) Studies on carbon sequestration potential (above and below ground) of different tree species and stands, soil carbon monitoring, and implications to the tapping of carbon trade;
- (xii) Studies on the effect of deforestation and forest degradation on the release of Green House Gases (GHGs) to the atmosphere;

- (xiii) Modelling and mapping of production and flow of ecosystem/ environmental goods and services under climate change;
- (xiv) Evaluation of species distribution responses as a result of climate change; and
- (xv) Strategic Environmental Impact Assessment (SEIA) for investments on forest lands.

Inputs

The estimated cost of conducting research related to this programme is estimated to be TZS 2.25 billion. During NAFORM III implementation, each Research Institution will budget research funds in their annual plans based on their Strategic plans.

4.2 Urban and Farm Forestry

Background and Justification

Urban and Farm Forestry (UFF) apply to Agroforestry (AF) practices of planting, managing and utilizing trees/shrubs for various functions on crop lands, grazing lands, and home compounds (Msuya *et al.*, 2006a; URT, 2011). They also apply to the involvement of farmers and other members of the community in woodlot establishment, management and rehabilitation of degraded private and communal lands.

In terms of definition, AF is defined as a dynamic, ecologically sound system of natural resources management by integrating trees on farm (ToF) and in the agricultural landscapes, with a role of diversifying and sustaining production for enhanced economic, environmental and social benefits (World Agroforestry Centre, 2008). Agroforestry has for many years been practised on traditional lands in many parts of Tanzania, with its science being more recent.

In the past UFF research focused on two areas, namely, AF and woodlot

¹ During the implementation of the Research programme, it is assumed that each research focus area will have about three projects and each project will cost at least TZS 50 million.

establishment. AF researches started in Tanzania in the mid 1970s and to date several technologies have been developed and adopted. However, due to absence of researched information on establishment and management of woodlots, practices used in industrial plantations were adopted.

To date, several AF interventions and technologies have been developed. Among them are alley cropping, relay cropping, improved fallows, rotational woodlots, fodder banks, mixing cropping, boundary tree planting, homestead planting / home garden, ToF, *ngitili*, conservation agriculture and indigenous fruits and medicinal tree domestication and processing. Where adopted, AF has benefits on livelihoods (poverty alleviation, food security, good health, sustainable energy supply) and the landscape (biodiversity conservation, habitat and land rehabilitation and climate change adaptation and mitigation). Generally, AF has been a good strategy for increasing forest cover in many areas, so scaling up of these benefits is paramount.

The history of woodlots establishment in Tanzania goes back to 1960s, with goals being to supply wood for various purposes, rehabilitation of degraded lands and improvement of soil fertility. There have been variable successes in woodlot management and adoption by local communities in Tanzania. Good examples are in Makete, Njombe and Mufindi districts, and other parts of Southern Highlands, where woodlots have shown good performance and their contribution to livelihoods and landscape can be observed. Among the challenges facing woodlots establishment and management include time of planting and tending coinciding with time for planting and tending agricultural crops and prevalence of poverty. Because of competition for labour, communities opted to ToF. As a result, they constitute a vast tree sources in Tanzania and form a major source of wood and NTFPs for domestic use and for sale. For the prevalence of poverty, a bad practice of premature tree harvesting is dominant in these areas.

Other challenges are limited germplasm supply as well as low quality, limited diversity and low productivity of germplasm. Poor management techniques of ToF and woodlots, on farm productivity of trees and AF systems being tested at limited agro-ecological zones, small scale famers lacking organizational and business skills, and low access to markets and information for AF and woodlots products are other notable challenges. Moreover, carbon sequestration potential of AF systems and woodlots is not well known and vulnerability and adaptation of AF systems and woodlots to climate variability and change has not yet been assessed.

Programme Objective

To increase access to high quality germplasm and ensure improved management, utilization and marketing of trees and AF products and services.

Research Focus Areas

- (i) Studies on species and provenances of various trees/shrubs for AF, urban and woodlots in various ecological zones, farming systems and end uses;
- (ii) Socio-economic and biological evaluation of various AF technologies for various end uses in sets of ecological zones and farming systems;
- (iii) Selection, propagation, domestication, management and processing of high-value indigenous fruit, medicinal and ornamental trees;
- (iv) Assessment and development of management techniques/ guidelines for urban forests, woodlots and ToF;
- (v) Carbon sequestration potential of AF systems, urban forests and woodlots;
- (vi) Vulnerability and adaptation of AF systems, urban forests and woodlots to climate variability and change;
- (vii) Tree and AF products value chains and marketing of products and services,

- (viii) Studies on tree species suitable for AF, value chain of AF products, marketing of products and services for industrial development; and
- (ix) Studies on the effects of exotic ornamental invasive species.

Inputs

The cost for implementing the nine research focus areas is estimated at TZS 1.35 billion.

