National Guidelines for the Preparation of Forest Management Plans for Plantation Forests in Ethiopia

The Federal Democratic Republic of Ethiopia
Ethiopian Forestry Development

Addis Ababa, July 2024

Table of content

List of tables

List of figures

Abbreviations

AAC	Annual Allowable Cut
AOP	Annual Operational Plan
BFP	Biodiversity and Forestry Project
CBO	Community Based Organisation
CRGE	Climate Resilient Green Economy
DBH	Diameter at Breast Height
DEM	Digital Elevation Model
EFD	Ethiopian Forestry Development
FGD	Focus Group Discussions
FMC	Forest Management Class
FMP	Forest Management Planning
GDP	Gross Domestic Product
GIS	Geographical Information System
GPS	Global Positioning System
GTP	Growth and Transformation Plan
IDI	In-depth interview
MAI	Mean Annual Increment
MEFCC	Ministry of Environment, Forest, and Climate Change
NFSDP	National Forest Sector Development Program
NTFP	Non-Timber Forest Products
NRLAIS	National Rural Land Administration Information System
PFM	Participatory Forest Management
PPP	Public Private Partnership
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SDG	Sustainable Development Goals
SFM	Sustainable Forest Management
SLMP	Sustainable Land Management Program
UNCED	United Nations Conference on Environment and Development

Foreword

Ethiopia hosts diverse forest ecosystems, primarily due to unique physical conditions and variations in altitude, which have resulted in significant climatic and soil diversity. This extensive altitudinal and biophysical variation has fostered the development of a wide range of woody species, each colonising its optimal niche within respective ecological amplitudes. In addition to the country's native tree and shrub species, this ecological diversity also supports the establishment of plantations from a variety of exotic species tailored to meet specific end uses.

Accordingly, plantations of various species have been established in Ethiopia over many decades to serve multiple purposes. Most of these plantations are small- to medium-sized woodlots cultivated by farmers to meet household wood needs and generate income through the sale of various wood products. Recently, nearly 100,000 hectares of such plantations have been developed across different regions through projects implemented by the Ethiopian Forestry Development (EFD). Eucalyptus species, which are fast-growing and satisfy a wide range of demands, are predominantly used for these woodlots. These plantations (comprising various tree and shrub species) play a significant role in fulfilling household wood requirements, generating income, and reducing pressure on remnant natural forests and their biodiversity. For instance, woodlots of *Acacia mearnsii* in the Awi Zone of the Amhara Region have made substantial contributions by sustaining household incomes, generating considerable royalty fees, and rehabilitating unproductive landscapes, while the larger-scale eucalyptus woodlots are well recognised for fulfilling wood product demands.

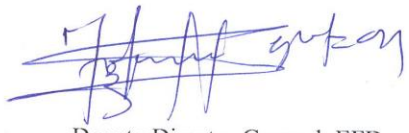
Beyond woodlots, approximately 200,000 hectares of industrial plantations have also been reported, primarily consisting of Eucalyptus and Cupressus species. Most of these are managed by the two state forest enterprises. These forest resources provide timber and other wood products for various domestic uses and contribute substantially to the economic value of forest resources while creating green jobs in Ethiopia.

Given the significant gap between the supply and demand of wood products (such as fuelwood, medium-density fibreboard, and plywood), interest is growing to expand plantations, improve management, and produce value-added wood products to more effectively meet demand. This interest is further strengthened by opportunities to replace imports and generate high revenues from wood product exports. However, despite these promising developments, appropriate silvicultural practices to enhance growth performance, stand quality, and yield in plantation forests are lacking, and suitable forest management plans to guide silvicultural operations are largely absent. Ethiopia's recent Forest Development, Conservation, and Utilisation Regulation mandates that the development, conservation, and utilisation of large-scale forests be guided by comprehensive forest management plans.

To address this requirement, a guideline for forest management plan preparation has been developed in collaboration with the GIZ Forestry and Biodiversity Programme. The objective of this guideline is to improve planning and management in plantation forests, thereby contributing to the well-being of local populations and enhancing the social, cultural, environmental, and economic benefits derived from these forests.

This document was developed with substantial contributions from international, regional, and national forestry experts and partners actively engaged in the sector. It is hoped that the extensive consultation process and the significant involvement of national experts, as well as regional and international institutions, in preparing this guideline will encourage their widespread adoption. The Ethiopian Forestry Development extends its gratitude to the GIZ Biodiversity and Forestry Programme and all other stakeholders involved in this process for their invaluable support and input in the preparation of this guideline.

Motuma Tolera (PhD)



Deputy Director General, EFD.

1 Background of Forest Management Planning

1.1 Sustainable Forestry and Forest Management Planning

Forests are vital natural resources that provide economic, ecological, and social benefits. Whether in developed or developing countries, forests contribute significantly to environmental health (e.g., climate regulation), social well-being (e.g., recreation), and economic development (e.g., employment, contribution to GDP). These multifaceted and essential functions can only be sustained and enhanced through effective management. Proper forest management plans are essential to achieve this, as without them, the sustainable provision of forest products and services cannot be ensured.

Forest management involves the application of various silvicultural practices based on technical, economic, and ecological principles within a forest stand to produce and supply desired products and services. The goals of forest management typically include the supply of products (e.g., timber and non-timber forest products such as medicinal plants or berries) and the provision of services (e.g., carbon stock preservation, watershed protection, consistent spring flows, flood mitigation, landslide prevention, and biodiversity protection). Professional management is necessary to enhance the quantity and diversity of these products and services. This controlled manipulation, involving a series of silvicultural actions (e.g., weeding, pruning, thinning, enrichment planting) applied systematically in the right places and at the right times, is the essence of forest management.

Sustainable forest management underscores the need for ongoing intervention within forest stands to ensure a steady supply of forest-derived products and services for future generations. This approach implies that forest manipulation should not compromise the ecosystem's productive capacity (e.g., timber yield), economic value (income generation), social significance, or ecological importance.

Achieving sustainable forest management requires careful planning regarding what actions to take, where, when, by whom, and how. These plans are formalised in a Forest Management Plan (FMP), which specifies goals, targets, actions, and control measures for a designated period. An FMP is a structured document that provides guidance on systematically implementing actions to optimise benefits from a forest ecosystem. It outlines management activities and indicates the timing for their execution. A Forest Management Plan is essential for detailing the actions required over time, formalising administrative arrangements, and establishing a basis for monitoring forest activities.

In recent years, global priorities for forests have broadened. Today, forest management is focused not only on timber production but also on environmental services, particularly climate change mitigation and biodiversity conservation. Environmental and social objectives are becoming central, especially in the management of natural forests. Consequently, forest management plans must respond to evolving societal needs.

Social considerations reflect the reliance of many forest-dependent local communities on forests, not only for fuelwood and construction timber but also for non-timber forest products, which are crucial for subsistence and local trade. These products include honey, medicinal plants, forest coffee, and more—resources that are often more important to these communities than timber itself.

Environmental goals primarily focus on carbon stock management and biodiversity conservation. In developing countries, forestry is a primary sector for promoting green growth and achieving carbon neutrality. Consequently, Forest Management Plans aim not only to preserve existing carbon stocks

but also to manage stands and ecosystems for additional carbon sequestration. Forests, whether planted or natural, should thus be managed with a view to enhancing carbon stocks.

These expanding and evolving demands highlight the need for forest management strategies that prioritise more than just timber production.

1.2 The Current Context

Ethiopia's forest management practices have been shaped by two key influences:

a) **National needs**: These include addressing the country's growing demand for wood through tree planting, restoring forest lands via afforestation and reforestation, and reducing deforestation and forest degradation through approaches such as Participatory Forest Management (PFM). Meeting these needs also helps reduce the cost of importing wood products. To support these goals, Ethiopia has launched initiatives such as the Climate Resilient Green Economy (CRGE), Reducing Emissions from Deforestation and Forest Degradation (REDD+), Participatory Forest Management (PFM), Growth and Transformation Plan (GTP), Sustainable Land Management Programme (SLMP), National Forest Sector Development Programme (NFSDP), and the Green Legacy initiative.

b) **Global discourses**: Since the 1960s, international forest management priorities have evolved, initially focusing on industrial exploitation and later, by the 1990s, shifting towards ecologically sustainable development, as emphasised at the United Nations Conference on Environment and Development (UNCED, 1992). Global goals such as the UN's Sustainable Development Goals (SDGs) and the Paris Climate Agreement (2015) marked turning points, reinforcing the multifunctional role of forests. This shift was also reflected in the Bonn Challenge (2011), which set targets to restore 160 million hectares of degraded and deforested land by 2020 and 350 million hectares by 2030.

Increasing pressure on Ethiopia's remaining natural forests is evident in many regions, driven by growing demand for forest products and the expansion of smallholder plantations (private forests). Eucalyptus plantations established in open areas help to alleviate pressure on natural forests. Beyond optimising timber production, forest management planning is now expected to address environmental and biodiversity protection, community well-being (through consultation and participation), the economic and cultural interests of local communities, climate change considerations, as well as policy and legal factors.

Accordingly, any forest management planning guidelines, as well as the forest management plans themselves, are expected to be developed in alignment with Ethiopia's national forestry needs, prevailing global forestry priorities, and the country's overarching national priorities.

1.3 Legal and Policy Framework

Ideally, forest management planning, along with the guidelines that direct it, is developed under the following conditions: a) the presence of a land use policy and planning framework; b) favourable macroeconomic policies that minimise adverse impacts on forests; c) secure and stable land and forest tenure; d) effective interaction between forest policy and other relevant economic sectors; e) integration of forest policies into national priority areas supported by efficient organisations; f) recognition of forest stakeholders, including those who depend on forests; g) forest product pricing

policies to ensure fair revenue shares for forest owners and managers; h) a digital cadastre, among others.

Ethiopia's forest-related and other pertinent policies may not yet fully address all these aspects; however, several policies and legal frameworks have been developed that align with progressive and effective forest management planning. A key gap remains the absence of a comprehensive land use policy. Below is a brief overview of the relevant legal and policy framework, with particular attention to the 2018 forest law, which is considered especially pertinent to this discussion.

a) **National Forest Sector Development Programme (NFSDP), Ethiopia** (Ministry of Environment, Forest and Climate Change, 2017): This programme provides the master plan and roadmap for future forestry actions at both federal and regional levels. The overall vision of the NFSDP is to build on Ethiopia's substantial forest resources, attract foreign investment (both from donors and through Public-Private Partnerships), and leverage existing momentum (such as the establishment of MEFCC) to transform Ethiopia's forestry sector in a way that promotes GDP growth, generates employment, supports self-sufficiency in forest products, and enhances environmental services. The primary pillars and their contributions to the Sustainable Development Goals (SDGs) are outlined in Table 1.

Successful implementation of the NFSDP aims to achieve the following key performance indicators:

- Increase forest cover from 15.7% to 20% by 2020 and to 30% by 2025.
- Double the forestry sector's contribution to GDP from 4% to 8% by 2020.
- Achieve 50% of the national emissions reduction target.

Action programmes to increase forest cover by 2027 include:

- Establishing new commercial plantations, including bamboo: 0.6 million ha (0.5%)
- Afforestation/reforestation: 3 million ha (2.7%)
- Forest and landscape restoration: 7.5 million ha (6.75%)
- Purposeful tree planting in the form of woodlots: 5 million ha (4.5%)

The programme highlights several points relevant to forest management planning:

- Integration of forestry into the rural economy through sustainable land management;
- Forest landscape restoration;
- Inclusion in land administration frameworks;
- Promotion of intersectoral cooperation;
- Improvement of forest management information systems;
- Development of regional sector programmes;
- Aggregation of data on the economic value and production of forest products and services;
- Establishment of new commercial forest plantations;

- Enhanced management of existing plantations;
- Promotion of non-timber forest products (NTFPs);
- Enhancement of environmental functions;
- Sustainable biodiversity use;
- Restoration of 15 million ha of degraded and deforested land;
- Development of human capacity for sustainable forest management;
- Improved commercial management of natural high forests;
- Better management of bamboo resources.

Table 1: National Forest Sector Development Program Pillars

Pillar	Barriers/challenges addressed by this pillar	Paradigm shift potential logic	Contribution to meeting SDGs
Enabling environment and institutional development	Implementation of the policy and legal framework inadequately provides enabling conditions to foster public and private investments in forests, and institutional mandates.	Capacity development and establishment of cascaded MEFCC institutional structure will improve extension service provision, thereby improving the success of NFSDP interventions; improved investment climate will attract private sector.	***Goal 8.*** Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
Sustainable forest production and value chains	Growing gap between supply and demand is increasingly met through unsustainable harvesting in forest and woodlands and imports.	Parallel investments in establishing forest resources and manufacturing ensures resource intensive sectors, e.g. construction, grow in a CRGE-compatible way; PPPs and out grower schemes result in spill-over effects of know-how, bringing productivity improvements for sector as a whole.	***Goal 15.*** Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
Forest environmental services	Degradation is rendering forest ecosystems less able to provide important eco-system services such as climate mitigation and biodiversity conservation.	Integrated landscape approach as proposed in REDD+ strategy and other initiatives such as PFM will scale up demonstrated interventions that are vetted at local and national levels for their multiple benefits.	***Goal 13.*** Take urgent action to combat climate change and its impacts.
Forests and rural livelihoods	Forest and land degradation is further entrenching rural poverty, with climate change exacerbating negative impacts.	Purposeful tree planting with clear benefits of tree-based restoration and im-proved production-market linkage will trigger adoption of various NFSDP activities in rural areas.	***Goal 2.*** End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
Urban greening and urban forests	Rapid urban growth does not allow cities to maintain green spaces and tree cover standards that are required for maintaining clean air and healthy living.	By giving momentum to and creating further awareness of the on-going urban greening and urban forest initiatives, the NFSDP can secure public and private support for this pillar.	***Goal 3.*** Ensure healthy lives and promote well-being for all at all ages.

a) **Land**: The 1995 Constitution designates land as public property, ensuring farmers and pastoralists free access to land, protection against eviction, and compensation for expropriation.
b) **Land Administration and Land Use, Proclamation No. 456/2005** (Federal Democratic Republic of Ethiopia, 2005):

1. Provides holding certification with no time limit on holding rights and allows the transfer of these rights.
2. Prohibits the use of land with slopes over 60% for farming or grazing, restricting it instead to trees, perennial plants, and forage production.
3. **Limitation**: Land planted with trees is certified as agricultural land rather than as forest land.

c) **Environmental Policy of 1997** (Federal Democratic Republic of Ethiopia, 1997): Grants people the right to full consultation and the ability to express views on the planning and implementation of environmental policies and projects that directly affect them.

d) **Wildlife Strategy and Policy** (Federal Democratic Republic of Ethiopia, 2011) and **Wildlife Law and Regulations** (Federal Democratic Republic of Ethiopia, 2007 and 2008): These policies and regulations safeguard wildlife resources in line with international wildlife conventions to which Ethiopia is a signatory, and they encourage community and investor participation in wildlife conservation.

e) **Access to Genetic Resources and Community Knowledge Proclamation** (Federal Democratic Republic of Ethiopia, 2006) and **Community Rights Regulation** (Federal Democratic Republic of Ethiopia, 2009): Aligned with the Nagoya Protocol, these laws govern access to genetic resources, community knowledge, and the protection of these rights. The proclamation outlines access rights, obligations, and benefit-sharing principles, granting communities the right to regulate access to their knowledge and an undisputed right to use their genetic resources.

f) **Environmental Impact Assessment Proclamation** (Federal Democratic Republic of Ethiopia, 2002): Prohibits the implementation of any project that requires an Environmental Impact Assessment (EIA) without authorisation from federal or regional environmental agencies.

g) **Economic Policy**: Ethiopia's economic policy is gradually moving from a mixed economy toward the privatisation of publicly-owned means of production; forest development is open to private entities, with incentives in place to encourage participation.

h) **Expropriation Law** (Federal Democratic Republic of Ethiopia, 2005): Expropriation refers to the cessation of use rights and is limited to the movable property on land, excluding the value of the land itself, as it remains state property. This framework is particularly relevant to the implications for forest management.

i) **Investment Proclamation** (Federal Democratic Republic of Ethiopia, 2020): Promotes investment in agriculture and other sectors through incentives, specifying areas in which investors may or may not engage.

