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Review of the context, framework and progress

Melaku Bekele
Solomon Zewdie
Manuel Boissière
Stibniati Atmadja

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Melaku Bekele
Wondo Genet College of Forestry and Natural Resources (WGCFNRs)

Solomon Zewdie
National REDD+ Secretariat, Environment, Forest and Climate Change Commission

Manuel Boissière
CIFOR
CIRAD

Stibniati Atmadja
CIFOR

Center for International Forestry Research (CIFOR)

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Photo by Mesfin Tsegaye
Ethiopia's National Forest Inventory (NFI) team collecting field data.

CIFOR
Jl. CIFOR, Situ Gede
Bogor Barat 16115
Indonesia

T +62 (251) 8622-622
F +62 (251) 8622-100
E cifor@cgiar.org

cifor.org

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Abbreviations

AD	Activity Data
AFOLU	Agriculture, Forestry and Other Land Use
BSM	Benefit-Sharing Mechanism
CDM	Clean Development Mechanism
CRGE	Climate Resilient Green Economy
EF	Emission Factor
EFCCC	Environment, Forest and Climate Change Commission
EMA	Ethiopian Mapping Agency
ESMF	Environment and Social Management Framework
EWNRA	Ethio Wetlands and Natural Resources Association
FAO	Food and Agriculture Organization of the United Nations
FCPF	Forest Carbon Partnership Facility
FDRE	Federal Democratic Republic of Ethiopia
FPIC	Free Prior and Informed Consent
FRL	Forest Reference Level
GFOI	Global Forest Observatory Initiative
GHG	Greenhouse Gas
GIS	Geographic Information System
GTP	Growth and Transformation Plan
GRM	Grievance Redress Mechanism
(I)NDC	(Intended) Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
LULC	Land Use Land Cover
MEFCC	Ministry of Environment, Forest and Climate Change
$MtCO_2e$	Million tonnes of Carbon-dioxide equivalent
MRV	Measurement, Reporting and Verification
NFI	National Forest Inventory
NFM(S)	National Forest Monitoring (System)
NGO	Non-governmental Organization
PF	Process Framework
PFM	Participatory Forest Management
PMRV	Participatory MRV
RBP	Results-based Payment
REDD+	Reducing Emissions from Deforestation and forest Degradation (REDD) and conservation of forests, Sustainable Forest Management and Enhancement (REDD+)
RPF	Resettlement Policy Framework
R-PP	Readiness Preparation Proposal
RRCU	Regional REDD+ Coordination Unit
RS	Remote Sensing
SDI	Spatial Data Infrastructure
SESA	Strategic Environmental and Social Assessment
SIS	Safeguard Information System
SLMS	Satellite Land Monitoring System
SNNPR	Southern Nations Nationalities and Peoples' Regional States
UNFCCC	United Nations Framework Convention on Climate Change (UNFCCC)
UN-REDD	United Nations REDD+ Programme
WGCF-NR	Wondo Genet College of Forestry and Natural Resources (University of Hawassa)

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Executive summary

Ethiopia's REDD+ program is embedded in the country's climate resilient green economy (CRGE) strategy and aims at contributing to the emission reduction goals of the forestry sector. To this end, Ethiopia has been implementing REDD+ readiness activities since October 2012. Between 2012 and 2018, the country has made significant progress in developing the four key 'design' elements required for the national REDD+ implementation, as noted in the Cancun Agreement (Decision 1/CP.16). These are the National REDD+ Strategy; National Forest Monitoring System for the Measurement, Reporting and Verification (MRV) of REDD+; Forest Reference Emission Level or Forest Reference Level; and Safeguard Information System.

An MRV system is a prerequisite for REDD+ implementation and a basis for results-based payments (RBPs)/results-based finance (RBF) for REDD+ participant countries. The Intergovernmental Panel on Climate Change (IPCC) provides technical guidelines and procedures for MRV that REDD+ participant countries are required to follow. These include guidance for setting the national emission baseline, the scope of intervention or types of greenhouse gases (GHGs) being measured and the procedure for the MRV of emission reductions. The Warsaw Framework for REDD+ (Decision 11/CP.19) provides a set of guidance on the establishment of national MRV systems. According to this guidance, national MRV systems should be designed to incorporate a set of general and specific functions, be consistent with IPCC guidelines, and be transparent and consistent with the established national Forest Reference Level (FRL) as submitted to the United Nations Framework Convention on Climate Change (UNFCCC).