4.3 Forest Plantations and Tree Improvement

Background and Justification

Plantation forestry in Tanzania was initiated in the 1950s. Successful large scale planting of the various exotic tree species in Tanzania was due to early research in seed and nursery aspects, species and provenance selection, establishment and management. To date, the area covered by forest plantations is 554,500 ha (TFS, 2018). Out of this, government owns 472,822 ha (116,850 ha planted), while the rest is owned by private companies and smallholder tree growers. The importance of plantation forestry is their quick provision of direct and indirect benefits. The direct benefits include provision of wood and NTFPs, job creation, and food security through taungya, export promotion and revenue through taxation and forest rent. Indirect benefits include environmental services such as water catchment and act as a Carbon sink. They also reduce utilization pressure on natural forests.

Large scale establishment of forest plantations was through seeds imported from Mexico, Australia, Zimbabwe, South Africa and others, which had a longer experience with plantation forestry. With time, local seed sources, i.e. seed stands and seed orchards were established. Currently, local seed sources continued to be supplemented by importation through the then TTSA, to meet domestic demand, especially for species which failed to flower or produce reasonable number of viable seeds in a foreign environment.

Over time, tree improvement efforts to produce advanced generation of seed orchards or clonal material were neglected. As a result, improper seed (unregistered sources) continued to be used. This resulted into general low quality, poor and low productivity of plantations. Low quality and low productivity of plantations has sometimes been due to poor species/provenance site matching and use of low intensity cultural practices. Other factors which contributed to decline in quality and productivity included attacks by various diseases and insect pests resulting to some tree species being banned / quarantined to be grown in some parts of Tanzania.

Tree improvement in Tanzania has been carried out for both indigenous and exotic tree species. Notable examples include improvement of *Tectona grandis* (Teak) through screening plus trees from superior stands in Mtibwa and Longuza (Kihuhwi block) plantations for establishment of seed orchard at Mtibwa Forest Plantation. Also, screening of plus trees for indigenous trees species, namely *Azelia quanzensis*, *Milicia excelsa* and *Khaya anthotheca* for establishment of seed orchards at Mtibwa Forest Plantation. In addition, improved hybrid clones have been multiplied at Kwamarukanga in Korogwe and Lushoto in Tanga, Kibaha in Pwani Region and Mufindi in Iringa Region and planted by different stakeholders for production of poles, timber and fuelwood. These clones have been established based on their results after extensive adaptability research and their growth performances depending on the agro-ecological conditions.

The hybrid clones have been improved by combining *Eucalyptus grandis* x *E. camaldulensis* (GC), *E. grandis* x *E. urophylla* (GU) and *E. grandis* x *E. tereticornis* (GT) with the desired traits for growth and drought tolerance, growth and disease resistance and growth rooting ability. Others include short rotation age and production of better wood quality and uniform stands with the ability to meet various demands such as electricity transmission and distribution poles, fencing poles, pulp, fuelwood and timber within

the shortest period. This will ensure availability of raw materials for wood based industries in the country within a short period of time.

Moreover, improved planting materials in seed orchards and gene conservation stands have been established for *Pinus radiata* and *P. patula* from Zimbabwe; and *Eucalyptus cloeziana*, *Grevillea robusta* and *P. patula* from Muguga Kenya. Similarly, *ex-situ* gene conservation stands of fast growing tree species for *Melia azedarach* and *Gmelina arborea* have been established. Likewise, seed orchards for *E. grandis* and *P. patula* *E. pellita* and *E. urophylla* as well as gene conservation stand for *P. maximinoi* have been established in Mufindi and Lushoto Districts. Research work has broadened the number of tree species for planting in forest plantations. However, management guidelines for these species need to be in place. In this aspect, management trials (spacing, pruning and thinning) for these species need to be initiated.

The tree quality and productivity of second and subsequent rotations will have to be studied while new areas being opened up for plantations will have to be increased to meet the increasing domestic and international demands for wood and wood products. Strategies that will increase yield per unit area, e.g. by using improved, adaptive and diversified seeds for single or mixed species plantations, use of appropriate soil and site management practices which limit /minimize attacks by diseases, pests and fires will have to be adopted. Generally, this may serve as an insurance against pests, pests and climatic fluctuations, hence increased market security through species and product diversification.

Forest plantations, as it is for natural forests, have a service role of sequestering atmospheric carbon. In this context, forest plantations contribute to climate change mitigation and adaptation and diversify income sources of plantation owners when the sequestered carbon is sold.

Despite the benefits and proposals to increase and even expand forest plantations, the environmental impacts of these plantations have been a controversial topic and several regional and international meetings have debated these issues (Bernhard-Reversat, 2001). Many environmental groups consider plantations as a threat to biodiversity, water resources and soil fertility. They are susceptible to pests and diseases and lead to displacement of indigenous tree species. These issues have recently been examined (FAO, 2001a, b; Cossalter and Pye-Smith, 2003; Nair, 2003; Farley *et al.*, 2005). These studies found that proper species choice, appropriate models, and indicators for fitting productive plantations into the landscape considering social and environmental aspects are imperative to minimize the negative impacts of plantation forests on the environment. But, these researches have not been conducted in Tanzania.