Ethiopia's forest policies and legal frameworks—dating back to 1965 and updated in 1980, 1994, 2007, and 2018—mandate forest management planning as a requirement for forest exploitation, development, and utilisation. Forest management and related forestry activities are expected to comply with the country's forest policies, laws, and regulations, some of which are influenced by international discourses. Relevant articles from Ethiopia's forest policy and forest law, which should be considered in preparing the Forest Management Plan (FMP) guideline, are presented below.

j) **Forest Development, Conservation and Utilisation Policy and Strategy** (Federal Democratic Republic of Ethiopia, 2007): This policy encourages the engagement of the private sector and farmers. Key policy strategies include promoting private forest development and conservation, advancing forest development technologies, strengthening forest product markets, managing state forests, preventing deforestation, and establishing an up-to-date information database.

k) **Forest Law** (Federal Democratic Republic of Ethiopia, 2018): This law categorises forest ownership into four types:

1. **State Forest**: Any forest exclusively conserved and managed for productivity under the ownership of the Federal Government or a Regional State.
2. **Private Forest**: Forests developed on private or institutional land that are not classified as state or community forests.
3. **Community Forest**: Forests developed, conserved, utilised, and managed by communities on communal or private land in accordance with community-developed by-laws and plans.
4. **Association Forest**: Forests developed, conserved, utilised, and managed by associations established to promote forest development.

Forest development within each ownership category may require tailored management plans that take into account the specific characteristics of each forest type. The 2018 law defines a "Forest Management Plan" as a plan developed for the sustainable development, conservation, and utilisation of natural or plantation forests, based on a detailed study of forest resources.

Numerous sections of the law address forest management planning and the involvement of surrounding communities in these efforts.

> Article 12 (3) (Productive State Forest) reads: *Formulate forest development, conservation and utilization plans to allow the participation of local communities in the development and conservation and also in the sharing of benefits from the forest.*
>
> Article 13 (1) (Protected Forest) reads: Prepare and implement participatory management plan for forests.
>
> Article15 (1) (Management and Utilization of Productive State or Protected Forest) reads: *The forest shall be utilized in accordance with the management plan prepared and approved by responsible authority*.
>
> Article 19 (4) (Forest Development, Conservation and Utilization): *Government shall formulate forest development, conservation and utilization plans to allow the participation of the local community in the development and conservation and also in the sharing of benefits from the development of state forests.*

Articles 13, 14, and 15 of the forest law mandate that certificates of title deeds, supported by maps, be issued for productive, protected, and preserved forests. This requirement integrates these forests into the cadastral system of the Land Administration.

The revised 2018 forest law also addresses new issues such as REDD+, Participatory Forest Management (PFM), benefit sharing, and carbon rights—topics that previously lacked legal recognition. Forest management plan guidelines, as well as the management plan itself, may need to account for the following provisions in the law:

- Access to lease-free land and tax grace periods, certificates of title deeds, and rights to transfer use rights and sell products in local and foreign markets;
- Professional support from the government in forest development, conservation, utilisation, and trade;

- Benefits from carbon sales and ecosystem services generated by the forest under the individual's management or possession;
- Compensation in cases of expropriation for public purposes;
- Community forest developers may share benefits generated from adjacent natural forests and receive priority access to forest concessions granted by the government;
- Rights to use, trade, and add value to forest products in accordance with the approved management plan;
- The State's obligation to build roads and other facilities, promote good working relationships between federal and regional entities, prepare FMPs, and ensure forest sustainability.

Forest Development, Conservation, and Utilisation Regulation (544/2024) states that:

- Large-scale private forest developers must manage forests according to an approved forest management plan (Art. 7).
- Forests and forest lands must be demarcated and mapped, with boundaries marked by permanent signs or pillars based on land holding certificates (Art. 13).
- A national database will be organised to identify and register Ethiopia's forest resources and provide information on forest holdings.
- Forests must be designated as productive, protective, or preserved (Art. 13).
- Forests must be utilised in accordance with an approved forest management plan (Art. 14).
- Participatory forest management beneficiaries must prepare a forest management plan in collaboration with relevant government bodies.
- Forests may be transferred to another party under a concession contract if they are demarcated, designated as protected or production forests, and have a comprehensive forest management plan.
- The Ethiopian Forestry Development shall:
    - Organise a national forest database and make it accessible to users.
    - Conduct a forest inventory every five years.
- Association Forest Developers with five hectares or more are subject to the same obligations as large-scale private forest developers as stated in Art. 7 (e.g., managing the forest according to an approved forest management plan).

Article 20 specifically addresses forest management plans:

1. Forest management plans for large-scale forest developers must be prepared by professionals with certified competence.
2. When an authorised body prepares a forest management plan, it must consult stakeholders with rights to benefit from the forest.

3. The authorised management body shall be responsible for approving, requesting revisions, or rejecting the forest management plan submitted by forest developers.

4. If significant changes to the forest management plan are required, the forest owner must revise the plan and submit it for approval.

5. When the lifespan of a forest management plan expires, the forest developer must prepare a new plan if they wish to continue forest development.

The regulation does not explicitly address natural forests. Productive forests are primarily intended to provide economic benefits, with plantations classified as productive forests. These forests must not cause significant negative impacts on ecosystems or biodiversity.

Unfortunately, protected and preserved forests are not well defined. The protection function—such as preventing landslides, floods, and similar disasters—should be classified under "Protection Forest." This is a functional classification, and even productive forests (including exotic species) can serve a protective role if located on steep slopes near roads or villages. In these cases, they cannot be harvested by clear-cutting but only through selective extraction of individual trees. Preserved forests can also serve protective functions.

Preserved forests do not necessarily have to be located in areas prone to landslides, floods, and similar disasters; they are often referred to as conservation forests and are protected for their high conservation value.

EFD's Webpage Statement (https://www.efd.gov.et/about/): One of the duties outlined on the EFD's webpage is, "In collaboration with relevant regional authorities, identifying, demarcating, registering, and securing land use right certificates for forests and forestlands; classifying forests into protection and production categories based on their intended uses; ensuring that all forests have management plans and are managed accordingly in collaboration with relevant stakeholders; and identifying reserve forests, drafting legislation for their legal designation and full protection, and, once approved, working with relevant authorities to implement the law."

1.4 Socio-Economic and Cultural Aspects

Socio-Economic and Cultural Issues: A Forest Management Plan (FMP) must recognise the existing social and cultural benefits derived by local communities from forests during the FMP preparation process. These include the economic and social conditions of villagers; their reliance on forest resources, which creates continuous pressure on these resources; occupational activities (such as agriculture, animal husbandry, and beekeeping); infrastructure availability (education, transport, health); level of dependency on forest resources; cultural ties to forests; lack of alternative income sources; and the remoteness of villages. Socio-cultural elements may also encompass religious beliefs and rituals, amenity values (such as the iconic status of certain trees), medicinal benefits, and traditional mechanisms for conflict management.

Stakeholder Consultation and Participation: Engaging stakeholders is essential in the FMP preparation process. Primary, secondary, and key stakeholders each play different roles in forest management; some are more central or "key" than others. Understanding their individual and collective contributions is crucial for the effective preparation of FMPs.

1.5 Land Related Issues

Land designated for forest establishment is a major and likely the most crucial input for forest development. Therefore, it is essential that forest management planners have prior knowledge of:

a) Legal titles or types of holding certificates registered at the Kebele or Woreda level;
b) Availability of a certified land use plan, if applicable;
c) Validity of the land title according to land law, including confirmation of rights;
d) Lease or rental agreements, including contractual use rights, limitations (attached duties), and time limits;
e) Traditional or customary use rights associated with the land;
f) Confirmation that the land designated for forest development is free from claims by community members or private individuals;
g) Identification of stakeholders with use rights or those who might be affected by the plan;
h) Implementation checks to ensure forest management operations align with the established timeline and that management objectives are being achieved as planned;
i) Availability of well-trained professionals, including foresters, ecologists, wildlife experts, and socio-economic specialists, for forest management plan preparation;
j) Existing formal or informal conflict management mechanisms;
k) Incentives for forest development and related investments, such as sawmilling;
l) Current demand and supply situation;
m) m) Considerations for the import and export of forest products.

The Government of Ethiopia is currently implementing a second-level certification for all rural lands. Orthophotos, satellite imagery, and GPS delineation are used for large-scale certification of rural land parcels in several regions, such as Sidama, Southern Ethiopia, and Amhara. Cadastral information is recorded in the National Rural Land Administration Information System (NRLAIS). Cadastral maps should serve as the basis for Forest Management Plans. Where these maps are available, they should be used to define the outer boundaries of the planning areas (forests), eliminating the need for GPS measurements. GPS measurements should only be conducted where cadastral data is unavailable. Effective interinstitutional cooperation with the Land Administration Bureaus is essential, as the outer boundaries of FMP planning areas must be officially recognised.

1.6 Sustainable Forest Management

Forest Management Plans (FMPs) are a tool of Sustainable Forest Management (SFM). FAO defines SFM as:

> *The stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems.*

ITTO defined seven criteria, 18 indicator groups, and 58 indicators for SFM in the tropics (International Tropical Timber Organisation, 2016):

1. Enabling conditions for sustainable forest management
   1.1. Policy, legal and governance framework
   1.2. Institutional framework
   1.3. Planning and monitoring framework
   1.4. Economic framework
2. Extent and condition of forests

3. Forest ecosystem health and resilience
   3.1. Addressing threats to, and vulnerabilities of forests
   3.2. Restoration of degraded forests and lands
4. Forest production
   4.1. Resource assessment
   4.2. Harvesting planning and control procedures
   4.3. Silviculture in natural and planted forests
5. Forest and biological diversity
   5.1. Ecosystem diversity
   5.2. Species diversity
   5.3. Genetic diversity
   5.4. Biodiversity conservation in production forests
6. Soil and water protection
   6.1. Extent of protection
   6.2. Protective functions in production forests
7. Economic, social, and cultural aspects
   7.1. Economic aspects
   7.2. Social and cultural aspects
   7.3. Community and indigenous peoples' rights and participation in forest management

FMPs are developed in periods of five to ten years to:

- Assess the current condition of the forests.
- Review previous forest management practices. Determine if there was a systematic management approach or if only ad hoc (possibly illegal) harvesting occurred. If a prior Forest Management Plan exists, the planner should review and evaluate the implementation of the most recent plan.
- Plan measures for the upcoming planning period, taking into account ecological, economic, and social criteria. Planning may extend beyond the immediate period, for instance, when rotation areas are established.

Forest Management Plans (FMPs) for natural forests typically span 10 years, while those for plantations cover 5 years. These plans are tools for implementing national and regional legislation, policies, and strategies to ensure sustainability. In plantations, sustainability can be achieved by regulating the forest using the area control method.

The results of the FMP serve as the foundation for:

- Determining the volume of timber that can be sustainably harvested;
- Regulating forestry practices to support continuous forest management;
- Medium-term economic planning;
- Annual operational planning;
- Monitoring and evaluating the implementation of planned measures;
- Ensuring the delivery of ecosystem services and incorporating nature conservation considerations;
- Engaging rural populations in forest management activities, with a focus on income generation and benefit-sharing arrangements.

The goals and objectives outlined in the FMP, along with the associated measures, are mandatory and must be implemented in the subsequent planning period. The preparation of an FMP follows a standardised process (detailed in Chapter 4).

Forest Management Plans must be prepared for forest properties of at least 5 hectares or more. Each FMP comprises:

- A report with annexes;
- A digital database;
- Maps based on spatial data within a Geographical Information System (GIS)

A key component of the FMP is a table listing the planned measures for each sub-compartment, with columns for tracking implementation (see Table 15). This table serves as the basis for implementing the FMP as well as for monitoring and evaluation. A summary table highlights key results for decision-makers. The full table of contents is presented in Chapter 10.1.

Small-scale private forest developers managing forest areas smaller than 5 hectares are not required to prepare an FMP but retain full access to extensions, training, and other professional support.

FMPs address essential components of the landscape, making close interinstitutional coordination vital when developing Land Use Plans.