This paper reviews the development of Ethiopia's REDD+ MRV system, the architecture and policies of its national MRV system, progress to date and plans. It also analyzes the challenges and opportunities to improve operationalization of the MRV system. The paper is based on published and unpublished literature on Ethiopia's REDD+ program, combined with in-depth interviews and consultations with key MRV stakeholders (in the form of a workshop) from governmental, non-governmental and international organizations in Ethiopia. It is not a technical review of the current MRV system.

This document is organized into an introduction section followed by three sections with the following topics related to the REDD+ MRV system:

1. **Context:** summarizes the historical context of forest monitoring in the country, forest definitions, the functions of REDD+ MRV and National Forest Monitoring systems, and the spatial data collection used for REDD+ (e.g. forest/non-forest classification, forest cover change, carbon stock assessment and reference levels).
2. **Framework**: describes the institutional arrangements of REDD+ MRV, financial resources and spatial data infrastructures needed, and social aspects of REDD+ MRV (e.g. social safeguards, benefit sharing and local communities' participation).
3. **Progress**: summarizes the current and planned implementation of REDD+ MRV in the country, and identifies challenges and opportunities.

Ethiopia's REDD+ MRV system is an integral part of the National Forest Monitoring System (NFMS). The development of the NFM/MRV system was based on a roadmap that identified actions needed in designing a sustainable MRV system. The national FRL is based on an historical average (2000–2013), taking into account deforestation and afforestation/reforestation (A/R). Remote sensing was used to determine historical forest-area change (i.e. activity data [AD]). Deforestation and afforestation are assessed as average annual

forest loss and average forest gain in hectares in 2000–2013. The carbon stock/potential emission (i.e. emission factor [EF]) of the different forest types was based on a National Forest Inventory (NFI) following a forest definition. This definition includes trees with a potential to grow more than 5 m high, with a canopy cover of 10% and a minimum area of 0.5 ha. In determining the carbon density in forest types, Ethiopia's forest vegetation was stratified into four forest biomes (*Combretum–Terminalia*, *Acacia–Commiphora*, Dry Afromontane and Moist Afromontane). Biomass carbon stocks were determined for three carbon pools: above ground, below ground and dead wood. Ethiopia used IPCC's Tier 2 methodology for AD and EF determination, where country-specific remote sensing and EFs were used. The AD will be revised every two years, while the EFs will be revised at least every five years.

Ethiopia's MRV implementation is based on a decentralized institutional framework, where roles and responsibilities are distributed among national (federal), sub-national (regional) and local levels. Different actors were engaged in the development of the MRV system, including academic, research, civil society organizations and line ministries. The Food and Agriculture Organization of the United Nations (FAO) undertook short-term training to build technical capacity of the Ministry of Environment, Forest and Climate Change (MEFCC, which became the Environment, Forest and Climate Change Commission or EFCCC in October 2018), academic institutions, other relevant line ministries and regional entities. Hawassa University's Wondo Genet College of Forestry and Natural Resources developed MSc programs for MRV in agriculture, forestry and energy. With the technical support from FAO, Ethiopia equipped and staffed an MRV unit within MEFCC's Forest Inventory and Resource Demarcation Directorate at the national level, with additional MRV units being established in four regional states.

Overall, Ethiopia has made significant progress in establishing an NFM/MRV system. Among the milestones achieved are the acceptance of Ethiopia's FRL by the UNFCCC and the completion of the NFI. Various reporting streams should be consistent and linked with each other to ensure the credibility of MRV results. We found that the methodological approach and data used in the GHG inventory were inconsistent with that of the FRL. Ethiopia has yet to link REDD+ MRV with other GHG measuring systems. The country also needs to address the high turnover of trained experts and continued demand for additional capacity. There are plans to seek better linkages between the national MRV and the national GHG focal points, and efforts are underway to develop the administrative capacity for REDD+. Developing web-based systems is one way to improve transparency and linkages. An MRV web portal, still under construction, can improve data transparency. A framework for a safeguards information system drafted in 2018 also includes a web platform. The level of engagement of key actors – particularly local communities – in MRV remains a challenge. Improving the participation of local communities and civil society in MRV is paramount in ensuring sustainability and accountability.