Programme Objective

To generate technologies to secure sustained production of major indigenous and exotic plantation tree species for given end uses.

Research Focus Areas

- (i) Screening of genetically improved materials for use in plantations and development of seed orchards; including suitable tree species for gum and resin production;
- (ii) Studies on application of biotechnology on tree improvement;
- (iii) Evaluation of impact of silvicultural practices and environment on the productivity of succeeding rotations;
- (iv) Research on new plantation tree species with emphasis on indigenous species;
- (v) Monitoring and evaluation of forest health with respect to insect pests, pathogens, invasive species, fire and climate change;
- (vi) Carbon sequestration potential of different tree species in plantations;

- (vii) Improvement and development of management practices/ guidelines for different new tree species in plantations;
- (viii) Establishment and evaluation of mixed tree species in plantations; and
- (ix) Assessment of effects of forest plantations on water resources, biodiversity and soil health.

Inputs

The cost for implementing the nine research focus areas is estimated at TZS 1.35 billion.

4.4 Forest Resources Assessment

Background and Justification

Sustainable Forest Management demands accurate and reliable data and information. Informed decisions have to be made to enable forest management achieve its overall goals. On the other hand, for the sector to sustain its long term goals its capacity to forecast the trend changes and their consequences is necessary. In broad terms forestry information is needed for three main uses:

- i. National policy development and planning;
- ii. Investment appraisal and decision making; and
- iii. International policy development and negotiation.

Before the national forest inventory carried out in 2010 through NAFORMA, all the previous forestry inventories in Tanzania were characterized by localization and poor coordination, low area coverage, irregular data collection and were designed to meet specific objectives and, did not involve many stakeholders and information was fragmented. Thus, NAFORMA was designed to address these shortcomings and generated substantial information for management and monitoring of forest resources.

Programme Objective

To enhance national capacity to collect, compile and disseminate reliable and accurate information and statistics on tree and forest resources for both local and international needs.

Research Focus Areas

- i. Development of standards and classifications, definitions and structure of trees and forest resources data and information;
- ii. Monitoring of permanent sample plots (PSPs) established under NAFORMA in various representative vegetation types including establishing new ones where necessary;
- iii. Estimation at regular intervals of forest cover, stocking, timber and NTFPs, yield, in different vegetation types for management and carbon accounting;
- iv. Development of affordable technology for collecting, processing and validating tree and forest resources/services database;
- v. Development of appropriate forest resource assessment methods for local communities;
- vi. Development of growth and yield models for different species and vegetation types;
- vii. Quantification of deforestation and forest degradation;
- viii. Studies on regeneration recovery dynamics for sustainable management of natural forests;
- ix. Assessment and evaluation of the impact of land use and land cover change on watershed hydrology for improved catchment management; and
- x. Evaluation of the impact of climate change on hydrology of forested watersheds.

Inputs

The cost for implementing the ten research focus areas is estimated at TZS 1.5 billion.

4.5 Socio-economics, Policy and Extension

Background and Justification

Forestry activities/investments are characterized by being long term compared to other production activities such as agriculture. Due to this, they are subjected to prevalence of externalities. Further, as a result of this, free interplay of market forces will not bring about socially desired outcomes. The world is becoming aware of these market failures; the latest experience being the global economic meltdown. Contemporary effort is to internalize the externalities and make them part of the general accounting equation. It is apparent that the primary challenge facing the forest sector is to reduce the excessive rate of deforestation by concerted efforts towards sustainable management of the remaining, future forests and other wooded lands. Socio-economic factors need to be understood to be able to address these challenges effectively. In addition, though the recently formulated Reduced Emissions from Deforestation and Forest Degradation (REDD) strategy is expected to reverse the current trend in deforestation and forest degradation, policy studies are needed to map opportunities, challenges and enabling architecture and processes.

Policy issues have significant influence on decisions which the society takes toward forests either individually or collectively. Most of the policy changes have influenced reforms that have taken, and will take place in Tanzania and elsewhere, have a bearing on the development and sustainable management of forests. However, the impact of these macro and sectoral policy changes on the conservation and management of forest resources is not well known and understood.

Despite inspiring forest extension initiatives reported by Msuya *et al.* (2006a), among others, and noting the extent of requisite interventions, national coverage of these initiatives is needed. Socio-economic and extension issues influence the establishment, management and utilization, and ultimately conservation of forest resources. The dismal performance

of some social forestry programme in Tanzania is partly explained by the reluctance of communities to constructively participate in such programmes. Reasons behind this reluctance seem to be understood in terms of generalities such as poor institutional linkages, limited contact and linkage between extension agents and farmers, land tenure restrictions, priority needs, etc. These generalities do not apply equally everywhere. Research supported land use specific approaches need to be tailored.