1.7 Participatory Forest Management

Participatory Forest Management (PFM) prioritises sustainable forest management and the distribution of forest benefits to local communities. Under PFM, the rural population is no longer seen as a threat to forests but as a partner. Local communities become key participants in the conservation and sustainable management of forest resources. Proclamation 1065/2018 on Forest Development, Conservation, and Utilisation (Federal Democratic Republic of Ethiopia, 2018) defines PFM as a collaborative forest management approach executed through an agreement between the state and local communities residing within or around forest areas. This agreement outlines the management, protection, and utilisation of state-owned forests based on predefined responsibilities and benefit-sharing mechanisms. Community forest developers have the right to “engage voluntarily in participatory forest management and receive support to develop forests on communal land or areas designated by the government as forest land.” Communities are thus active managers of the forests rather than passive beneficiaries. The core principles of PFM are Local Legal Control, Local User Rights, and Mutual Trust.

The traditional role of forestry staff has shifted from that of a “policeman” to a provider of technical and administrative support. Forestry staff now act as facilitators, with roles that include:

- Providing technical advice to the community and sharing practical information;
- Serving as a liaison between the community and Woreda offices, judiciary, and administrative offices on forestry matters;
- Facilitating interactions between community groups and other agencies focused on livelihood development in the area;
- Acting as mediators when needed between PFM communities or groups;
- Coordinating connections among different villages and actors;
- Negotiating forest management rules and regulations;
- Monitoring PFM processes and forest management agreements;
- Analysing forest management challenges; and

- Introducing new technologies and innovations.

Several guidelines have been developed on Participatory Forest Management in Ethiopia, including works by Ziyenu Lemma, Dawit Biru, Ahmid Said, P. O'Hara (2015); Ahmid Said and P. O'Hara (2010); Irwin (2007); and the Forest Development Authority.

For PFM to succeed economically, additional measures are often necessary, such as improving market access for forest products. However, even with improved market access, the economic benefits often fail to adequately reach the poorest community members (Dambala G. and Muchapondwa, E., 2015). Winberg (2011) also observes that "More effort is needed to find a solution for the financial sustainability of PFM," noting that "At the community level, clear benefits and incentives are needed that appropriately outweigh the investments made in managing the forests." Winberg suggests that "One strategy to consider is sustainable timber extraction for income generation."

1.8 Scope

These guidelines detail the preparation of Forest Management Plans (FMPs) for plantation forests, drawing on extensive experience in Ethiopia. Comparable experiences with natural forests that could serve as a basis for similar guidelines are currently lacking in Ethiopia. Therefore, guidelines for preparing FMPs for natural forests should be developed in due course. Given certain methodological overlaps, the guidelines for plantation forests could provide a foundational framework for natural forest guidelines, which will incorporate new insights and experiences as they are developed.

For each chapter of the FMP, the necessary content and methods for obtaining that content are explained. These guidelines aim to standardise Ethiopia's FMPs and promote the sustainable use of the country's forests. Many existing FMPs are overly lengthy, containing extensive copy-pasting from other FMPs and forest-related documents. It is essential to avoid replicating generic information across plans. Generally, content that is copied and pasted is often unnecessary. For example, it is not required to repeatedly emphasise the importance of forests, the extended production period, or the potential impacts of pests and fires. Such risks should only be mentioned if specific parts of the planning area are at heightened risk and require targeted interventions. Planned treatments (measures) must be based on the results of the assessment.

2 General Situation of the Planning Area

These chapter provides information derived from secondary sources, such as geographical and geological maps or data from meteorological services. Assessment results are presented in Chapter 6, "Results."

2.1 Ownership, Legal Status, and Stakeholders

The management plan report should specify the ownership of the areas, the legal status of that ownership, and the history of the enterprise or management unit. It should also include relevant information about the forest owner(s), such as their status profile, available capital, assets, establishment dates, management, and other pertinent characteristics. A table based on cadastral data should indicate the specific parcels included in the FMP.

Table 2: Parcels of the planning area

Parcel code	Area (ha)	Owner	Further information*
Total area			

*For example, user rights, ownership (state, private, association, community)

The various stakeholders involved in the forest to be managed should be identified. These may include the local community, government entities, environmental organisations, NGOs focused on land use, and others. A stakeholder map should be developed to show each party's interests, contributions, and potential roles in the forest management plan. This map forms the basis for effective consultation during the FMP preparation process (see Chapter 4). Stakeholders play different roles in forest management; some are more central or influential than others. Understanding their individual and collective contributions is essential for the successful preparation of FMPs.

Relevant national policies and strategies, along with their implications for forest management planning, should also be outlined.

2.2 Personnel Organisational Structure

This chapter of the FMP provides a general description of the forest user responsible for managing the planned area. This could be a unit of the Ethiopian Forestry Department, a forest enterprise, a community, an association, or a private enterprise. A brief description of the forest management unit, its organisational structure, infrastructure, and administrative framework should be included. The chapter also offers an overview of the human resources (administrative and technical staff) available for FMP preparation and implementation, along with the necessary logistics, financial resources, and other supports. If capacity development is required, this should be stated.

The chapter also specifies who prepared the FMP (e.g., in-house staff or an external consultant) and who is responsible for approving the plan. According to regulation Article 20, FMPs for large-scale forest developers with forest properties of 5 hectares or more must be prepared only by certified professionals.

2.3 Socio-Economic Information

Demographic and social information should be obtained from official statistics and documents (regional, woreda, kebele levels), Ethiopian Forestry Department (EFD) offices, other public administrations, NGOs, development projects, and workshops conducted as part of the FMP preparation process. In addition to demographic characteristics, information on land use patterns, economic activities (primary income sources), infrastructure, forest-related activities, and other relevant activities should be presented.

The chapter should describe pressures on forests, such as illegal logging, encroachment, and poaching. Relationships and cooperation with forest managers and the EFD must also be documented, including any contracts, conflicts, or instances of illegal activity. Agreements like Joint Forest Management (JFM) should be outlined, including obligations and benefits for both parties (in both theoretical and practical terms).

Any information that is unavailable should be obtained as described in Chapter 5.2.1.

2.4 Geographical Information

2.4.1 Location

This section describes the location of the forest area, including adjacent land users and their locations. A digital map (GIS) should be provided, showing main and nearby towns, major roads close to the forest, and significant rivers. For large forest enterprises, such as the Amhara Forest Enterprise (AFE), which manages extensive areas with dispersed smaller forests, it may not be feasible to print an overview map containing all forests; however, the forest areas can be displayed in a GIS.

2.4.2 Topography and Land Cover

This section provides details about the forest site's main land cover types and landscapes, topography, and drainage characteristics, both within and around the forest site. The description should be supported by maps, and a summary table can be used to present information related to topography and drainage.

2.4.3 Geology

The geology of the planning area should be briefly described, based on available geological maps.

2.4.4 Cadastral Information

In most regions, the establishment of a digital cadastral system is well advanced, with second-level certification completed in many areas. In forests, however, only first-level certification is typically in place. The certified forest parcels and surrounding parcels form the basis of the planning area. The outer boundaries of the planning area are defined by the borders between forest and non-forest parcels. Recent orthophotos are available and should be obtained from the Land Administration. Effective inter-institutional cooperation is essential.

2.5 Climate

This section describes climate information, including average rainfall (mean, minimum, maximum, patterns, seasonality) and temperature (mean, minimum, hottest, driest, wettest, and coldest months), as well as any adverse effects such as frost, wind, and drought. If the forest site spans different agro-ecological or agro-climatic zones, it may be helpful to visualise the forest sites

according to these zones. Climate information can be presented in charts, which can aid in planning plantation activities (e.g., seedling raising, site preparation, planting).

2.6 Forest Types

This chapter describes the following aspects, if available:

- **Forest Type According to Forest Legislation:**
  - Productive forest
  - Protected forest
  - Preserved forest
- **Ethiopian Forest Vegetation Types (Potential Natural Vegetation)**: These types are categorised into four biomes:
  - Dry Afromontane forest
  - Moist Afromontane forest
  - Acacia-Commiphora
  - Combretum-Terminalia
- **Biological Diversity**: For natural forests, describe plant and animal species, measures of species richness or evenness, major tree species, quality of standing stock, disturbance status, and the importance species index, among other factors. For plantations, include any relevant biodiversity information, such as the presence of rare animal or plant species.
- **Description Based on Existing Forest Data**: If previous data is available, include information on age class distribution, diameter class distribution, volume measures, the general status of non-timber forest resources, and other significant forest resource data.

2.7 Problems

This section should summarise the problems identified in the preceding analysis. Additional issues discovered during preliminary work and initial discussions with the team and local populations (through social surveys) in surrounding villages should also be documented here.

3 Guiding Principles and Objectives

Guiding principles may be defined before the assessments begin. The primary principle should be sustainable forest management that respects ecological, economic, and social considerations. National and regional policies should be implemented, and the FMP should align with other government plans, such as land use plans. Common guiding principles include:

- Manage the forest to prioritise its long-term sustainable economic benefits and ecological health, ensuring a continuous forest cover.
- Implement forest management practices that adhere to federal and regional Good Forestry Practices standards.
- Employ adaptive management to support continuous improvement in forest management.
- Manage the forest in a fiscally responsible way, aiming to reduce costs and increase revenue.
- Integrate this plan with existing government strategies, especially those focused on environmental protection and poverty reduction.
- Apply a collaborative approach with active participation from the local population.
- Ensure forest management remains flexible to adapt to unforeseen administrative, technical, environmental, and other changes and impacts.
- Prioritise participation of the concerned population.

In this chapter, the forest owner or management entity should also state their general objectives, which set the plan's direction and reflect the forest owner's intentions. These objectives are established independently of the assessment results and should outline how an appropriate balance among social, economic, and environmental goals will be achieved. For instance, management might state that the age distribution of the forest must be normalised to ensure a continuous income flow or that stands primarily consisting of exotic species should be enriched with endemic[1] or indigenous species to enhance biodiversity..

Following the assessments, more specific objectives for the planning period can be formulated, such as defining the timeframe in which the age distribution will be normalised.

[1] Endemic species only are found in Ethiopia, for example *Erythrina brucei*, *Milletta ferruginea*

4 The Process

The preparation of an FMP should follow a standardised process. This process must be thoroughly documented, with relevant materials—such as meeting minutes, terms of reference, and other pertinent materials.

4.1 General Process

This process applies to state, private, community, and association forests. Typically, it involves three major phases:

Initialisation:

1.1. Establish planning team and supervising body(ies)/persons
  1.1.1. Preparation of terms of reference
  1.1.2. Familiarisation of the planning process
  1.1.3. Train planning team and supervising persons
  1.1.4. Avail budget and necessary logistics
1.2. Desk study of federal, regional, and other forest policies and strategy documents, of existing maps and of relevant documents/databases on climate, geology, vegetation, sociological topics etc., study of historical forestry and related trends, study of other plans like land use plans. This also covers information from woredas and kebeles on demographics, social, and gender aspects etc.
1.3. Stakeholder analysis (including social surveys)
  1.3.1. The population of the surrounding area, their organisations, historical, and religious institutions
  1.3.2. Forest users
  1.3.3. Governmental organisations
  1.3.4. Non-governmental organisations
  1.3.5. Private sector
  1.3.6. Gender aspects
  1.3.7. Social and cultural institutions and their attitude, and behaviour on forests
1.4. Consultative meetings
  1.4.1. Kick-off meeting
  1.4.2. Set of meetings from woreda to kebele level
  1.4.3. Set objectives at each administration level
  1.4.4. Define the area to be managed under Participatory Forest Management
  1.4.5. Form a community team to participate in delineation and assessments
  1.4.6. Discuss and decide on benefit-sharing
  1.4.7. Make agreement
1.5. Train participating community members
1.6. Definition of goals and objectives
1.7. Determination of the planning period (not to be confused with rotation periods)

2. Plan preparation:

2.1. Social assessments
2.2. Preparatory GIS work
  2.2.1. Compilation of existing spatial data (orthophotos, cadastral maps, shape files with woreda and kebele boundaries)

2.2.2. Delineation of outer boundaries of the planning area using parcels of cadastral maps (which are official boundaries) as much as possible
2.2.3. Addition of shape files with region, zone, woreda, and kebele boundaries
2.2.4. Stratification of young, medium-age, and mature forests on the orthophotos
2.2.5. Addition of systematic grid for sample plots (100 m * 100 m or 100 m * 50 m)
2.2.6. Forest division (delineation of blocks, compartments, sub-compartments, forested and non-forested areas for PFM) on orthophotos supported by cadastral data

2.3. Field resources assessments
2.3.1. Refinement of the delineation (2.1.6) and correction where necessary
2.3.2. Forest inventory
2.3.3. Assessments on sub-compartment level
2.3.3.1. Evaluation of implementation of planning of previous FMP (monitoring), if it is the first FMP general evaluation of former treatment, positive and negative impacts in the past
2.3.3.2. Description of stands
2.3.3.3. Planning for the sub-compartment

2.4. Analyses of inventory data
2.5. Consolidation of results of forest inventory (level of planning area) and of assessments on sub-compartment level like biophysical description, stocking, volume, basal area, etc
2.6. Summarising the results in tables, graphs, and maps
2.7. Presentation of findings and proposals for planning (including a digital map) in a workshop, which includes a field visit
2.8. Preparation of FMP report and (digital) map incorporating the outcomes of the workshop
2.9. Presentation of the final draft
2.10. Approval of final version by responsible authority

3. **Plan implementation**
3.1. Prepare Annual Operational Plans (AOPs)
3.2. Implement AOPs
3.3. Monitoring and evaluation

The FMP plus the Annual Operational Plans are the base for monitoring and evaluation.

These guidelines cover the first two phases.

4.2 Participatory Forest Management

“The common features across all Participatory Forest Management (PFM) models practised in Ethiopia include introducing the PFM concept, raising awareness and mobilising the community, establishing Forest Management Associations or Community-Based Organisations, conducting participatory forest resource assessments, preparing forest management plans, signing management agreements, and, finally, implementing the management plans.” (Messay Sintayehu and Tsegaye Taddesse, eds., 2012).

According to the *Guideline for Participatory Forest Management (PFM) in Ethiopia* (Messay Sintayehu and Tsegaye Taddesse, eds., 2012), PFM comprises three main phases:

1. **Mobilisation**: This includes stakeholder analysis and the establishment of community-based forest management institutions.

2. **PFM Planning**: In this phase, activities include participatory forest resource assessment and mapping (PFRA), forest management planning, and the formulation and signing of a forest management agreement.

3. **Implementation**: This phase primarily involves capacity building, skills development, and monitoring and evaluation activities.