1 Introduction

1.1 Background

There has been a global effort by nations to respond to climate change challenges through the United Nations Framework Convention on Climate Change (UNFCCC). These efforts have led to multilateral negotiations and adoption of a blend of policies and measures to avoid the dangerous interference of anthropogenic activities in the climate system (UNFCCC 1992; IPCC 2014). The policies and measures are principally aimed at improving resilience and reducing risks of climate change impacts. They did this through adaptations and limiting the extent of climate change by controlling sources and enhancing removals of greenhouse gases (GHGs) through a range of mitigation actions (Page 2016).

The global climate change discourse in recent years has emphasized increased commitment and contribution of individual countries. Accordingly, countries are required to submit their national contribution regarding climate change mitigation and adaptation activities referred to as Intended Nationally Determined Contributions (INDCs). Ethiopia's INDC (later converted into NDC) was submitted in May 2015, containing mitigation actions and goals based on the national strategy to achieve a climate-resilient green economy (CRGE) (FDRE 2015).

The modalities of monitoring, reporting and verification (MRV) of NDCs were established at UNFCCC's 19th Conference of the Parties in Warsaw in November 2013. Under the Paris Agreement, countries are required to track mitigation actions and implementation progress, including changes in GHG emissions and policies leading to sustainable development impacts (Singh et al. 2016). As signatory to the Paris Agreement, Ethiopia is expected to follow the transparency framework for MRV of its NDC. However, the implementation of Ethiopia's NDC is conditional on the availability of financial support from international and multilateral entities (FDRE 2015).

Among mitigation actions globally negotiated and recommended, reducing emissions from deforestation and forest degradation, sustainable forest management, conservation of forests and enhancement of forest carbon stocks in developing countries (REDD+) has taken the UNFCC's center stage over the last decade (Brockhaus et al. 2017). The REDD+ approach is considered to make a significant contribution for global mitigation as it engages developing countries where most of the tropical forest resources are found and where land-use change activities result in GHG emissions. REDD+ is both a policy approach and an incentive mechanism whereby developing countries will implement policies and measures to reduce deforestation and forest degradation (in their jurisdiction). In turn, these countries receive financial incentives based on verified results of emissions reduction. With the emphasis on verifying emissions reduction, REDD+ has spurred the need for countries to build national MRV systems for forests.

This paper reviews the development of Ethiopia's REDD+ MRV system, the architecture and policies of its national MRV system, progress to date and plans. It also analyzes the challenges and opportunities to improve operationalization of the MRV system. The paper is based on published and unpublished literature on Ethiopia's REDD+ program, combined with in-depth interviews and consultations with key MRV stakeholders (in the form of a workshop) from governmental, non-governmental and international organizations in Ethiopia. It is not a technical review of the current MRV system.

Since 2012, national REDD+ readiness activities have been initiated in Ethiopia with the financial support of the Forest Carbon Partnership Facility (FCPF), the governments of Norway and of the United Kingdom. The World Bank (through FCPF), as the financial trustee, technically supported the readiness activities. The implementation of Ethiopia's REDD+ programs follows a phased approach where,

like most REDD+ countries, Ethiopia implements its program through three interrelated phases: (i) readiness; (ii) implementation; and (iii) results-based payments (RBPs). This phased approach provides flexibility based on national capacities. Apart from the phased approach, the UNFCCC negotiations provided guidance related to the MRV on the performance of national REDD+ interventions. The establishment of national MRV systems is one of the four prerequisites for moving into the third RBP phase of REDD+.

The establishment of national arrangements, also sometimes referred to as 'national systems', should ensure a transparent, comparable, coherent, complete and accurate reporting of GHG emissions and removals from REDD+ activities (Hewson et al. 2013). Accordingly, REDD+ participant countries such as Ethiopia, along with subnational entities, are required to follow a set of technical guidelines (e.g. IPCC guidelines) and procedures in setting the emission baseline, the scope of the intervention and the type of GHGs being measured, and the procedure of monitoring and reporting the results. The establishment of a national MRV system is a significant milestone in the readiness phase. In general, national arrangements for REDD+ MRV should include all institutional, legal, financial and procedural arrangements. This will allow anthropogenic emissions sources and sinks, in all categories and activities included in the monitoring plan, to be estimated, reported and archived (Hewson et al. 2013).