In this context, it would appear that the success in Sustainable Forest Management needs inputs from increased understanding of the complex factors related to socio-economics, policy and extension.

Programme Objective

To improve forest policy and decision-making for establishment, management and conservation of forest resources for social and economic development of Tanzania.

Research Focus Areas

Policy Research

- (i) Assessment of current revenue collection methods and development of marketing options for forest products;
- (ii) Studies on the effect of various extra-sectoral policies such as agriculture, mining, energy, livestock, land, financial, trade and investment; and international conventions and agreements on the management of forest resources;
- (iii) Studies on global and national Reduced Emissions from Deforestation and Forest Degradation (REDD+) and climate change policies;
- (iv) Assessment of the effect of different policy options on taxes, subsidies, tariffs and regulations; and international transfers to governments to protect forests;
- (v) Assessment of variables that affect supply and consumption of forest products from different production systems;

- (vi) Studies on opportunity costs and trade-offs on land use options;
- (vii) Studies on different forest concession options for sustainable forest management; and
- (viii) Studies on the adoptions, and impacts of existing forest policy on the management of forest resources.

Socio-economic

- i. Studies on socio-economic impact of anthropogenic activities on forest resources and the surrounding communities;
- ii. Climate change impacts on forests and livelihoods, adaptation and mitigation measures;
- iii. Studies on effectiveness of Participatory Forest Management (PFM) and cost benefit analysis in forest management and estimation of opportunity costs for different land uses;
- iv. Investigation of factors contributing to failure to meet woodfuel, pole and construction timber demand;
- v. Investigation of modes of land and tree tenure, and the effect of alternative property right regimes on sustainable forest management;
- vi. Contribution of the forest sector to food security, GDP, local economy and employment;
- vii. Studies on the magnitude of environmental benefits including eco-tourism potentials;
- viii. Studies on tangible and intangible values of various forest ecosystems including mangroves;
- ix. Modalities of payment for environmental services (PES) including carbon trade opportunities at local and national levels;
- x. Studies on financing mechanisms for sustainable forest management;
- xi. Studies on effects of crosscutting issues on forest management including gender, HIV and /AIDS, non-communicable diseases, unemployment, governance and environment;
- xii. Assessment of impacts of invasive species on rural livelihoods; and
- xiii. Assessment and promotion of value addition of forest products.

Forestry Extension

- i. Studies on effectiveness of extension services and dissemination on forest management;
- ii. Studies on the impact of technologies and forestry programmes/projects to local communities' livelihoods; and
- iii. Surveys of existing indigenous forestry knowledge under different land use systems.

Inputs

The cost for implementing the 24 research focus areas is estimated at TZS 3.6 billion.

4.6 Sustainable Harvesting and Utilization of Forest Resources

4.6.1 Sustainable harvesting of forest resources

Background and Justification

Although timber harvesting is the main economic activity undertaken during harvesting of forest resources, other products including both wood and non-wood products like charcoal, firewood, medicinal plants, honey, mushrooms, resins and gums are increasingly becoming of high demand. Also, because of their increasing demand and their economic importance, there is need to ensure that besides timber harvesting, these other products are sustainably harvested and cause minimum environmental degradation.

Traditionally, timber harvesting activity is the first sequence of events to convert a forest from a collection of trees into intended consumer products. As stated above, timber harvesting was considered solely as an economic venture, mainly production of commercial timber. However, recent concerns for the environment, biological diversity and society's aspirations have brought in other perspectives. Effects of timber harvesting on soil, potential tree crops and other vegetation, water regimes, wildlife

and aquatic resources, do among others, call for environmental protection or conservation in addition to economic considerations.

Generally, in undertaking timber harvesting activities, one must consider several factors. These include the objectives of the forest or enterprise, control quality and quantity of production, (Ole-Meiludie *et al.*, 1997), cost efficiency, capital requirements, information needs for terrain and timber, available harvesting technologies and transportation systems, costs and benefits (Silayo *et al.*, 2007). Others are environmental effects notably to soil and water, infrastructure and maintenance demands for harvesting systems, workforce requirements and utilization, safety and health implications (Fue *et al.*, 1996, 1999, Balama and Shemwetta, 2005) and post-harvest operations for reforestation and other purposes, such as reduction of fire hazard.

Efficient harvesting of forest resources requires a system balancing of many factors such as appropriate use of machines and personnel, environmental and conservation concerns. A system is balanced when the units are harmonized in such a way that they are sufficiently utilized (Shemwetta *et al.*, 2004; Silayo *et al.*, 2007). Harvesting needs to be considered as a production process with refined objectives while accounting for the physical limitations, economic expectations and environmental concerns. There is a need to establish through research, how these factors influence productivity and costs during harvesting of forest resources (Shemwetta *et al.*, 1999).