The process outlined in Chapter 4.1 for plantation forest management closely aligns with the PFM process shown in Figure 1.

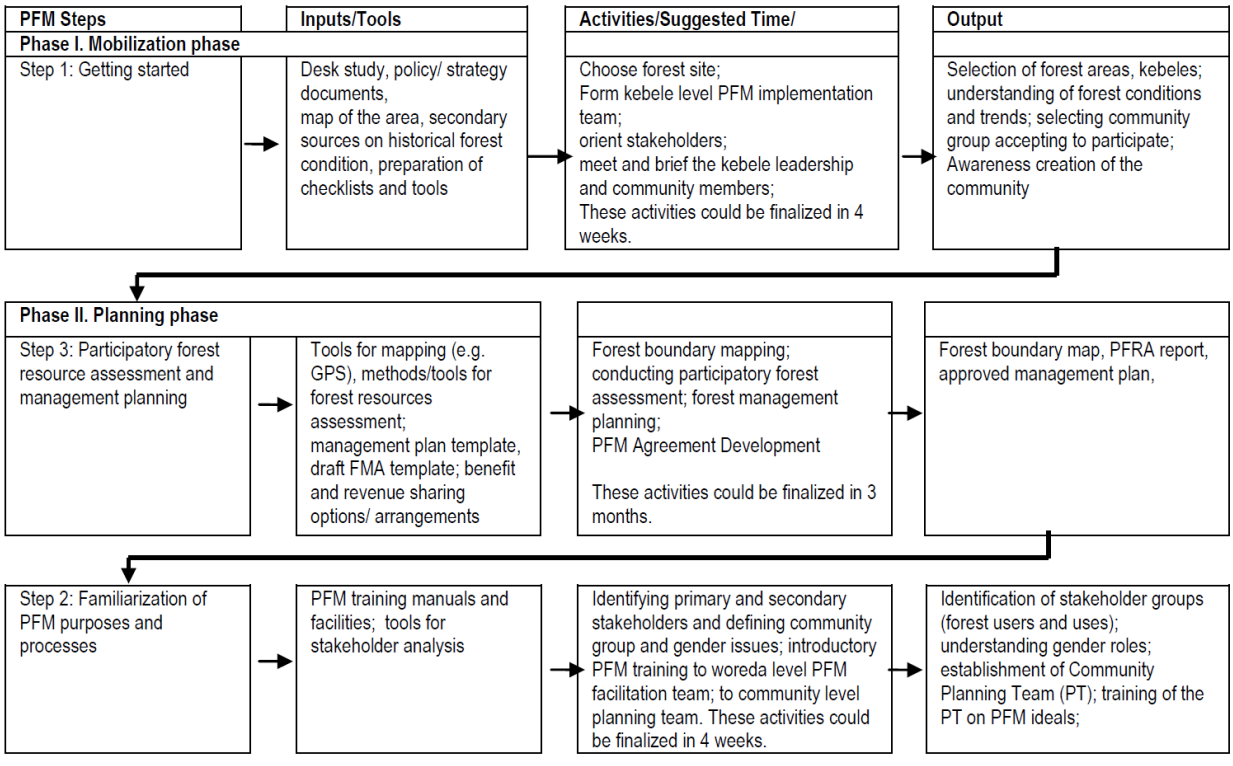


Figure 1: Mobilisation and planning phase to establish Participatory Forest Management (Messay Sintayehu and Tsegaye Taddesse (eds.), 2012)

5 Methodology

This chapter describes the methods to be used in preparing the FMP. These methods should not be repeated in individual FMPs; only deviations from the methods described in the following sub-chapters need to be documented.

5.1 Planning Period

The planning period should not be confused with the rotation period. The planning period, or the validity of the FMP, should be five years for plantations and ten years for natural forests. In contrast, a rotation period represents the time from the establishment of a stand to its final harvesting and can extend up to 40 years, meaning FMPs cannot cover an entire rotation period.

Rotation periods depend on management objectives, including considerations of species, ecological, economic, and social factors, and should be determined by the management team with support from planners. It is essential to note that rotation periods should not be based solely on calculations to maximise growth increments. Such calculations are intended as decision-support tools. Other criteria can include technical factors (e.g., dimensions of timber suitable for sawmills, value maximisation over growth maximisation), ecological criteria, or economic factors (e.g., harvesting fewer large trees is more cost-effective than harvesting numerous small trees; larger logs may command higher prices).

5.2 Assessments

5.2.1 Social Assessments

The first step is to gather as much secondary data as possible (see Chapter 2.3) on the conditions surrounding the planning area. To fill any gaps and obtain updated information, the following methods should be used:

1. **Semi-Structured Interviews with Villagers**
   The interview schedule should include a mix of predetermined closed-ended questions (70-80%) and open-ended questions (20-30%) that encourage discussion. This approach allows interviewers to explore specific themes or responses without limiting participants to a fixed set of answers, enabling them to bring up additional relevant issues.

2. **In-Depth Interviews (IDI) with Key Representatives**
   Conduct IDIs with representatives from the Ethiopian Forestry Department (EFD), Land Registration offices, kebeles/woredas, and other relevant organisations. The IDI schedule should include both closed-ended and open-ended questions, allowing respondents to discuss topics they consider pertinent. These interviews will gather insights into the FMP's relevance, the importance of involving villagers, and the significance of implementing the FMP to support sustainable forest management.

3. **Focus Group Discussions (FGD)**
   Organise FGDs with six to ten villagers and EFD representatives, led by a supervisor, to assess participants' views on how FMP implementation might affect their lives and livelihoods. FGDs should last 45-90 minutes and be conducted with a diverse group of individuals who use the forest and may be affected by the plan. Audio recording of FGDs is recommended, subject to participants' consent.

The choice of method(s) should be flexible, depending on the population's homogeneity and the forest area size. For smaller areas (e.g., 30 hectares), it may be feasible to interview all individuals involved. For larger areas (e.g., 10,000 hectares), a representative sample is necessary, requiring adaptability from the planning team. The assessment should cover the following topics:

1. Date of the assessment
2. Region, zone, woreda, kebele, sub-kebele
3. Respondent: name, sex, age, education, position in kebele
4. Name of the forests in the kebele
5. Ownership (state, community, private, association)
6. Natural forests, plantations, or other types of forest lands
7. Year of establishment (in case of plantations)
8. Name of kebeles adjacent to the forest
9. Major economic/livelihood activities (crop production, animal husbandry, forest, etc) in the kebele (% and priorities)
10. Other livelihood options in the community besides farming
11. Major benefits for the community gained from the forest
    a. Economic
    b. Environmental
    c. Social/cultural
    d. Others
12. What other benefits do the community expect from the forest
13. Types of products/services obtained from the forest (Timber, NTFP, etc)
14. Does logging take place in the forest?
15. Any challenges/harm imposed by the forest on the community
16. Suggestion to make economic benefit from the forest
17. Suggestions regarding the future development, management, and utilisation of the forest
18. Priority development needs of the community
19. Major croup cultivated in the kebele
20. The main source of cash income for the community
21. The main energy source of the community
22. Landholding (ha)
    a. Average
    b. Minimum
    c. Maximum
23. The major source of animal feed
24. The major source of construction wood, fuel wood and other forest products
25. Market availability
    a. Name of the nearest marketplace
    b. Distance to the nearest market
    c. Market segment and value chain
26. Main CBOs in the kebele
27. Are any CBOs (e.g., PFM, cooperative, etc) working on forest development and utilisation?
28. Have you ever faced a dispute/conflict that occurred regarding accessing/using the forest?
    a. Within the kebele? (Yes/No); if yes, how?
    b. With communities of adjacent kebele (Yes/No); if yes, how?
29. Which legal mechanism (norm, by-law, etc) controls sustainable utilisation of the forest by the community?

These questions are not comprehensive nor mandatory. They depend on the specific situation in every planning area.

5.2.2 Forest Demarcation

Close cooperation between the Ethiopian Forestry Department (EFD), forest enterprises, and other organisations managing forests with the State Bureaus of Land Administration is recommended. For instance, forest enterprises can plan which forests will have FMPs prepared over the next five years. Forest and land administration teams can then collaborate on second-level land certification (Ministry of Agriculture, 2021). The certified parcels will form the outer boundaries of the planning areas.

Forest sites should be organised hierarchically as branches, forests, blocks (optional), compartments, and sub-compartments:

- **Branch**:
  In regions with forest enterprises, each forest is typically managed by a branch, identified by its first two letters. In other regions, it may also be beneficial to group forests into branches, as these form management units, each with a single FMP.

- **District**:
  The district represents a lower institutional administrative level responsible for managing, developing, and utilising forest resources, especially in the Oromia Forest and Wildlife Enterprise (OFWE). A district may encompass one or more woredas.

- **Forest**:
  A forest is the largest permanent unit at the branch level, comprising multiple forest stands in a defined area. Each forest must be mapped to establish its size and location. The outer boundaries are usually delineated by the Land Administration and certified, forming the basis for maps produced by the planner. Each forest should have a clear name and an abbreviation formed from its first three letters.

- **Block (optional)**:
  Blocks may be used for administrative purposes (e.g., woreda level) and consist of several compartments. Blocks are named with uppercase letters (A, B, C, etc.). If subdivision into blocks is unnecessary, the entire forest can be designated as Block A.

- **Compartment**:
  Compartments are identified by natural or man-made boundaries, such as ridges, rivers, roads, or canals, which are easily recognisable in the field. Compartment boundaries should be maintained unless significant changes occur, such as the loss of a boundary feature. Each compartment must be mapped and should range from 25 to 100 hectares in size, labelled numerically (1, 2, 3, etc.).

- **Sub-compartment**:
  A sub-compartment is a forest stand for which specific silvicultural treatments are outlined. It is the smallest unit for recording and reporting and must be delineated and mapped in the field (with GIS support on a tablet). If a compartment contains only one stand, it consists of a single sub-compartment. Each sub-compartment requires a description of site conditions, the current stand, and proposed silvicultural treatments. Sub-compartments should be between 0.5 and 25 hectares in size, identified by lowercase letters (a, b, c, etc.). A sub-compartment designation might read, for example, as branch Injibara, forest Betteria, block A, compartment 1, sub-compartment a (InBetA1a).

In some regions, demarcation terminology may vary (e.g., sub-compartments may be called compartments), but it is recommended to follow the classification outlined here. The delineation sequence for an FMP is described in the following sections.

Note: The classification described above applies to forest enterprises. Forests not managed by enterprises should also follow this hierarchy, beginning with Block (optional), Compartment, and Sub-compartment.

5.2.2.1 Cadastral Data and Orthophotos

In several regions, extensive cadastral mapping has been completed, with many parcels certified at the second level. These certified parcel boundaries must be adopted by the managing institution (enterprise, forest bureau, etc.). Shape files containing these parcels should be obtained from the Land Administration Bureau, and their outer boundaries should form the FMP's perimeter. If a forest parcel is not yet part of the cadastral system, the boundaries of adjacent certified parcels should be used as the forest (FMP) area boundaries. These official boundaries should be respected, as each mapping exercise cannot establish its own boundaries. Where official boundaries exist, field delineation with GPS is unnecessary.

Additionally, a shape file containing all parcels within the planning area should be extracted from cadastral data, with attributes such as owner, zone, woreda, kebele, user rights, and area (hectares). Major roads and open areas can also be incorporated from cadastral data. Combined with orthophotos, the cadastral data should be uploaded to a tablet with mapping software (e.g., QField GIS).

5.2.2.2 Forest and non-forest areas (orthophotos)

The planning area should be divided and mapped as follows (see also Chapter 11.1.1):

1. **Plantations**
   1.1. Stocked
   1.2. Unstocked (temporarily without trees or designated for afforestation)
2. **Multiple-use Forests**
   Areas designated for community use in accordance with the Guidelines for Participatory Forest Management.
3. **Bushland**
   Areas primarily covered with shrubs.
4. **Preserved Forest**
   Forests set aside for conservation purposes.
5. **Non-forest Areas**
   5.1. Open areas essential for forest management, such as forest roads wider than 5 m, nurseries, buildings, and timber yards (exceeding 0.2 ha).
   5.2. Other open areas, including agricultural lands, rocky areas, lakes, rivers, etc.

Only the plantations (item 1) are included in the assessments and planning.

Delineation is initially conducted in the office using GIS on orthophotos or satellite images. Field corrections should then be made using GIS on a tablet with GPS support (as outlined in subsequent chapters). It is important to distinguish between open areas and unstocked areas. Unstocked areas are part of the planning since they will be afforested, although they are not included in the forest inventory. The total planning area consists of both plantations and unstocked areas. By the end of the planning period, the forest area will have expanded to include the newly afforested unstocked areas.

Additionally, roads and other open areas not present in the cadastral shapefile should be delineated before fieldwork begins.

5.2.2.3 Stratification (Orthophotos) Based Sample Grid

A grid with sample points (point shape) for the forest inventory is overlaid on the planning area. Based on orthophoto interpretation, the forest area is stratified into young, medium-aged, and mature stands, which are associated with different types of treatment (see Chapter 5.2.5.3). The planning process prioritises stands scheduled for harvesting, many of which are over-mature and require prompt harvesting. Therefore, sampling intensity is increased for the “mature” stratum as follows:

1. Young stands: 100 m x 100 m
2. Medium-aged stands: 100 m x 100 m
3. Mature stands: 100 m x 50 m

These grid intervals are commonly used in Ethiopia and other countries (Kangas & Maltamo, 2009; Böckmann, 2016; Böckmann et al.). Increasing sampling density in older stands is advisable, as these stands incur the highest harvesting costs but also generate the highest revenues. The stratum is recorded as a column in the sample grid’s attribute data, with the stratum (1, 2, or 3) assigned to each sample point based on orthophoto interpretation. This stratum classification is also used to delineate sub-compartments.

5.2.2.4 Delineation of Compartments and Sub-Compartments (Orthophotos)

Forests are subdivided into blocks (optional), compartments, and sub-compartments. Sub-compartments should consist of stands with distinct species compositions and silvicultural treatment needs and should be delineated accordingly on orthophotos in the office as much as possible. Boundaries derived from cadastral data, orthophoto interpretation (distinguishing forest and non-forest areas, roads, nurseries, etc.), and the stratified sample grid attributes (1, 2, or 3) are used in compartment and sub-compartment delineation. Each sub-compartment should fall within a single stratum and have boundaries that are recognisable in the field. Several sub-compartments can be grouped into one compartment, and compartment boundaries should align with prominent features such as roads, rivers, creeks, or ridges that are easily identifiable in the terrain.