This paper starts with an introduction to Ethiopia's CRGE strategy, the roles of forests and REDD+ in this strategy, and the methods and tools used to develop this paper. This introduction is followed by three sections: (i) on the MRV system's contexts in terms of history, functions, components and data; (ii) the system's institutional, financial, social and human framework; and (iii) the system's progress. The paper concludes with an overall review of the national MRV system and key issues to be addressed.

1.2 Ethiopia's Climate Resilient Green Economy (CRGE) strategy

The Government of Ethiopia launched the Growth and Transformation Plan (GTP) aimed at increasing agricultural productivity, strengthening the industrial base and fostering export growth. In so doing, the GTP aims to triple gross domestic product per capita and achieve middle-income status for the country by 2025 (FDRE 2010). Ethiopia seeks to achieve this while developing a green economy. It wants to avoid a significant increase in GHG emissions and natural resource degradation through a shift from the conventional development path to a green path (FDRE 2010).

The CRGE strategy complements the GTP as it provides an ambitious cross-sectoral plan for achieving the transition without increasing current levels of GHG emissions (FDRE 2011a). CRGE includes actions to reduce GHG emissions while safeguarding economic growth ("green economy") and adaptation initiatives to reduce vulnerability to climate change ("climate resilience"). It includes strategies for the following sectors: agriculture; forestry; power; and transport, industry and buildings.

REDD+ is identified as one of the four initiatives[1] for fast-track implementation to achieve the CRGE objectives (FDRE 2011a). The CRGE document further assessed the institutional setup and the personnel capacity; and the need for developing the enabling environment (policies, legal frameworks and institutions) for implementation of the CRGE initiative. These enablers include developing an MRV system to provide credible GHG abatement and support a benefit-sharing mechanism (BSM).[2]

1.3 Forestry in the CRGE strategy

Ethiopia contributes little to the global increase in GHG emissions that have taken place since the Industrial Revolution. Its total annual emissions were estimated at 150 million tonnes of carbon-dioxide equivalent ($MtCO_2e$) and represent less than 0.3% of global emissions (FDRE 2011a). The forestry sector accounts for 37% of national GHG emissions; it is ranked second only to the agricultural sector, which contributes to half of all emissions. This makes forestry a crucial

1 The green economy plan is based on four pillars: improving crop and livestock production ... while reducing emissions; protecting and re-establishing forests for their economic and ecosystem services, including as carbon stocks; expanding renewable sources of energy; and leaping to modern and energy-efficient technologies in transport, industrial sectors and buildings (FDRE 2011a).

2 A benefit-sharing mechanism defines the benefits and the modality for benefit sharing from potential financial incentives from GHG abatement.

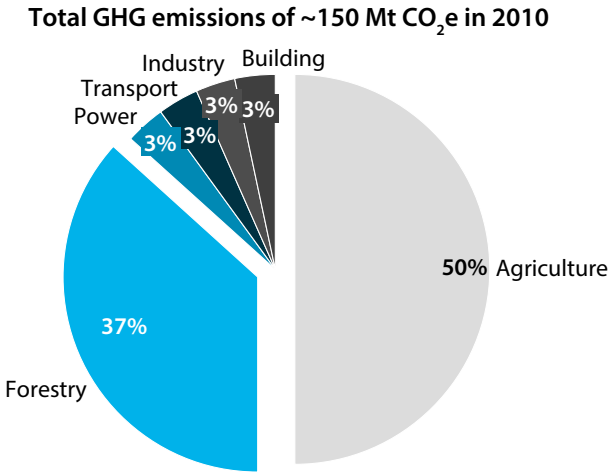

Figure 1. Share of GHG emissions of different economic sectors in Ethiopia.

Source: FDRE 2011a.

element in emission reductions. Also, the power, transport, industry and building sectors each account for 3% of national GHG emissions (FRDE 2011a) (Figure 1).

Under the business-as-usual scenario, the forestry sector will remain the second largest contributor to land-based emissions, due to forest loss from other sectors such as agriculture, livestock and energy. Agricultural land expansion is estimated to result in the deforestation of nearly 9 million ha of forest (FDRE 2011a). Under the same scenario, a significant rise in annual fuelwood consumption will lead to forest degradation. Meanwhile, a projected increase in the cattle population will put additional pressure on forests as demand for grazing land increases (FDRE 2011a).