Timber harvesting in natural forests for commercial purposes has often been characterized by poor utilization of the resources (Abeli and Dykstra, 1981) and high selectivity resulting to over-exploitation of some high-grade species. Damage on remaining trees due to poor harvesting methods and soil disturbance affect forest regeneration (Ole-Meiludie *et al.*, 1999). Furthermore, use of inappropriate harvesting equipment has often led to high operational costs (Ole-Meiludie and Dykstra, 1982, Abeli *et al.*, 2003),

and adverse environmental impacts (Ole-Meiludie and Njau, 1989, Abeli and Sawe, 1999; Mauya *et al.*, 2013). There is a need also to stipulate suitable harvesting methods for high montane, Miombo woodlands, mangroves, and other forest types (Abeli *et al.*, 1988, 2007; Abeli and Maliondo, 1994). Special techniques should also be designed through research and development, for harvesting village, and other growers' woodlots.

It is worth mentioning that during forest plantation establishment, timber harvesting did not have local research based information. In recent years, a number of studies have contributed to development of labour-intensive logging methods and tools, performance levels of different harvesting systems, and improved design and construction of harvesting systems (Abeli and Magomu, 1993; Abeli, 1993; Abeli *et al.*, 2000, Migunga, and Dykstra, 1983, Ole-Melodies *et al.*, 1988 & 1989; Kweka *et al.*, 2007).

Following the inception of commercial forest harvesting, systems applied have mainly been geared to suit available techniques rather than seeking appropriate technologies which meet local conditions. Limited research has advocated for ergonomic application to the workforce, pertaining to workload, skill, payment and safety (Abeli and Ndossi, 1984, Mauya and Kweka, 2013). Improvement in forest harvesting call for exploration, testing and application of new approaches (new techniques and methods) so as to avoid maintaining the status quo.

Sub - Programme Objective

To promote harvesting practices that will improve resource utilization and minimize adverse environmental impacts.

Research Focus Areas

- (i) Studies on optimum logging productivity under various terrain conditions at minimum costs;

- (ii) Assessment and improvement of forest staff working conditions and welfare;
- (iii) Development of road design guidelines which minimize road construction, hauling and maintenance costs;
- (iv) Studies on logging and log/timber hauling technologies, costs and their impacts on roads;
- (v) Studies on impacts of harvesting trees and Non Wood Forest Products (NWFPs) on environment;
- (vi) Development of harvesting guidelines/protocols for woodlots, plantations and natural forests;
- (vii) Studies on integrated logging system for efficient utilisation of forest resources, and
- (viii) Studies on sustainable harvesting of NTFPs.

4.6.2 Sustainable utilization of forest resources

Background and Justification

Forests are a natural resource capable of producing wood, non-wood and environmental services. Wood products include sawnwood, wood-based panels, paper and paperboards, poles and fuelwood. Many of the wood products are market or tradable goods and have recognised market values. Over 92% of the total population of Tanzania depends on wood as main source of domestic energy (URT, 2018a). Per capita consumption seems to be season dependent, and is also influenced by the scale of the study (i.e. community compared to national or regional). Rates ranging from 0.5 to 1.8 m³ of solid wood are reported (FAO, 1984). Globally the use of wood as fuel is the single largest utilization avenue. It is estimated that 50% of the wood consumed in the world is used for domestic energy and in Tanzania it covers about 97% of total wood removals.

Optimal utilization and marketing of wood products has been curtailed by several economic and technical challenges. Despite the research and development information generated in wood structure and properties

(Ishengoma and Gillah, 1992), utilization (O’Ktingati, 1984, Nkana and Iddi, 1991), seasoning, durability, preservative treatment etc. (Chihongo, 2003) among others, more research is needed to improve the processing, and utilization of wood products. Moreover, research is needed on marketing strategies of both traditional, and lesser marketable wood species for the purpose of minimizing skewed demand on limited and scarce tree species, and capturing realistic market values of prime timbers and their products.

Most non-wood products consist largely of no-tradable goods without an established market value. It has been realized however that NTFPs and services have high social and environmental values whether measured by scarcity or social preference. Emerging trends (Kowero and O’Ktingati, 1990, Makonda *et al.*, 1999, Msuya *et al.*, 2006b) among others, amply testify their important role in supporting peoples’ economic activities and wellbeing. Thus, there is a pressing need to quantify sustainable flows of non-wood products. By extension, there is compelling need for designing efficient ways of harvesting; processing and utilizing NTFPs. Achievement of these requires contributions from research.

Sub-Programme Objective

To develop technologies for improved utilization of forest resources and trees.