If clear delineation is not possible on the orthophotos, adjustments should be made during the forest inventory.

5.2.3 Forest Management Classes

For stands (sub-compartments) with varying rotation periods, treatment types (e.g., even-aged plantations, high forest, coppice forest, or selective logging), Forest Management Classes (FMC) can be defined. Each stand is assigned to an FMC, and forest inventory results are analysed separately for each FMC. All calculations are performed on a per-FMC basis. Additional FMCs may be defined during fieldwork as needed.

5.2.4 Forest Inventory

The shape files produced in Section 5.2.2 (delineation, stratified sample grid), along with orthophotos, satellite images, and other relevant data, are uploaded to mapping software such as QField on a tablet. Additional digital resources, such as topographic maps, geological maps, or digital elevation models, can also be uploaded if available. Equipped with this data, the inventory team conducts fieldwork.

In the field, a GPS connected to the tablet displays the team's location, helping them navigate to sample plots. Only sample plots located at least 6 metres from the forest border are included to minimise border effects. During the inventory, the team makes any necessary corrections to the office-determined delineation and stratification.

Each sample point serves as the centre for three circular plots, with plot radius determined by tree diameter:

- DBH < 5 cm: 1.26 m (5 m²)
- DBH 5 cm to 17.9 cm: 3.99 m (50 m²)
- DBH >= 18 cm: 5.64 m (100 m²)

First, the planner registers his name and the date of the assessment. The following data is then collected in each sample plot:

- Stratum (the stratum identified on the orthophoto may have to be corrected)
- Forest Management Class
- Elevation: GPS
- Slope in percent
- Aspect (N, NE, E, SE, S, SW, W, NW)
- Trees
  - **Species**
  - **Age (for plantations)**
  - **Tree Count**: Trees with a diameter at breast height (DBH) of less than 5 cm are counted within a circular sub-plot with a 1.26 m radius.
  - **DBH Measurement**:
    - Trees with a DBH of 5 to 17.9 cm are measured within circular sub-plots with a 3.99 m radius.
    - Trees with a DBH of 18 cm or larger are measured within circular plots with a 5.64 m radius.
    - DBH should be measured precisely using a caliper or diameter tape, with the exact diameter recorded rather than a diameter class to avoid information loss. The analysis software can then classify diameters as required.
  - **Tree Height**:
    - The height of trees with a DBH of 5 cm or larger should be measured, rounded to the nearest metre. Height is measured with a Vertex laser hypsometer, hypsometer, clinometer, or relascope (Bitterlich).
    - Measurements should be taken from a point approximately level with the tree's base. If this is not feasible, adjust the distance accordingly. Two measurements are taken—one to the tree's base and one to the top. These are added together; if the observer's eye level is below the tree's base, the value is subtracted.
  - **Log Quality**: Rated as high, medium, or low.
  - **Damage**: Damage (e.g., from human activity, disease, fire, storms, landslides) is assessed and recorded in 10% classes.
  - **Canopy Cover**

5.2.5 Sub-Compartments

At the sub-compartment level, the planner:

1. Assesses parameters needed for planning measures in the upcoming period, such as tree species, Diameter at Breast Height (DBH), and tree height.

2. Describes the stand, for example, as an over-mature Eucalyptus stand with decaying stems or an *Acacia decurrens* stand with natural regeneration of species A and B.

3. Evaluates the implementation of planned measures from the previous Forest Management Plan (FMP). If no FMP exists, the planner assesses past treatments (both positive and negative, legal and illegal) and other impacts on the stand (e.g., storm damage, pest infestation) as part of monitoring and evaluation.

4. Proposes the treatment plan for the stand for the upcoming planning period.

5.2.5.1 Assessments

After completing inventory measurements, the planner describes the sub-compartment based on sample plot results, orthophoto data on the tablet, and field observations. The following parameters are estimated with support from measurements in the sample plots for the relevant sub-compartments:

- DBH (cm) per species (average)
- Height (m) per species (average)
- Volume (m^3) per species (average)
- Log quality
- Damages

Additionally, the following parameters should be assessed.

- **Slope and Aspect**: Average slope of the sub-compartment, as indicated by sample plots; provide a verbal description if necessary.
- **Topography**: Classification as dry ridge, upper slope, lower slope, or flat.
- **Silvicultural System**: Characterisation as high forest (planted, seeded, or natural regeneration) or coppice forest (resprouting from cut stumps).
- **Age Structure**: Designation as even-aged, two-aged, or uneven-aged.
- **Treatment Age**: Classification as young (weeding, replanting, pre-thinning, and other maintenance treatments), middle (pruning, thinning, sanitary cuttings, and other treatments), or mature (ready for harvest).
- **Vitality Class**: Rated as high, medium, or low based on crown foliage, stem decay, or presence of pests such as fungi.
- **Soil**: General soil conditions.
- **Site Suitability for Stand Species**: Based on field evidence, indicate suitability as “no” if the stand’s height is significantly below average or if health problems are observed.
- **Stand Stability**: Indicate stability as “unstable” (due to diseases, open canopy, storm damage, etc.) or “stable.”
- **Possible Extension of Rotation Period**: If the stand is stable, extension is possible; if not, indicate “no.”
- **Implementation of Previous Planning Period Objectives**: Indicate if objectives were implemented, partially implemented (e.g., 70% of the planned harvesting was completed), or not implemented. Note any special observations, such as illegal logging.

5.2.5.2 Treatment

The planner determines the appropriate treatment for each stand (sub-compartment) in the field. This process involves five steps (see Table 3):

1. Identification of treatment age.
2. Assessment of treatment needs and available options.
3. Selection of treatment type or silvicultural model.
4. Adjustment of the silvicultural model to meet the specific conditions and requirements of the stand, including estimates of harvesting volumes and the number of plants needed for replanting or enrichment.

Additional verbal descriptions and explanations may be provided as needed.

Table 3: Five steps to define the needed treatment (following page)

Steps in forest management planning for plantations to develop detailed planning

Identification of stands with similar treatment conditions	Identification of treatment age	Assessment of treatment needs and options	Treatment type	Treatment details adjusted to individual stand conditions
Definition and delineation of sub-compartment	Mature (1)	Stable mature stand (1.1)	No action stand (1.1.1)	No treatment
			Little action stand (1.1.2)	Extract suppressed trees, harvest: 10-20 m³/ha
			Medium action stand (1.1.3)	Select good trees, extract competitors, harvest: 20-35 m³/ha
		Un-stable mature stand (1.2)	Clear cut (1.2.1)	Clear cut: 100% of stock with following replanting with 2,500 to 5,000 plants per ha, regeneration is taken over wherever possible
			Shelterwood cut (1.2.2)	Harvest: 80% of stock, remaining trees to be mother trees and shelter, plant 2,500 to 5,000 plants/ha, encourage natural regeneration
			Group regeneration (1.2.3)	Select good tree groups to remain, extract mature groups to create opening for regeneration, harvest: 50% of stock, encourage regeneration, plant where needed
	Middle age (2)	Wanted stand type (2.1)	Strong thinning (2.1.1)	Select future trees (500-700/ha), identify competitors, remove 1 competitor per future tree, harvestable volume: average tree volume * number of competitors, prune future trees
			Careful thinning (2.1.2)	Select future trees (350-450/ha), identify competitors, remove 1 competitor per future tree, harvestable volume: average tree volume * number of competitors, prune future trees
		Stand requiring structure changes (2.2)	Only thinning (2.2.1)	Select future trees by quality and species, identify their competitors, identify of unwanted tree, remove of competitors and unwanted trees, harvestable volume: average tree volume * number competitors, prune future trees
			Thinning and planting (2.2.2)	Selection of future trees by quality and species, identification of their competitors, identification of unwanted trees, removal of competitors and unwanted trees, harvestable volume: average tree volume * numb. competitors, under planting or gap planting wanted species
	Young (3)	Well established (3.1)	Tending (3.1.1)	Protection against grazing, removal of competing vegetation where needed, singling of coppices, removal of poorly shaped trees
		Not well established (3.2)	Maintenance & Re-planting (3.2.1)	Protection against grazing, removal of competing vegetation where needed, singling of coppices, removal of poorly shaped trees, re-planting of gaps to complement with wanted tree species

(1) Mature stand decisions

- Biological maturity
- Economic maturity
- Technical maturity (depends on intended use, such as transmission poles, saw logs, or pulpwood)

Stable Stand: Health and vitality are good, no visible diseases, closed canopy without significant gaps; the final harvest can be deferred to the next planning period. Proceed to (1.1).
Unstable Stand: Poor health, visible disease, canopy gaps, physical damage (e.g., windbreaks), or natural regeneration in place, indicating a need for final harvest within the current planning period. Proceed to (1.2).

(1.1) Stable Mature Stand Decisions

(1.1.1) No Activity Stand

- Conditions: Shallow or poor soils, limited water balance, low growth rate, high age, low vitality. Homogeneous stand with minimal lower layer or suppressed trees.
- Activities:
    - Silvicultural Treatment: None
    - Harvesting: None
    - Planting/Regeneration: None

(1.1.2) Low Activity Stand

- Conditions: Deep, average-quality soils with moderate water balance. Medium growth rate, high age, medium vitality, heterogeneous stand with lower layer and suppressed trees.
- Activities:
    - Silvicultural Treatment: Harvest lower layer and suppressed trees, avoid disturbing dominant layer canopy
    - Harvesting: Low volume, 10-20 m^3/ha
    - Planting/Regeneration: None

(1.1.3) Medium Activity Stand

- Conditions: Deep soils at lower slopes, good water balance, high growth rate, high age, and good vitality. High canopy density, requires opening for best trees.
- Activities:
    - Silvicultural Treatment: Select best trees (good crown, no damage) spaced at 6m; remove immediate competitors.
    - Harvesting: Medium volume, 20-35 m^3/ha

- Planting/Regeneration: No planting, natural regeneration may occur in small openings

(1.2) Un-Stable Mature Stand Decisions

(1.2.1) Clear Cut:

- Conditions: Unstable stand with gaps, declining health, crown density below expectations, non-optimal species composition.
- Activities:
  - Silvicultural Treatment: Clear cut; protect against grazing post-planting
  - Harvesting: Complete stock removal, estimated from stand inventory
  - Planting/Regeneration: Select species based on site; 1x2 or 2x2m spacing, 2,500-5,000 plants/ha

(1.2.2) Shelter Cover Cut:

- **Conditions**: Gaps present, declining health, sufficient mother trees with good vitality distributed evenly.
- **Activities**:
  - **Silvicultural Treatment**: Remove 80% of stocks, encourage natural regeneration, enhance soil if necessary, plant where regeneration is insufficient; protect against grazing
  - **Harvesting**: 80% of stock, estimated from inventory
  - **Planting/Regeneration**: Site-appropriate species in gaps, spacing 1x2 or 2x2m, 2,500-5,000 plants/ha

(1.2.3) Group Regeneration:

- **Conditions**: Gaps, declining health, mother trees grouped, adequate for another 10 years, suited for natural regeneration.
- **Activities**:
  - **Silvicultural Treatment**: Harvest 50% of stocks to create gaps for group regeneration; encourage natural regeneration, possibly with soil improvement, and plant where regeneration is insufficient
  - **Harvesting**: 50% of stock, estimated from inventory
  - **Planting/Regeneration**: Group planting, spacing 1x2 or 2x2m, 2,500-5,000 plants/ha

(2) Middle Aged Stand Decisions

The stands are of middle age, and still need more than 3 to 10 years to reach maturity based on the species.

(2.1) Wanted Stand Types

The species composition and log quality of the stand meets the expectations. The species is well adapted to the soil and water regime, it provides the expected root system to contribute to erosion control in erosion prone landscape situations.

(2.1.1) Strong Thinning:

- **Conditions**: Deep soils, good water balance, high growth rate, high vitality.
- **Activities**:
    - **Silvicultural Treatment**: Select 500-700 future trees/ha, remove 1-2 competitors per tree
    - **Harvesting**: Volume based on tree volume x competitors/ha
    - **Planting/Regeneration**: None

(2.1.2) Careful Thinning:

- **Conditions**: Shallow soils, medium to low growth rate, moderate vitality.
- **Activities**:
    - **Silvicultural Treatment**: Select 350-450 future trees/ha, remove 1 competitor per tree
    - **Harvesting**: Volume based on tree volume x competitors/ha
    - **Planting/Regeneration**: None

(2.2) Undesired Stand Types

The species composition and log quality of the stand does not meet the expectations. The species may not be well adapted to the soil and water regime, the present species may not provide the expected root system (shallow rooting) to contribute to erosion control in erosion prone landscape situations. The growth rate may be much lower than expectations of other trees species at the prevailing site conditions.

(2.2.1) Thinning Only:

- C**onditions**: Medium or high growth rate, mixed species with quality variance.
- **Activities**:
    - **Silvicultural Treatment**: Select future trees by quality/species, remove competitors/unwanted trees
    - **Harvesting**: Volume based on tree volume x competitors/unwanted trees/ha
    - **Planting/Regeneration**: None

(2.2.2) Thinning and Planting:

- **Conditions**: Medium or high growth rate, some desired trees, low-quality species dominant.

- **Activities**:
  - **Silvicultural Treatment**: Select future trees, remove unwanted trees, plant desired species in gaps
  - **Harvesting**: Volume based on tree volume x unwanted trees/ha
  - **Planting/Regeneration**: Group planting in gaps or underplanting

(3) Young Stand Decisions

Stands recently planted or established, no timber production.

(3.1) Well Established

The stand is well established, canopy closure and survival rate meet the expectations.

(3.1.1) Tending: Site conditions: Not specified. Stand / Plantation is about to be closed or canopy closure has already been achieved.

- ***Activities:***
  - ***Silvicultural Treatment: Protect from grazing, remove competing vegetation as needed, thin coppices, remove poorly shaped trees***
  - ***Harvesting: None (except for a few poles)***
  - ***Planting/Regeneration: None***

(3.2) Not Well Established

The stand is not well established, canopy closure and survival rate do not meet the expectations.