The goal is thus to curb these impacts so that by 2030 Ethiopia will have a net zero emission compared to the reference year 2010. In making this happen, appropriate mitigation measures in the forestry sector will need a total GHG emission abatement potential of 130 $MtCO_2e$. This would represent more than half of the total GHG emission abatement plan (250 $MtCO_2e$) until 2030. To this end, the forestry Sector Technical Committee of the CRGE recommended the prioritization of three forestry abatement levers: scaling up efficient cookstoves, afforestation/reforestation and sustainable forest management. On top of these interventions, Ethiopia pledged at the 2014 UN Climate Summit in New York to restore 15 million ha of land through area exclosures (Kassa et al. 2017). A portion of the restoration target is achieved through implementation of actions outlined in the REDD+ strategy. Other initiatives (e.g. Sustainable Land Management Program) contribute toward achieving the remaining restoration targets.

1.4 The REDD+ program in Ethiopia

Ethiopia's REDD+ program was initiated to address the drivers of deforestation and forest degradation. It also aimed to create a mechanism to monetize the abatement potential to attract climate finance through the REDD+ framework. Hence, REDD+ is expected to provide an opportunity for generating sustainable financial incentives to support sustainable forest management, conservation and restoration, which in turn enhance environmental, social and economic benefits (MEFCC 2015a).

Ethiopia's REDD+ program and the evolution of REDD+ MRV have gone through several milestones (Table 1). A major REDD+ MRV-related event was the development of a "Terms of Reference for Developing Capacities for a national MRV System to support REDD+ participation of Ethiopia" in June 2013 (FDRE 2013). It provided a roadmap for the development of a national REDD+ MRV system. Following an agreement between the Food and Agriculture Organization of the United Nations (FAO) and Ethiopia, the National Forest Inventory (NFI) was launched in March 2014. Information from the NFI is used in generating key MRV-related data such as emission factors (EFs), while remote sensing (RS) data are used to generate activity data (AD).

The Ministry of Environment, Forest and Climate Change (MEFCC)[3] approved a new forest definition in February 2015 and communicated it to the UNFCCC in January 2016 (Section 3.1 on Ethiopia's forest definitions). According to the new definition, a forest is "Land spanning at least 0.5 ha covered by trees (including bamboo) attaining a height of at least 2 m and a canopy cover of at least 20% or trees with the potential to reach these thresholds in situ in due course." (FDRE 2016, 1). Another important REDD+

3 MEFCC became the Environment, Forest and Climate Change Commission (EFCCC) in October 2018. MEFCC is used throughout the document since this document covers events prior to this change.

MRV milestone was the first submission of national Forest Reference Levels (FRLs) to the UNFCCC in January 2016. Ethiopia received feedback from the UNFCCC's technical assessment team, which was addressed by MEFCC; the UNFCCC eventually approved the resubmitted document. Soon after, a federal MRV unit was established at MEFCC as the responsible unit for forest monitoring and sustainable forest management. In June 2017, MEFCC developed an institutional framework for REDD+ MRV implementation, which defines the roles/responsibilities, current capacities and future needs of the different government organizations at federal, subnational and local levels.

1.5 Methods and tools

This document combines literature review with input from workshop participants. The literature review comprises published and unpublished materials on Ethiopia's REDD+ program between 2010 and mid-2018, including national policy, program and project documents, and other relevant REDD+ literature. Documents were collected online using Google search and using the following keywords: "Ethiopia REDD+", "MRV", "National Forest Inventory", and "R-PP". Other documents collected from government organizations at the federal level include:

- national MRV capacity building toward climate-resilient development in Ethiopia, Project Document (WGCF-NR 2013)
- study of causes of deforestation and forest degradation in Ethiopia (MEFCC 2015a)
- analysis of the legal and institutional arrangement for REDD+ implementation (MEFCC 2015b)
- curriculum in renewable energy utilization and management (WGCF-NR 2016a)
- curriculum in forest resources assessment and monitoring (WGCF-NR 2016b)
- curriculum in climate-smart agriculture (WGCF-NR 2016c)
- draft national REDD+ strategy (FDRE 2017a)
- REDD+ Investment Plan (FDRE 2017b).

Table 1. Milestones in Ethiopia's REDD+ program development.