Research Focus Areas

- (i) Studies on anatomical, physical and strength properties, and natural durability of wood as basis for timber grading and classification for different uses;
- (ii) Studies on the use of different biomass materials and processing technologies in wood based industries;
- (iii) Studies on value addition and marketing of timber and NTFPs;
- (iv) Studies on investments and business enterprises in wood based and non-wood products including artisanal woodworks and crafts;

- (v) Development of efficient technologies for producing quality biomass energy from different tree species and other sources;
- (vi) Development of technologies for converting biomass material into gaseous and liquid fuel;
- (vii) Studies on forest certification schemes for international trade;
- (viii) Evaluation of environmental friendly wood treatment technologies, including use of indigenous knowledge for efficacy tests of various plants;
- (ix) Assessment of indigenous knowledge with respect to use and management of timber and NTFPs; and
- (x) Studies on recovery rates of different technologies for converting wood into different forms for sustainable forest management.

Inputs

The cost for implementing the 18 research focus areas is estimated at TZS 2.7 billion.

CHAPTER FIVE

5.0 THE SUPPORT PROGRAMME

The support programme has four sub-programmes: human resources, infrastructure, publications, dissemination and technology transfer, and financing of research.

5.1 Human Resources

Background and Justification

Capacity to conduct effective research depends on investment in human resources. Forestry Research and Academic Institutions, forest companies and organizations dealing with forest establishment need well trained, skilled and experienced Researchers, Technical and Support staff. Since staffs with such attributes and wide knowledge are scarce and on high demand, Research Institutions need to effectively plan how to recruit, train and retain them by preparing sustainable human resource development programmes.

As stated in the National Forest Policy (1998), the roles of Forest research and education institutions in producing trained and skilled manpower is critical in order to ensure that all forests and related industries are professionally managed. Currently, the human resource capacity in forestry sector is relative low. This implies that there is inadequate manpower for proper forest resource and research management.

In order to ensure that there is adequate manpower for implementation of NAFORM III, each Research Institution shall be guided by her Corporate Strategic Plan on recruitment and training of its staff. Depending on the relevance and level of expertise required, staff with Certificate education, Diploma, Bachelor, Master and PhD degrees will be recruited and retained. In addition, such Institutions will ensure that their staffs are facilitated to undergo short courses leading to managerial and business

skills improvement, use of ICT, research proposal writing, research management, time management, supervisory skills, strategic leadership and staff performance management.

Sub-Programme Objective

To develop national human resource capacity to conduct forestry research in order to meet the National and International obligations.

Focus Areas

Focus areas in this sub programme are:

- (i) Replacement and recruitment of new staff based on manning levels;
- (ii) Development of long term training programmes based on Institution's training needs assessment;
- (iii) Establishment of Institutional linkages locally and internationally; and
- (iv) Review and improve scheme of service for research staff in order to motivate, promote and retain skilled and experienced staff with the right attitudes.

Inputs

Given the current manpower shortage in Research Institutions, it is estimated that about 20 staff will be recruited and 10 undergo further training each year. Research Institutions therefore need to set aside a total of TZS 24 billion for employment/recruitment of new staff (TZS 1.0 million per month/Staff) and TZS 1.0 billion for staff training (TZS 10.0 million per staff per year) during NAFORM III implementation.

5.2 Infrastructure

Background and Justification

To ensure conducive working environment, Forestry Research Institutions need to have well equipped laboratories, field equipment, transport facilities and good offices with internet and telephone services. Further, to ensure

efficient use and undue duplication of equipment and facilities, efforts to share and coordinate the availability of these facilities to different Research Institutions need to be worked out or encouraged.

Sub-Programme Objective

To strengthen the infrastructure capacity of Research Institutions in order to improve research working environment.

Focus Areas

- (i) Planning and construction of new infrastructure based on Institutions' current and future needs;
- (ii) Assessment and routine maintenance of infrastructure;
- (iii) Acquisition of new equipment and facilities and replacement of old ones; and
- (iv) Establishing a culture of sharing research facilities.

Inputs

In their Corporate Strategic Plans and Annual budgets, Forestry Research Institutions shall include budgets for infrastructure development and rehabilitation/maintenance of the existing ones. It is estimated that during the implementation of NAFORM III, a total of TZS 100 billion (4 institutions @ 2.5 billion per year) will be set aside for infrastructure development and rehabilitation. Budget for procurement of new research equipment/facilities/materials is expected to be TZS 1 billion (4 institutions @ 250 million per year)

5.3 Publications, Dissemination and Technology Transfer

Background and Justification

Research outputs need to be published and disseminated to end users or beneficiaries. Developed technologies also need to be transferred and made accessible to the beneficiaries. Research results published by scientists also need to be deposited and managed by TAFORI as per

Section 3 (9) of Act No. 5 of 1980, which stipulates that “*All information on forestry research needs to be furnished to the Institute*”. TAFORI therefore needs to establish a national repository of all forestry research outputs and host a National Forestry Library. Each Forestry Research Institution to set aside funds for publishing and disseminating research findings in accordance with their Corporate Strategic plans. In addition, all research Institutions are required to avail copies of the research outputs to TAFORI repository Unit. Based on deposited materials, Research Coordinating Unit at TAFORI to summarize, prepare and disseminate policy briefs and Research Newsletters regularly. Lastly, TAFORI needs to collaborate and network with other institutions locally and internationally in order to get more research information.