(3.2.1) Tending:

- **Conditions**: Canopy closure and survival below 75%.
- **Activities**:
  - **Silvicultural Treatment**: Protect from grazing, remove competing vegetation as needed, thin coppices, remove poorly shaped trees
  - **Harvesting**: None (except for a few poles)
  - **Planting/Regeneration**: Replant gaps with desired species

5.2.6 Data Analyses

Once fieldwork is complete, the collected data is analysed using appropriate software or spreadsheets. The forest inventory provides results for each stratum within the planning area or Forest Management Class (FMC). The boundaries of these strata often align with sub-compartment boundaries.

Detailed results are generated for each stratum and FMC, including metrics such as total volume per species, basal area, and diameter distribution (see Table 6 and Table 7). These results support decision-making, as indicators such as the Mean Annual Increment (MAI) can be calculated to assess sustainability. The results provide insight into how much volume should be harvested, the area requiring replanting post-harvest, and additional needs for reforestation, such as plant requirements and nursery capacity. Stratum-level results serve as indicators of sustainability, and the aggregated plans for sub-compartments should align with these results.

The analysis produces results at both the planning area and sub-compartment levels. The forest inventory data serves as a foundation for management-level decisions, including species distribution, Diameter at Breast Height (DBH), Annual Allowable Cut (AAC), and identifying areas for harvesting or planting. Combined with sub-compartment assessments, these results provide the basis for technical decisions regarding stand treatments for the planning period.

5.2.7 Protected Forests

Protected forests fulfil important protective functions, such as preventing landslides, safeguarding rivers and creeks, and preserving water sources. These areas must be mapped using GIS tools (e.g., orthophotos, digital elevation models) and field observations, which may include mapping slopes exceeding 30% or areas within 30 metres of creeks and rivers. Plantations can also serve protective roles; in such cases, clear-cutting is prohibited, and only selective harvesting is permitted.

5.3 Organisational Aspects

The process for preparing a Forest Management Plan is outlined in Chapter 4. This participatory and administrative process must be carefully planned and fully documented, with supporting documents such as minutes from participatory events included as annexes.

The implementation team should be established in a timely manner, with team members appointed and trained as necessary. All training sessions, office work, and fieldwork must be documented, including participant names and dates. Any deviations from the guidelines should be explained.

Challenges such as limited information on tree species growth increments, time constraints, or a shortage of skilled team members should be noted and explained in this chapter.

6 Results

This chapter presents the outcomes of the forest inventory, sub-compartment assessments, and additional evaluations. It includes an evaluation of the implementation of the previous Forest Management Plan (see Chapter 6.6). This evaluation should cover not only whether planned measures were implemented but also whether external factors affected their success, such as cattle grazing in newly established plantations, illegal logging, or fire damage impacting the achievement of objectives.

6.1 Socio-Economic Information

This section presents the results of the social survey, including an overview of the local population and main economic activities, the forest's significance to the community, and future expectations. It should outline the financial and other benefits (or any negative impacts) for the local population and stakeholders resulting from FMP implementation. Considerations include:

- Are there usage agreements in place?
- In cases of joint forest management, what experiences have been documented, and what areas need improvement?
- How are responsibilities distributed among stakeholders?
- Are there existing conflicts, and where is change needed?

6.2 Administrative Division of the Planning Area

Cadastral (digital) maps, along with related attribute information, form the basis of the FMP's maps. A summarised table should be created using data from the cadastral system (if available), showing the distribution of forest and related areas by woreda/kebele. This information is particularly important for benefit-sharing purposes. The bottom row should show the total areas of plantations, natural forests, and unstocked lands, which will serve as the foundation for subsequent calculations. This table should be included in the initial FMP, with planners of subsequent FMPs verifying its continued accuracy.

Table 4: Forest and related areas in zones, woredas and kebeles

Zone/ woreda/ kebele	Productive (ha)		Non-productive(ha)			Total (ha)
	Plantation	Un-stocked	Natural forest*	Open area	Others	
Zone 1						
Woreda 1						
Kebele 1						
Kebele 2						
Woreda 2						
Kebele 1						
Kebele 2						
Zone 2						

Total (ha)			

*It is assumed that there is no logging in the natural forests. If there is logging it should be classified as “productive”.

The following table should show the ownership of the forests. This may vary in the different regions.

Table 5: Ownership of the forests and areas of productive and non-productive areas (example)

Forest	Blocks	Compartments	Sub-compartments	Productive (ha)		Non-productive (ha)		
	(n)	(n)	(n)	Plantation	Un-stocked	Natural forest	Open area	Others
PFM								
Forest 1								
Forest 2								
Private								
Forest 1								
Forest 2								
Enterprise								
Forest u								
Forest v								
Community forest								
Forest w								
Forest x								
State forest								
Forest w								
Forest x								
Association forest								
Forest y								
Forest z								
Total								

6.3 Forest Inventory Results (Mandatory Tables)

The forest inventory provides essential data for decision-making across the entire planning area. The following table displays the age class distribution of the plantation forests within the planning area. If there is more than one Forest Management Class (FMC), a similar table should be presented for each FMC. Numerical values should be limited to one decimal place, and volumes should have no decimal places to avoid conveying a false sense of precision, as the measurement error is too high for results of this specificity. The results shown in Table 6 and subsequent tables must be carefully interpreted.

Table 6: Area (ha) and volume (m³) per age class

Species		Age class										
		0	1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	26 - 30	31 - 35	36 - 40	>40	Sum %
Cupressus l.	Area (ha) Volume (m³)											
Grevillea r.	Area (ha) Volume (m³)											
Cordia a.	Area (ha) Volume (m³)											
Pinus p.	Area (ha) Volume (m³)											
	Area (ha) Volume (m³)											
	Area (ha) Volume (m³)											
Sum	**Area (ha)** **Area (%)**											
	Volume (m³)											

Table 7 presents the key results from the forest inventory. The Mean Annual Increment (MAI) represents the volume per hectare per year, including any volumes removed during thinnings. In many cases, however, thinnings have not occurred, so the total MAI is calculated as the stocked area multiplied by the mean volume per hectare. Ideally, estimates of illegally harvested timber should also be included, though accurate estimations are required for this. If the age class distribution is balanced, the total MAI can serve as the Annual Allowable Cut (AAC) each year. Caution is advised in interpreting these indicators, as rotation periods are often significantly exceeded. Given the varying rotation periods, MAI (along with other parameters) should be calculated separately for each FMC.

Table 7: Total timber volume per Forest Management Class (FMC) with the main parameters

FMC	Area (ha)	Number of trees (n/ha)	Average DBH (cm)	Average height (m)	Basal area (m²/ha)	Volume (m³/ha)	Mean Annual Increment (m³/ha/yr)	Total volume (m³)
1 2 3 4								
Sum*								

*The total area is important. This must be the same in all the tables. Also, the total volume is important as a base for management decisions (labour, machinery etc).

It is unnecessary to specify that calculations are based on the “Stocked area,” as this is the area being planned for. In each table, the sum of areas should correspond to the “Stocked area.” If discrepancies exist in the total area, it indicates a calculation error, and the source of the error must be identified.

6.4 Forest Inventory Results (Optional)

Additional results from the forest inventory can be provided in tables if relevant to the planning area's specific conditions. This inclusion is at the discretion of the management.

6.5 Results of Sub-Compartments

Sub-compartments serve as the primary planning units, and the results of assessments at this level form the basis for fieldwork. For instance, if a branch's FMP covers a five-year period with 250 sub-compartments, 50 sub-compartments will need to be managed each year. Before the start of each year, management, supported by GIS data and the knowledge of field officers, selects these sub-compartments. Ensuring adequate human resources and equipment for this work underscores the importance of thorough assessments in each sub-compartment.

A table containing essential information for implementing the plan should be provided (see Table 8). Only forest areas defined in Chapter 5.2.2.2 (plantation, unstocked areas) are classified and delineated as sub-compartments and included in calculations. Open areas are not classified as compartments or sub-compartments and therefore do not have codes. Given the potential volume of sub-compartments, this type of list should be annexed.

Table 15 should list sub-compartments along with planned treatments and columns for recording implementation details. This list is crucial for monitoring FMP implementation and should also be annexed. An Excel file is recommended for digitally recording measures, ideally as part of a forest management information system.

All assessed data serves as attribute data for the sub-compartment shape files, which do not need to be printed. These shape files should be uploaded to a tablet for the implementation team leader to access and utilise as needed.

Table 8: Key parameters of the sub-compartments

Sub-compartment	Species	Percentage of species (%)	Area* (ha)	Age (years)	Number of trees (n/ha)	Treatment age	Height (m)	Basal area (m^2/ha)	Volume (m^3/ha)	Mean annual increment (m^3/ha/yr)	Total volume (m^3)
1	Eucalyptus glandulosa	80									
	Species b	15									
	Species c	5									
2	Acacia decurrens	100									
3											
Sum			xxx**								xxxx

*This is the theoretical area of the species. For example, a stand of 20 ha with 80% Eucalyptus glandulosa, 15% species b and 5% species c has theoretically 16 ha Eucalyptus glandulosa, 3 ha species b and 1 ha species c

**Only total values can be summed (area and total volume). Values per ha cannot be summarized.

6.6 Evaluation of the Previous Planning Period

Monitoring and evaluation of activities from the previous planning period are essential tasks for the planner. The repeated preparation of FMPs serves as a primary monitoring tool, making the evaluation of forest activities an integral component of each FMP. The planner assesses whether activities, such as thinnings, were implemented effectively, evaluating if they were conducted properly and had a positive impact on stand development or if harvested areas show successful regeneration. Additionally, the planner evaluates the effectiveness of conservation measures and checks for any changes in endangered species populations.

The planner also documents and evaluates any adverse effects, including illegal logging, grazing, or natural impacts like storms or flooding. This assessment addresses potential risks to the forest from illegal activities or environmental factors. Observations are summarised in a dedicated chapter of the report, with additional commentary included in sub-compartment descriptions as needed. Descriptions of best practices may also be provided to guide other forestry institutions.

7 Planning

7.1 Objectives

Specific objectives for plantation forests with a significant number of over-mature stands may include:

- Normalising the age class distribution
- Prioritising the harvest of over-mature stands
- Enhancing regeneration (in plantations) with indigenous species to increase biodiversity
- Thinning overly dense young stands

7.2 Forests with Unbalanced Age Distribution

Planning in plantation forests is highly influenced by age distribution. In these forests, area control is a practical approach, where the area designated for harvest is divided by the rotation period to determine the annual harvest area in a "normal" forest. However, in many regions, plantations contain a high proportion of mature and over-mature stands, making it unrealistic to achieve a balanced age distribution within a single rotation period.

Moreover, harvesting all mature and over-mature stands within a short period often exceeds the operational capacity of the managing unit. This approach could also lead to extensive open areas with artificial or natural regeneration, which may have negative ecological impacts and pose challenges for management, as these areas may be difficult to protect from grazing. Additionally, harvesting all available mature stands would create a gap, resulting in a lack of medium-aged stands and limiting future harvesting options. As a result, it is necessary to postpone the harvesting of mature stands in good condition to subsequent planning periods.

The following tables illustrate an unbalanced age distribution, showing a significant surplus of mature and over-mature stands and a shortage of middle-aged stands.

Table 9: Normalization of the age class distribution with over-mature stands but lack of medium-age and mature stands

Year/ age class	Area (ha)								
	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	Total
2020	303.8	261.4	2.8	10.0	4.8	20.6	0.0	145.2	748.6
2025	149.7	303.8	261.4	2.8	10.0	4.8	16.1		748.6
2030	149.7	149.7	303.8	145.4	0.0				748.6
2035	149.7	149.7	149.7	299.5	0.0				748.6
2040	149.7	149.7	149.7	149.7	149.7				748.5

Table 9 illustrates the age class distribution of a forest with a rotation period of 25 years and 145.2 hectares of over-mature stands, which is approximately the area of one “normal” age class (149.7 hectares). The planning period (the FMP’s validity) spans 5 years. In this period, 149.7 hectares can be harvested, including some hectares in the 21-25 year age class.

In the subsequent planning period, however, there will be a shortage of harvestable stands, totalling only 30.9 hectares across the 16.1, 4.8, and 10.0 hectare age classes. To reach the "normal" target of 149.7 hectares, theoretically, 117.8 hectares of non-mature stands would need to be harvested, resulting in a significantly reduced income for this second planning period.

One possible solution is to harvest only 75.2 hectares in the current planning period and reserve 70 hectares for the second period. Extending the rotation period in this way would require favourable health conditions for the stands.

Table 10: Normalization of the age class distribution with excessive areas of over-mature stands and lack of medium-age and mature stands

Year/ age class	Area (ha)										
	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	Total
2020	269.7	30.3	0.0	0.0	67.3	0.0	0.0	340.0			707.3
2025	141.5	269.7	30.3	0.0	0.0	67.3	0.0		198.5		707.3
2030	141.5	141.5	269.7	30.3	0.0	0.0	67.3			57.0	707.3
2035	141.5	141.5	141.5	269.7	13.1						707.3
2040	141.5	141.5	141.5	141.5	141.3						707.3

Table 10 provides another example of an unbalanced age class distribution (rotation period of 25 years, planning period of 5 years). In this case, the area of over-mature stands, at 340 hectares, is more than twice the "normal" area size of 141.5 hectares. To achieve a balanced age class distribution within a 25-year rotation period, the rotation period must be extended to 50 years. This approach requires that the physical condition (health) of the stands be sufficiently good to reach an age of 50 years without significant decay or other losses.

7.3 Summarised Planning

The results at the FMP level are essential for planning and decision-making at the management level. These results provide details on how much timber of each species should be logged and how many plants are needed for afforestation, reforestation, and enrichment across specific hectares. The planning relies on the Area Control Method, where the area harvested each year is the total area of the Forest Management Class divided by the rotation period. This method enables proper activity planning over the planning period and allows for accurate economic forecasting. Annual operational plans are subsequently developed based on this overall planning.

In many cases, forests have not been properly managed, often due to delayed harvesting, resulting in over-mature stands and an overrepresentation of older age classes. Achieving the correct age class distribution according to the Area Control Method may require more than one planning period in such situations (see Chapter 7.2).

Table 11 outlines the hectares of each species to be harvested, the type of cutting to be implemented, and the anticipated timber volume.