Year	REDD+ Milestones
2008	June: Letter of intent and REDD+ Readiness Plan Program Idea Note (R-PIN) submitted to FCPF
2010	April: Start of Ethiopia's Readiness Preparation Proposal (R-PP) development led by the Federal Environmental Protection Agency, which is the precursor of the MEFCC
2011	May: The R-PP submitted to the FCPF participant committee is approved; Ethiopia becomes a REDD+ participant country of the FCPF
2012	October: FCPF approves a readiness preparation grant of USD 3.4 million for implementation of Ethiopia's R-PP; the Government of Norway and the United Kingdom's Department for International Development provide an additional USD 10 million.
2013	January: REDD+ readiness process officially launched; REDD+ Secretariat, first established in the Ministry of Agriculture, and later moved to the then Ministry of Environment and Forest becomes the prime unit for the coordination and implementation of the national REDD+ readiness process
2013	June: "Terms of Reference for Developing Capacities for a national MRV System to support REDD+ participation of Ethiopia" developed by the Ministry of Agriculture, Federal Environmental Protection Agency, with support from the Norwegian Embassy and Wageningen University
2014	March: NFI launched
2015	February: Ethiopia adopts new forest definition
2016	January: Ethiopia's Forest definition communicated to UNFCCC January: Ethiopia submits national FRL to UNFCCC (1st communication) August: Ethiopia submits national FRL to UNFCCC (2nd communication) February: an MRV unit is institutionalized at MEFCC that includes the functions of Forest Monitoring and Sustainable Forest Management
2017	June: "Ethiopia's Institutional Framework for the MRV under the REDD+ Program" developed

REDD+ MRV actors from governmental, non-governmental organizations (NGOs) and international organizations such as FAO and the World Bank provided feedback on MRV performances, challenges and opportunities in the country at a consultative workshop. Their input was used to complement and triangulate information extracted through literature review. Workshop participants worked in three groups of six to eight people each. Organizers preselected the composition of each group to ensure varied viewpoints. To that end, each group included representatives of the different types of organizations (e.g. government, NGOs and academia). A workshop report was also produced and used in this analysis (Boissière et al. 2017a).

Authors of this document facilitated each group and elicited participants' views on one of the following discussion points/questions:

1. **MRV institutions**: How effective is Ethiopia's technical and institutional capacity for implementing MRV for REDD+? What are the challenges and ideas to overcome them?
2. **MRV technical implementation**: How have data been collected thus far? How have data been integrated from local to federal levels? What are the challenges and ideas to overcome them?
3. **MRV sustainability:** How have benefit sharing, social safeguards and local participation been addressed within the current MRV system? How can they be improved?

2 REDD+ MRV system context

2.1 Historical context

In discussing the historical context of the MRV system in Ethiopia, we use three time periods: (i) the pre-REDD+ period, which spans between the 1970s until Ethiopia started preparing the R-PP in 2010 for becoming a REDD+ country participant of the FCPF; (ii) the post-REDD+ period when Ethiopia started actively engaging in REDD+ international processes until the start of a partnership with FAO in 2014 to develop capacity for building and implementing a REDD+ MRV system; and (iii) the current phase (2015 until 2018). This section focuses on the pre (the 1970s–2010) and post (2011–2014) REDD+ phases.

2.1.1 Pre-REDD+ (1970s–2010)

In the 1970s, the problem of deforestation and land degradation in Ethiopia began receiving serious attention and a national action was initiated (Hurni 1988). The national concern was and still is mainly due to the recurrent drought and subsequent famine that resulted in the loss of millions of lives in Ethiopia. Until now, the government's efforts to improve natural resource management and agricultural production encompass creating an enabling policy environment and interventions. Results, however, have been far from satisfactory (Yemiru 2011). In the last decade, a policy environment was created to promote reforestation and afforestation as a way of tackling land degradation. The Plan for Accelerated and Sustainable Development to End Poverty 2005/2006–2009/2010 encouraged forest restoration with a target of raising Ethiopia's forest cover from 3.56% to 9% (FDRE 2006).