Sub-Programme Objective

Research results/information documented and become available to other Researchers, extension staff and other stakeholders.

Focus Areas

- (i) Motivation of Researchers to publish findings in reputable and retrievable sources;
- (ii) Organization of annual scientific conferences/workshops for presenting research findings;
- (iii) Participation of Forestry Research Institutions in National and International Trade fairs and Agricultural shows;
- (iv) Facilitation of local journals to publish and disseminate research findings regularly;
- (v) Technology transfer and promotion of Intellectual Property Rights (IPR);
- (vi) Establishment of a National repository of forestry research outputs at TAFORI; and
- (vii) Establishment of a Coordinating Unit at TAFORI to coordinate and disseminate forestry research findings.

Inputs

A total of TZS 500 million (100 papers per year @ TZS 0.5 million) is expected to be set aside for publications and dissemination of research results. In addition, a total of TZS 800 million (80 researchers per year @ TZS 1.0 million per meeting) is expected to be set aside for organizing annual scientific workshops.

5.4 Financing of Research

Background and Justification

The main sources of funding forestry research in Tanzania are the Government, Development partners, Private sector and internal revenue generation. Considering the central role of research in the development of forestry and allied natural resources, the Government is expected to continue funding forest research because investment in forestry research is of long term, and too risky and uncertain to attract the Private sector. Since 2011, the Government has been setting aside research funds amounting to TZS 618,364,960.00, which were used for training researchers at Master and PhD levels. The funds have been coordinated by COSTECH and disbursed to Research Institutions on a competitive basis. The Government has also established the Tanzania Forest Fund (TaFF) in 2010 which has been supporting research and other activities in forestry. A total of TZS 1.8 billion from TaFF has been spent in forestry research and other forestry related activities since 2011.

The Tanzania Forest Service Agency (TFS) also supports research in various aspects, particularly in cases which need immediate answers. Most of the research has been demand driven aimed at enhancing sustainable management of forests. A total of TZS 267,384,920.00 has been set aside by TFS for research since 2011. The Eastern Arc Mountains Conservation Endowment Fund (EAMCEF) has also been supporting forestry research. A total of TZS 411,000,000.00 from EAMCEF was used to support forestry research since 2011.

Development Partners have also been supporting forestry research in Tanzania over the past 30 to 40 years including Forest Development Trust (FDT), World Wide Fund for Nature (WWF). This has strengthened forestry research capacity in terms of human resource and infrastructure capacity building. So far, the private sector has not supported forestry research significantly. It is expected that under NAFORM III, the private sector will be involved on 'win win' arrangement through Public-Private Partnership by linking forestry research to industry, investments on researched products and services and provision of technologies relevant to production of a diverse range of products and services. This relationship brings synergies for technology transfer, industrial growth and economic well-being of all actors in the value chain and the public.

Lastly, as a way of reducing too much dependence on financial support from Government and Development Partners, Research Institutions will be required to set aside 15 - 20% of their internal generated incomes to support research activities.

Sub-Programme Objective

To ensure sustainable funding of research activities.

Focus Areas

- (i) Identification of national forestry research and development priorities and linking them to the existing funding opportunities;
- (ii) Capacity building to write good research proposals which attract funds both locally and internationally;
- (iii) Engagement of Private sector and Non - Governmental organizations through conduction of demand driven research;
- (iv) Attraction of research funds from development partners through improvement of infrastructure, Institutions credibility or image;
- (v) Linkages with external Research Institutions in order to secure research funds; and
- (vi) Development of a sustainable financing model for forestry research.

Inputs

During the implementation of NAFORM III, each Research Institution is expected to solicit research funds from different sources including setting aside some percentage from internally generated incomes. Although each Research Institution has to show indicative research budget in their respective Corporate Strategic Plans and Annual budgets, the Government of Tanzania, through COSTECH and TaFF, is expected to contribute about 50% to support forestry research. Development Partners on the other hand are expected to contribute 30% while the Private sector and Non-Governmental organizations are expected to contribute about 5%.

CHAPTER SIX

6.0 IMPLEMENTATION ARRANGEMENTS

6.1 Overall Coordination and Regulation of NAFORM III

As per Parliament Act No 5 of 1980 which established TAFORI, one of the Institute's mandates is to conduct, coordinate and regulate forestry research in Tanzania. To ensure effective gauging, monitoring and coordination of forestry research, '*Forestry Research Guidelines*' will be formulated to provide a framework for Government and private sector to report on, among other things, research proposals and achievement made. Moreover, as recommended under NAFORM II, the overall coordination of NAFORM II was supposed to be done by a Coordinating Unit established at TAFORI. Although such a Unit has been formed, it is yet to be institutionalized or effectively operationalized, staffed and equipped with the necessary manpower and facilities. To ensure effective coordination of NAFORM III, this Unit needs to be well staffed and facilitated. The Unit should be under the Director of Research and report its activities regularly to the Research and Publications Committee of TAFORI Board of Directors. The main functions of this Unit are:

- (i) Soliciting funds from various sources to support NAFORM III;
- (ii) Call for research proposals, evaluate the proposals and make recommendations to higher decision organs for funding;
- (iii) Organize annual research workshops;
- (iv) Monitor and evaluate progress reports on all NAFORM III activities;
- (v) Collect, synthesize and deposit all published forestry research materials in the National forestry depository;
- (vi) Through consultations with stakeholders, set and review regularly forestry research priority areas; and
- (vii) Prepare and publish newsletters, policy briefs and extension materials from published research materials.