Table 11: Timber to be harvested by species

Species	**Total area (ha)**	**Clear cut**		**Coppice**		**Group tree selection**		**Single tree selection**		**Thinning**		**Sum harvests**	
		(m^3)	**(ha)**	**(m^3)**	**(ha)**	**(m^3)**	**(ha)**	**(m^3)**	**(ha)**	**(m^3)**	**(ha)**	**(m^3)**	**(ha)**
a													
b													
c													

Sums							

The FMP provides total volumes for the entire planning period (see Table 11) and average volumes per year (see Table 12). The specific, detailed annual harvest volumes are outlined in the Annual Operational Plans (AOP), which are prepared at the beginning of each year. The yearly yields specified in the AOPs should be summarised in a format similar to Table 12.

Table 12: Yearly planning and implementation of cuttings

Planned and implemented cuttings for each year of the planning perod	**Total**			**Harvest**			**Thinning**		
	(ha)	**(m³)**	**(%)**	**(ha)**	**(m³)**	**(%)**	**(ha)**	**(m³)**	**(%)**
Average planned									
Average unplanned*									
Average implemented									
Year 1 planned									
Year 1 unplanned*									
Implemented									
Year 2 planned									
Year 2 unplanned*									
Implemented									
Year 3 planned									
Year 3 unplanned*									
Implemented									
Year 4 planned									
Year 4 unplanned*									
Implemented									
Year 5 planned									
Year 5 unplanned*									
Implemented									
Total									
Planned									
Unplanned									
Implemented									

*Cuttings caused by catastrophes, diseases etc

This table's first row displays the average volume of timber to be harvested each year. At the end of the planning period, the actual harvested volume should be recorded. The "Unplanned" column captures the volume harvested in response to unforeseen events, such as storms, droughts, or pest infestations. Planned and unplanned harvests must be documented for each year in the rows below. It is essential that most harvests are planned; otherwise, unforeseen events will drive activities rather than the FMP.

Table 13 provides an example of a list of activities beyond harvesting. These activities depend on conditions within the planning areas and should be adapted as needed.

Table 13: Plantation and maintenance areas

Activity	Area (ha)	Percentage (%)
Planting (open areas)		
Replanting (after harvest)		
Enrichment planting**		
Coppice management		
Management of natural regeneration		
Weeding, care of planted areas		
Pre-thinning*		
Pruning		
Sanitary cutting		
Other activities		
Sums		

*Usually negative selection (removal of low-quality trees, no logs). Thinning (logs) is harvest.
**In stands which are not planned to be harvested in this planning period.

The following table specifies the types of regeneration, indicating the areas involved and, in the case of planting, the number of plants required per species. This table may need to be adapted to suit specific conditions in the planning area.

Table 14: Regeneration areas with the type of regeneration and the numbers of plants (by species)

Species	Planting un-stocked		Replanting		Enrichment		Coppice	Natural regeneration
	(ha)	(n)	(ha)	(n)	(ha)	(n)	(ha)	(ha)
a **b** **c** **d**								
Sums								

The sum of the three columns “Planting unstocked”, “Replanting”, and “Enrichment” gives the total number of plants that must be purchased or produced.

7.4 Planning for the Sub-Compartments

The sub-compartment-level planning provides totals for standing volumes per species or harvesting volumes. Additional criteria are essential to ensure that the total harvest volume aligns with sustainable forest management principles, ultimately supporting the determination of an Annual Allowable Cut (AAC). According to these criteria, the harvesting volume derived from sub-compartment assessments may need adjustment.

The Forest Management Plan sets the framework for the entire planning period, while detailed annual planning is carried out through Annual Operational Plans (AOPs). For example, in a plan involving 250 sub-compartments, 50 sub-compartments would need to be selected for treatment each year. Each sub-

compartment’s treatment requirements are specified, including human resources, equipment, preparatory work (such as road construction), volume to be harvested, and planting needs. The selection of sub-compartments is supported by GIS tools and the local knowledge of forest officers responsible for the areas concerned.

Table 15 provides a brief description of the sub-compartments along with planning details and columns for recording implementation. This table forms the basis for monitoring and should ideally be part of a digital forest management information system.

Table 15: Short description of the sub-compartments with planning and implementation

Sub-compartment	Area (ha)	Main species	Age	Silvicultural system	Treatment	Planning		Extension	Implemented				Remarks
						Volume (m^3)	Plants (n)		Date	Volume (m^3)	Plants (n)	Other treatment	
x	17,8	Eucalyptus glandulosa	38	High even-aged	Clear cut	3500			03/24	3300			
	17,8						45000		10/24		45000		30000 species a, 15000 species b
	17,8								10/25		8000		Gaps replanted with species a
y	9,7	Eucalyptus globulus	35	High even-aged	Thinning	500		yes	11/24	550			Final harvest not before the following planning period
Z	4,8	Cupressus lusitanica					8000		03/25		8000	Weeding	
Total	xxx*					xxx	xxx			xxx	xxx		

Table 96 shows the tree numbers, average diameter, and volume per diameter class (DBH class distribution) of a forest stands.

Table 16 Tree numbers, average diameter and volume per diameter class

Diameter class (cm)*		**6 - 9.9**	**10 - 14.9**	**15 - 19.9**	**20 - 24.9**	**25 - 29.9**	**30 - 34.9**	**35 - 39.9**	**40 - 44.9**	**45 - 49.9**	**>=50**	**Sum**	**%**
Speces a	Number of trees (n)											0.0	0.0
	Average diameter (cm)												
	Volume (m^3)											0.0	0.0
Species b	Number of trees (n)											0.0	0.0
	Average diameter (cm)												
	Volume (m^3)											0.0	0.0
Species c	Number of trees (n)											0.0	0.0
	Average diameter (cm)												
	Volume (m^3)											0.0	0.0
Sum	**Number of trees (n)**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	
	Volume (m^3)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	

*It is important to register the real diameters measured in the field (for example 17.8). With the software, the parameters can be classified as desired.

7.5 General Treatment Principles

In plantation forests, measures can be categorised by treatment age (see also Table 8). Since treatment is primarily determined by the average diameter of a sub-compartment, treatment ages can be classified as follows:

1. **Young**: Stands with an average diameter below 5 cm
2. **Middle-aged**: Stands with an average diameter from 5 to 17.9 cm
3. **Mature**: Stands with an average diameter of 18 cm and above

General treatment principles may differ between forests and species. The following chapters outline general guidelines for the three treatment ages. These guidelines are adapted by the planner, in cooperation with the management unit, to fit the specific conditions of the planning area.

7.5.1 Young Stands

The youngest stands within this treatment age category are recent plantations. They primarily require the following actions:

- **Protection from Cattle Grazing**
- **Removal of Competing Vegetation**
- **Management of Natural Regeneration**: In cases of natural regeneration, the spatial distribution of young trees may be uneven, resulting in overly dense areas. Tree groups developing in these dense spots may become unstable due to excessive competition, leading to smaller diameters and increased vulnerability to wind damage. This can prevent trees from reaching the desired diameters. It is crucial to thin out young trees in naturally regenerated areas to ensure a more even distribution.
- **Replanting Gaps**: Replant gaps within young plantations or naturally regenerated areas. In natural regeneration, this step can also serve to enrich the stand with desired tree species.
- **Singling of Coppices**
- **Pre-thinning**: This phase involves mainly negative selection, removing trees with undesirable traits, such as curved stems.
- **Pest and Disease Protection**

7.5.2 Middle Age

During this phase, treatments focus on enhancing stem quality and reducing tree density in a controlled manner. From the initial two to five thousand young plants per hectare in a plantation, only 400 to 500 high-quality trees should remain. Early intervention is crucial to achieving this goal. Key treatments during this phase include:

- **Pruning**: The objective of pruning is to produce node-free timber, with nodes confined to the core of the stem. After pruning, node-free wood grows around this core, yielding high-quality timber. Pruning should be carried out in young stands to allow sufficient

time for node-free wood growth. The crown must remain substantial, with a general rule of pruning the lower two-thirds of the tree while leaving one-third as the crown. Removing all branches and leaving only the terminal bud is a major error, as it eliminates the green material needed for photosynthesis, limiting growth. Pruning is usually unnecessary for species with good natural pruning capabilities, such as most *Eucalyptus* species, *Cordia alliadora,* and *Terminalia superba.* However, pruning is generally recommended for pines and *Cupressus lusitanica,* typically in two stages. Only the future trees, which will remain until the end of the rotation period, should be pruned, and care must be taken to avoid tearing the bark.

- **Thinning**: Thinning aims to concentrate growth on trees with the best vigour, quality, and growth potential. Between 350 and 700 future trees per hectare, evenly distributed, are selected and promoted throughout the stand's life. On high-quality sites, a higher number of future trees may be retained, while on poorer sites, 350 trees are adequate. Thinning removes poor-quality stems and the main competitors of the future trees.

7.5.3 Mature Stands

Mature stands should be harvested. At this stage, pruning is no longer necessary, as there is insufficient time to produce significant node-free wood. When there is an excess of mature or over-mature stands, it is advisable to prioritise harvesting open, lower-quality stands. If poor stand quality is due to unsuitable tree species, replanting should be carried out using appropriate species. Three types of regeneration are recommended (see Table 8):

- **Clear Cut**: Complete removal of trees, followed by replanting with 2,500 to 5,000 plants; natural regeneration should be incorporated wherever possible. This method is particularly suitable for open stands with poor growth and damaged or decaying trees.
- **Shelterwood Cut**: Removal of 80% of the trees, leaving the remaining trees evenly distributed; replanting with 2,000 to 4,000 plants; natural regeneration should be incorporated wherever possible. The remainder of the stand will be harvested in a subsequent phase.
- **Group Regeneration**: Removal of groups of trees to promote natural regeneration in newly created canopy gaps; 40% to 50% of trees should be removed. If natural regeneration is lacking, replanting in these gaps is required. The rest of the stand will be harvested in a second phase.

The harvest of high-quality, vigorous stands may be postponed, effectively extending the rotation period. If such stands are particularly dense, a final thinning can be performed, with the final harvest scheduled for the next planning period.

7.6 Economics

Economic calculations are not mandatory in Forest Management Plans; only rough estimates of costs and revenues are needed. Detailed financial planning is conducted through the Annual Operational Plans once decisions have been made on which sub-compartments will be treated in the given year. For example, plantation costs should be estimated based on actual costs of plantations in Ethiopia, while harvesting and maintenance costs should be roughly estimated using the enterprise's or institution's own historical data. The anticipated revenue from timber (both final cuts and thinnings) can be calculated using current market prices.

Net Present Value (NPV) calculations may also be included. This involves compiling and summarising yearly costs and revenues, with the totals for each year discounted back to the beginning of the planning period to determine the NPV. It is essential to note that NPV serves as a decision-support tool, but decisions should not rely solely on NPV outcomes.

7.7 Infrastructure Planning

As many forest enterprises, branches, or management units have limited accessibility, a comprehensive forest road network connected to the public road system may be required. Road construction priorities should align with the treatment priorities of sub-compartments, which may also dictate the need for skidding trails and timber storage areas. Road construction must be planned within the context of a comprehensive road network rather than implemented on an ad hoc basis. Additional infrastructure requirements, such as forest nurseries, firebreak strips, watch towers, or temporary equipment depots, should also be outlined in this section.

8 Risks

If assessment results indicate potential issues that could negatively impact the forests and related business activities, they should be detailed in this chapter. General risks, such as fire and pests, need only be addressed if the risk level in the planning area is unusually high. Likewise, it is unnecessary to mention the typical high initial costs and delayed returns, as these are inherent to forestry. Many plantations in Ethiopia are in a favourable position where investments were made 20 or 30 years ago, allowing returns to be realised imminently.

9 Conclusions and Recommendations

This chapter presents overarching conclusions drawn from the findings. These may include negative impacts caused by human activities (intentional or unintentional), past management failures, issues arising from inadequate agreements with local populations or lack of legal land ownership, institutional strengths and weaknesses, and limitations such as the absence of suitable software for data analysis. Some explanation should be provided to clarify why conditions are not “ideal.”

An overall description of the planning area’s status should be included, addressing aspects such as the socio-economic environment, stakeholder collaboration, and issues related to weaknesses in laws and regulations. Productivity levels and general stand quality should also be assessed. Additionally, it should be noted whether the forests are being managed sustainably.

Recommendations based on these conclusions should be presented in a sub-chapter, focusing on how the “less-than-ideal” situation can be improved and what current practices should be maintained.

General conclusions and recommendations that are copied and pasted from one plan to another are unnecessary.

10 Report and Maps

A Forest Management Plan has two components:

- A report
- Maps (digital)

10.1 Table of contents of the Report

The standard table of contents of the report is as follows:

0. Executive summary
1. General situation of the planning area
   - 1.1. Ownership and legal status
   - 1.2. Personnel, organisational structure
   - 1.3. Socio-economic information
   - 1.4. Geographical information
     - 1.4.1. Location
     - 1.4.2. Topography
     - 1.4.3. Geology
     - 1.4.4. Cadastral information
   - 1.5. Climate
   - 1.6. Forest types
   - 1.7. Infrastructure
   - 1.8. Problems
2. Guiding principles and objectives
3. The process
4. Methodology (only short; refer to guidelines, in detail only if deviating from the guidelines)
   - 4.1.Planning period
   - 4.2.Assessments
     - 4.2.1. Social assessments
     - 4.2.2. Forest demarcation
     - 4.2.3. Forest Management Classes
     - 4.2.4. Forest inventory
     - 4.2.5. Sub-compartments
       - 4.2.5.1. Assessments
       - 4.2.5.2. Treatment
     - 4.2.6. Data analyses
     - 4.2.7. Protected forests
   - 4.3. Organisational aspects
5. Results
   - 5.1.Socio-economic information
   - 5.2.Administrative division of the planning area
   - 5.3.Forest inventory results
   - 5.4.Results of stands
   - 5.5.Evaluation of the previous planning period
6. Planning
   - 6.1.Objectives
   - 6.2.Planning period and rotation periods

6.3. Summarised planning
6.4. Planning for the stands
6.5. General treatment principles
6.6. Economics
6.7. Infrastructure planning
7. Risks
8. Conclusions and recommendations
9. Report and maps
10. Monitoring and evaluation
11. References

Annexes

10.2 Maps

Maps are created using a Geographic Information System (GIS).