In subsequent years, the issuance of the 2007 Forest Management, Development and Utilization Policy further created an incentive framework that encouraged tree planting by farmers. This resulted in an increase in farm forestry and plantation forestry practices (FDRE 2011b). These positive changes were strengthened by the introduction of Participatory Forest Management (PFM) in the mid-1990s by non-governmental actors, the resulting reforms in the legal framework promoting PFM and stronger local community involvement. Policy instruments such as the Environmental Policy of Ethiopia (FDRE 1997), and the Forest Development, Conservation and Utilization Proclamation (FDRE 2007) underlined the engagement of local communities and other actors in forest management and their rights in getting benefits from it. The 2007 Federal Forest Proclamation (FDRE 2007) has provisions on the demarcation and registration of forestlands, including privately owned ones. However, little has been done in gazetting the forest reserves and much of the national parks (Bekele 2003).

Despite these positive changes to improve performance of the forestry sector, some loopholes remain. Significant challenges in this respect include weak law enforcement, lack of directives and regulations for effective implementation of the 2007 forest law and institutional gaps (Bekele et al. 2015).

2.1.2 Post-REDD+ (2010–2014)

The GTP and CRGE framed the policy environment within which Ethiopia's REDD+ program evolved. One important action by the government in support of the CRGE strategy and the coming of REDD+ was the establishment of a forestry institution in July 2013, i.e. the Ministry of Environment and Forest. Following its establishment, the new ministry revised the 2007 Forest Proclamation to address global and national issues related to climate change and REDD+, resulting in the 2018 Forest Proclamation (FDRE 2018).

As part of the REDD+ readiness activities, two technical studies were conducted in the last four years. One identified drivers of deforestation and

forest degradation (MEFCC 2016), and the other analyzed the legal and institutional environment, and its gaps (MEFCC 2015c). The development of a national forest monitoring system for REDD+ MRV purposes was significant among Ethiopia's REDD+ readiness activities.

The need for a forest monitoring system is framed under Ethiopia's R-PP, REDD+ objectives, together with the countries' ambition for a CRGE. A roadmap lays out how infrastructure and institutional capacity can be built for a functional system capable of measuring, reporting and verifying Ethiopia's REDD+ implementation (FDRE 2013). The MRV roadmap process involved the analysis of Ethiopia's forestry sector, particularly the historical forest cover change; available data on forest carbon stocks; the drivers of deforestation and forest degradation; and the REDD+ interventions needed to address these drivers. The roadmap further looked into capacity (i.e. infrastructure, human expertise and relevant data sets), the gaps therein and the capacity building required to fill these gaps and to realize the REDD+ MRV objectives. In addition, it analyzed the institutional arrangements required for REDD+ implementation and provided a plan involving key actions to put in place a functional national MRV system (FDRE 2013). The findings of the national assessment on existing technical, infrastructure and institutional capacity, the gaps and the actions needed were further discussed and enriched in a national validation workshop in September 2013. See also Table 2 for the MRV activities planned in the REDD+ MRV system.

According to FDRE (2013, 5), "The ultimate objective of this Roadmap document is to facilitate the development of a national system which will enable Ethiopia to provide measurable, reportable and verifiable estimates related to the implementation of REDD+ activities (hereafter referred to as a "REDD+ MRV System")", which includes:

1. Considering elements for designing an MRV system:
   - "Follow guidance for the estimation of carbon emissions and removals at the national level as outlined by the IPCC Good Practice Guidelines, as well as guidance for reporting laid out by the United Nations Framework Convention on Climate Change (UNFCCC)" (FDRE 2013, 6).
   - Consider "the specific needs of the national REDD implementation strategy including the identification of different land change drivers; in particular the relationships among deforestation and forest degradation with agriculture (i.e. cropland expansion and emissions) and energy (i.e. fuelwood and charcoal)" (FDRE 2013, 6).
   - Consider "other monitoring and reporting commitments in the forest sector in Ethiopia" (FDRE 2013, 6).
2. Bridging the capacity gaps through a detailed plan to establish sustained MRV capacities within the country, which includes
   - a "capacity gap assessment based on the state of the existing national forest monitoring technical capabilities and the requirements for the provision of carbon emissions estimates as part of a REDD+ MRV system" (FDRE 2013, 6);
   - the implementation of "a sustained and efficient institutional framework including competence in measuring and monitoring, support of national policies and REDD+ actions, establishment of forest reference levels, suitability for international reporting and verification, and linking with REDD+ actions on the sub-national level." (FDRE 2013, 6).