6.2 Monitoring and Evaluation of NAFORM III

Monitoring and Evaluation (M & E) is a management tool used to follow up or find out if the plan is being implemented accordingly. Monitoring and Evaluation is used to measure and document accomplishments, detect deviations and where there is need for adjustments, appropriate and timely actions to be taken. Monitoring and Evaluation will entail preparing an implementation matrix which tracks and reports on progress made on each activity, the extent of achievements, challenges, adjustments or remedial measures taken and the cost of implementation.

The Coordinating Unit will be responsible for monitoring and reporting progress made during implementation of NAFORM III to TAFORI Board of Directors through Research and Publications Committee. The Unit will issue guidelines and templates for preparing bi annual and annual progress reports to all Researchers and Heads of Research Institutions. Appendix II shows a template to be used for collecting information for preparing progress reports. The reports will also indicate emerging innovations, lessons learnt and suggest the way forward.

For stakeholders to be kept abreast of the progress made and the overall performance of NAFORM III, annual review workshops will be held for researchers to present progress reports and research findings. Comments given during stakeholders' review workshops will be incorporated when preparing annual reports.

In order to appraise NAFORM III in terms of relevance, effectiveness, efficiency and impact, there will be two types of evaluation namely Mid-term and End of term evaluation. Mid-term evaluation will take place after five years; End of term evaluation will take place after 10 years and will assess the extent of NAFORM III implementation and whether the planned objectives have been met.

Inputs

Since TAFORI is the overall in-charge of coordinating, monitoring and evaluation of NAFORM III; budgets for coordination, monitoring and evaluation have to appear in TAFORI's Annual budgets. It is estimated that it will cost TZS 1.0 billion to coordinate forestry research, while monitoring and evaluation will cost an estimated TZS 40 million per year for the entire period of 10 years.

CHAPTER SEVEN

7.0 CONCLUDING REMARKS

NAFORM III has been developed to cover the period 2021 to 2031. Meaningful efforts must be made to ensure its successful implementation. This demands active participation of all stakeholders, technical staff and scientists in appropriate fields. Also, sustainable financing and proper coordination are vital for successful implementation of NAFORM III. Research demanded by stakeholders including emerging new issues will be taken into consideration during implementation of NAFORM III.

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APPENDICES

Appendix I: Questionnaire for key stakeholders' survey

TANZANIA FORESTRY RESEARCH INSTITUTE (TAFORI)

DEVELOPMENT OF NATIONAL FORESTRY RESEARCH MASTER PLAN III (NAFORM III)

A. General information

- (i) Name of institution/organisation:
-
- (ii) Type of institution/organisation (Governmental, Non-Governmental, Private, or other):
.....
- (iii) Date:.....

B. Achievements and challenges of NAFORM II

1. Please provide a summary of research topics, key findings, and publications based on NAFORM II research and support programmes:
 - (a) Research programmes
 - (i) Natural Forests Management
 - (ii) Community and Farm Forestry
 - (iii) Plantation Forestry and Tree Improvement
 - (iv) Forest Resource Assessment
 - (v) Social-economics, Policy and Forestry Extension
 - (vi) Forest Operations and Utilisation
 - (vii) Other forestry research programmes
 - (b) Support programmes
 - (i) Human Resources
 - (ii) Infrastructure
 - (iii) Publications and dissemination
 - (iv) Other support research programmes

2. Please indicate challenges experienced and key lessons learnt during the implementation of NAFORM II and propose measures to overcome the challenges.

C. Priority and financing forestry research and support programmes

3. Please indicate/list priority forestry research and support areas for NAFORM III
4. Please propose sources of financing forestry research and support areas in NAFORM III
5. Please propose any other issue which is not covered in 1 – 4 above that will be useful in the development of NAFORM III

Thank you for your Cooperation

Appendix II: A Matrix for Reporting Progress during the Implementation of NAFORM III

Name of Institution:

Type of Report: Semi/Annual report.....

Reporting Period:

Programme Title:.....

Project Title:.....

Overall Objective:

..

.....

.....

S/N	Activity	What was planned to be done	What was done/ achieved	Challenges encountered	Remedial measures taken	Planned budget	Actual budget used	Remarks

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