An overview map should display all forests within the forest management area. If the area is large with small, dispersed forests, a printout may not be practical; in such cases, having this map available in the GIS is sufficient. Maps should be standardised in terms of colours, scale, legend, etc., and should depict the forests with their sub-compartments and treatment ages. Treatment age is the most important information to display, as it indicates the required actions. The recommended scale is 1:10,000. Additional maps, such as species distribution maps, can also be prepared.

11 Monitoring and Evaluation

11.1 Summarising the table of results of the Forest Management Plan

The annex presents the summarised results of the FMP, serving as a primary basis for monitoring and evaluating the implementation of planned FMP activities.

11.1.1 Areas

This table displays the forest and non-forest areas within the planning area:

- **Forest Area**
    - **Stocked**: Plantation forests.
    - **Unstocked**: Areas without forest cover that are planned for reforestation. In the next FMP, these areas will be classified as stocked areas. These should not be confused with "open areas," such as agricultural land, buildings, water bodies, or rocky terrain, which are not part of the planning area.
- **Non-Forest Area**: Includes buildings, agricultural land, forest nurseries, rocks, water bodies, and similar features.

Typically, the planning area encompasses the "productive area"—748.6 hectares in this example. This area should serve as the basis for calculations and appear as the total area in the bottom row of all tables. It is advisable to assign unmanaged natural forests dedicated to conservation to a separate Forest Management Class. In the example provided, the total forest area is 887.8 hectares, comprising 748.6 hectares of production forest and 139.2 hectares of natural forest designated for conservation.

11.1.2 Area Per Age Class

The age class distribution is essential information for decision-makers. Chapter 7.2 highlights the significance of age distribution in future planning under the area control method. Area control implies that, with a rotation period of 25 years, 4% of the total area is harvested each year. This table is therefore key to planning.

It is important to emphasise that the Area Control Method is a foundational approach for managing even-aged plantation forests; however, it should not be the sole criterion. Other considerations, such as ensuring a continuous income flow, ecological factors, or preventing landslides, may also play an important role.

11.1.3 Tree Numbers, Diameters, and Volume Per Diameter Class

This table is valuable for understanding tree numbers and volumes across various diameter classes. In some areas, *Eucalyptus* with an average diameter of 6 cm is already used for construction and poles, so the number and volume of such trees can be reviewed.

11.1.4 Stocking

These values are critical for the entire planning area or Forest Management Class. Metrics such as trees per hectare, basal area, and volume per hectare indicate whether the area is dominated by mature stands with high volume and fewer trees or by young stands with lower diameters, higher tree densities, and lower volume. Different types of increment exist; under the given conditions, the Mean Annual Increment (MAI) is used. This increment calculation typically includes thinnings and any unplanned losses, such as illegal cuttings or losses from

natural events. MAI is derived by dividing the volume (plus thinnings and other unplanned losses) by the age. While this approach is somewhat simplified, it is currently the only feasible increment calculation method available.

11.1.5 Harvest by Method and Species

This table presents the areas occupied by different species and types of harvests with the associated volumes. Areas are calculated based on species composition. For example, an area of 10 hectares containing 70% *Eucalyptus*, 20% species B, and 10% species C is represented as 7 hectares of *Eucalyptus*, 2 hectares of species B, and 1 hectare of species C.

11.1.6 Areal Planning

This table outlines areas designated for different treatments, aiding in decision-making at the enterprise or institutional level. Required human and technical resources can then be allocated accordingly. The specific layout of this table may vary between planning areas.

11.1.7 Regeneration Type

This table shows the area (in hectares) designated for planting, natural regeneration, and coppice. For example, it provides insights into the area that requires planting or the expected effort for coppice regeneration, informing plans for plant production or coppice management.

11.1.8 Species to be Planted

This table details the number of plants needed for various planting types, facilitating the establishment or maintenance of forest nurseries with the appropriate capacities.

11.2 Sub-Compartment-Wise Planning

Table 15 is central to implementation monitoring, detailing the planned treatments and completed activities. The subsequent planner will consult this table and assess implementation in the field. Evaluation covers not only completion status (“done” or “not done”) but also examines whether the planning was well-executed and if treatments were successful or impacted by external factors, such as storms, pests, or cattle grazing.

11.3 Annual Operational Plans

The Forest Management Plan (FMP), in conjunction with Annual Operational Plans (AOPs), forms the basis for monitoring and evaluation. The FMP outlines activities to be completed during the planning period. For example, if the planning period is five years and there are 250 sub-compartments, 50 sub-compartments must be selected each year for treatment. This selection process leverages GIS tools and the knowledge of local forest officers. Based on these selections, the AOP is developed to specify annual activities in detail. A table similar to Table 15 records the implementation of these activities, providing a foundation for the next planner to review all sub-compartments, verify, and evaluate the previous plan’s implementation. This system inherently supports ongoing monitoring and evaluation.

12 References

Amhara Forest Enterprise. (2022). *AFE guideline: Sub-compartment delineation and inventory.* Bahir Dar: AFE-GIZ.

Böckmann, T. (2016). Why is two-phase sampling for stratification so important for forestry enterprises? *Forstarchiv 87*, p. 31 - 37.

Böckmann, T. et al. (kein Datum). *Die Weiterentwicklung der Betriebsinventur in Niedersachsen - A New Conception for Forest Inventory in Lower Saxonia -.* Wolfenbüttel: Niedersächsische Forstliche Versuchsanstalt.

Burkhart, H., Avery, T. and Bullock, B. (2018). *Forest Measurements, 6th edition.* Long Grove, Illinois: Waveland Press.

Dambala G. and Muchapondwa, E. (2015). *Decentralization, Market Integration, and Efficiency-Equity Trade Offs - Evidence from Joint Forest Management in Ethiopian Villages - DP 15.* Addis Abeba: Environment for Development.

de Vries, P. (1986). *Sampling Theory for Forest Inventory.* Berlin, Heidelberg, New York: Springer-Verlag.

DeYoung, J. (2016). *Forest Measurements. An Applied Approach.* Open Oregon Educational Resources.

FAO. (2012). *Manual for integrated field data collection - National Forest Monitoring and Assessmet. Working Paper NFMA 37/E.* Rome: FAO.

FAO. (2017). *Voluntary Guidelines on National Forest Monitoring.* Rome: FAO.

FAO. (2023). *Field Manual for the National Forest Inventory of Ethiopia.* Rome: FAO.

Federal Democratic Republic of Ehtiopia. (2008). *A Proclamation to Provide for the Establishment of the Ethiopian Wildlife Development and Conservation Authority. Proclamation No. 575.* Addis Ababa.

Federal Democratic Republic of Ethiopia. (1997). *Environmental Policy of Ethiopia.* Addis Ababa.

Federal Democratic Republic of Ethiopia. (2002). *Environmental Impact Assessment. Proclamation No. 299.* Addis Ababa.

Federal Democratic Republic of Ethiopia. (2005). *Expropriation of Landholdings for Public Purposes and Payment of Compensation. Proclamation No. 455.* Addis Ababa.

Federal Democratic Republic of Ethiopia. (2005). *Land administration and land use. Proclamation No. 456.* Addis Ababa.

Federal Democratic Republic of Ethiopia. (2006). *Access to Genetic Resources and Community Knowledge, and Community Rights. Proclamation No. 482.* Addis Ababa.

Federal Democratic Republic of Ethiopia. (2007). *Development Conservation and Utilization of Wildlife. Proclamation No. 541.* Addis Ababa.

Federal Democratic Republic of Ethiopia. (2007). *Forest Development, Conservation and Utilization Policy and Strategy.* Addis Abeba.

Federal Democratic Republic of Ethiopia. (2008). *Wildlife Development, Conservation and Utilization. Proclamation No. 163.* Addis Ababa.

Federal Democratic Republic of Ethiopia. (2009). *Council of Ministers Regulation to Provide Access to Genetic Resources and Community Knowledge, and Community Rights. Regulation No. 169.* Addis Ababa.

Federal Democratic Republic of Ethiopia. (2011). *Wildlife Strategy and Policy.* Addis Ababa.

Federal Democratic Republic of Ethiopia. (2018). *Forest Development, Conservation and Utilization. Proclamation No. 1065. .*

Federal Democratic Republic of Ethiopia. (2020). *Investment Proclamation No. 1180.* Addis Ababa.

Forest Development Authority. (-). *Community Forest Management Planning - Inventory Manual.* Liberia: Forest Development Authority.

Forestry Commission. (2014). *Design techniques for forest management planning.* Edinburgh: Forestry Commission.

GIZ/CliPAD-TC. (2016). *Village Forest Management Planning Guideline.* Vientiane: GIZ.

International Tropical Timber Organisation. (2016). *Criteria and indicators for the sustainable management of tropical forests. ITTO Policy Development Series No. 21.* Yokohama, Japan.: ITTO.

Irwin, B. (2007). *The Key Steps in Establishing Participatory Forest Management - A field manual to guide practitioners in Ethiopa - Best Practices Series No. 1.* Addis Ababa: FARM-Africa/SOS Sahel Ethiopia, Oromiya Bureau of Agriculture and Rural Development, Southern Nations and Nationalities Peoples' Region, Bureau of Agriculture and Rural Development.

Kangas, A. and Maltamo, M. (2009). *Forest Inventory: Methodology and Applications (Managing Forest Ecosystems, Vol. 10.* Doordrecht: Springer.

Kershaw, J., Ducey, M., Beers, T. and Husch, B. (2016). *Forest Mensuration (5th Edition).* Hoboken, New Jersey: Wiley Blackwell.

Landesbetrieb Forst Brandenburg. (2011). *Betriebliche Anweisung zur Forsteinrichtung des Landeswaldes im Land Brandenburg. Betriebliche Anweisung 13/2011, Fassung: BA FE Bbg. 2023-04-15.* Potsdam.

Leuschner, W. (1990). *Forest Regulation, Harvest Scheduling, and Planning Techniques.* New York: John Wiley and sons.

Messay Sintayehu and Tsegaye Taddesse (eds.). (2012). *Guideline for Participatory Forestry in Ethiopia.* Addis Abeba: Ministry of Agriculture.

Ministry of Agriculture. (2021). *Second Level Land Certification (SLLC) for Rural Lands of Ethiopia: Processes, Experiences and Lessons - Final Report.* Addis Ababa: Ministry of Agriculture.

Ministry of Environment, Forest and Climate Change. (2017). *National Forest Sector Development Program, Ethiopia - Volumes 1 to 3.* Addis Abeba: Ministry of Environment, Forest and Climate Change.

Oberholzer. (2019). *Handbook for Silviculture in Ethiopia.* Addis Ababa: GIZ.

Said, Ahmid and O'Hara, P. (2010). *Participatory Forest Management Guidelines.* South West Ethiopia, Mizan Teferi and Addis Ababa, Ethiopia: Non Timber Forest Project – Participatory Forest Management - Research and Development Project.

van Laar, A. and Akca, A. (2007). *Forest Mensuration (Managing Forest Ecosystems #13).* New York: Springer.

West, P. (2015). *Tree and Forest Management. 3rd edition.* Switzerland: Springer International Publishing.

Winberg, E. (2011). *Participatory Forest Management in Ethiopia - Practices and Experiences.* Addis Abeba: FAO, Subregional Office for Eastern Africa.

Zerihun Asrat and Yerimu Tesfaye, (Eds.). (2013). *Training manual on: Forest inventory and management in the context of SFM and REDD+.* Wondo Genet: Hawassa University. 67 p.

Ziyenu Lemma, Dawit Biru, Ahmid Said, O'Hara, P. et al. (2015). *Participatory Forest Management Guidelines. , Mizan Teferi.* Mizan Teferi, Ethiopia and Huddersfield, UK: Wild Coffee Conservation by PFM Project, South West Ethiopia.

Annexes

Results of assessment and planning

Enterprise	
Branch	
Forest	

Date	1/1/2022

1. Areas

Stocked	712.2
Un-stocked	36.4
Productive area**	**748.6**
Natural forest*	139.2
Forest area	**887.8**
Other areas	9.0
Non-forest area	**148.2**
Total area	**896.8**

FMC	**Area (ha)**
Production	748.6
Natural forest	139.2
Total	**887.8**

* In this example it is assumed that there is no harvesting in the natural forests => Conservation (non-productive) If there is harvesting in the natural forests it should be classified as productive area and it should be classified as an own Forest Management Class

**This is the planning area of the plantations. In all the table and statistics, the total area must 748,6 ha.

2. Area per age class*

	Area (ha)												
Age class	**0**	**1 - 5**	**6 - 10**	**11 - 15**	**16 - 20**	**21 - 25**	**26 - 30**	**31 - 35**	**36 - 40**	**41-45**	**45-50**	**Sum**	**%**
Species a												331.9	44.3
Species b												130.3	17.4
Species c												250.0	33.4
Open (unstocked)	36.4											36.4	4.9
Sum	36.4	303.8	261.4	2.8	10.0	4.8	20.6	0.0	0.0	0.0	145.2	748.6	100.0
Target area		149.7	149.7	149.7	149.7	149.7	0.0	0.0	0.0	0.0	0.0	748.5	
Deviation		154.1	111.7	-146.9	-139.7	-144.9	20.6	0.0	0.0	0.0	145.2	0.1	

*Rotation period: 25 yrs, overhang of 154,1 ha aged 1 to 10 years and of 145,2 ha aged 45 - 50 years. Explanations in chapter 7.2.2 of the guidelines.

4. Stocking (productive forest)

	Number of trees	**Basal area**	**Volume per ha**	**Mean annual increment**	**Volume total**
	(n/ha)	**(m^2/ha)**	**(m^3/ha)**	**(m^3/yr/ha)**	**(m^3)**
Species a					
Species b					
Species c					
				Sum	

5. Harvest by method and species

Species	**Total area**	**Clear cut**	**Coppice**	**Group tree selection**	**Single tree selection**	**Thinning**	**Sum harvests**

	(ha)	(m^3)	(ha)	(m^3)	(ha)	(m^3)	(ha)	(m^3)	(ha)	(m^3)	(ha)	(m^3)	(ha)
Species a													
Species b													
Species c													

6. Areal planning

Treatment*	**Area (ha)**
Planting un-stocked areas and open areas after harvesting	
Enrichment planting	
Weeding and other maintenance of regeneration areas	
Pruning	
Pre-thinning	
Thinning	
Harvest	
Coppice maintenance	
Sum	

Glossary of terms

Other data

Maps