The roadmap for Ethiopia's NFM/MRV system evaluated the existing in-country capacity and the gaps in realizing the envisaged REDD+ MRV system. One of its recommendations was the need to seek technical assistance from international partner organizations on the generation of critical data and methods that should be employed. In response to this recommendation, the Government of Ethiopia and its partners discussed how to identify the international organization that could provide adequate technical support for development of Ethiopia's MRV system. FAO was selected for three reasons. First, FAO has long been engaged in projects in Ethiopia dealing with "support to policy making, natural resource management and land administration to livestock, crop and fruit production, and agribusiness development" (FAO 2016). Second, FAO has also been engaged in the Global Forest Resource Assessment. Third, FAO or its affiliates (e.g. United Nations Environment Programme/UNEP and United Nations Development Programme/UNDP) provided technical support for REDD+ participant countries through the UN-REDD National REDD+ readiness program.

Table 2. Key activities for establishing Ethiopia's REDD+ MRV system.

No.	Recommended implementation activities	Timeframe
1	Establish institutional arrangements.	
	Establish steering/coordination body for the REDD+ NFM/MRV system.	Immediate
	Establish a technical working group(s) and facilities.	Short-term
	Establish a mechanism for local engagement and exchange of capacities, experiences, and data between national and local forest monitoring activities.	Short-term
	Develop a framework to engage with research and higher education institutions.	Short-term
2	Improve national forest monitoring: AD.	
	Assess options for forest definitions.	Short-term
	Create an updated and improved national forest map.	Medium-term
	Conduct consistent national forest area change assessments.	Medium-term
	Assess and estimate AD for forest degradation.	Medium-term
3	Improve national forest monitoring: carbon stocks and EFs.	
	Design/update and implement a national forest inventory and carbon measurement system.	Short-term
	Collect and further develop carbon conversion, expansion factors, wood density and root/shoot ratio.	Medium-term
	Assess different drivers/processes of change and their carbon impact (EFs).	Medium-term
4	Improve estimation and international Land Use Land Use Change and Forestry (LULUCF), GHG inventory and REDD+ reporting capacities.	Short-term
5	Prepare for MRV of REDD+ activities on the national level.	
	Identify, integrate and conduct monitoring for local REDD+ demonstration activities.	Short-term
	Test approaches and options to derive Forest Reference (Emission) Levels.	Short-term
	Develop foundations and data sources for a REDD+ safeguard information system.	Medium-term
6	Implement a program for continuous improvement and capacity development.	
	Design and implement a capacity development program building on available national capacities and international support where needed.	Medium to long-term
	Seek partnerships with regional organizations and international research partners (i.e. South–South cooperation and student/staff exchange, etc.).	Medium to long-term
	Seek assistance from relevant international partners on crucial data and methods.	Medium to long-term
7	Continued national and local communication mechanism on REDD+ monitoring.	
	Conduct a series of regional workshops to inform and seek input to REDD+ and MRV among national and local actors.	Short-term
	Produce communication plan, website and outreach materials.	Short-term

Source: Adapted from FDRE 2013.

A collaboration between the Government of Ethiopia (MEFCC) and FAO[4] was officially initiated in March 2014 to improve the country's national technical capacity. This came after the signing of a technical support agreement to support Ethiopia's NFI (FAO 2016). The cooperation was extended until March 2018 to strengthen implementation of the NFM and MRV system to support Ethiopia's REDD+ initiative (MEFCC 2015c; FAO 2016).

4 In September 2013, a roadmap for MRV was produced with the technical support of Wageningen University. This roadmap identified both data and capacity gaps that should be addressed for a functional REDD+ MRV system.

FAO's technical support in Ethiopia focuses on assisting in establishing an appropriate institutional arrangement for forestry-related GHG estimates and reporting, including quality assurance/quality control. FAO's engagement on institutional arrangement includes data collection and analysis with regard to the NFI and NFM system (FAO 2017). This support is more relevant to submitting biennial update reports and national communications, FRL and NDC to the UNFCCC.

The NFI collaboration was founded to address the insufficient amount of quantified information on the status of forest cover and spatial information regarding the forestry sectors' underestimated contribution to the economy. This collaboration was extended to strengthening implementation of the NFM/MRV system for REDD+ through satellite-based monitoring, measurement of emissions and removal of the emission level due to deforestation (FAO 2017). The agreement identified five outputs that FAO will support in the establishment of Ethiopia's MRV system (Table 3). Under this agreement, FAO provided technical support for MEFCC through two experts embedded in MEFCC and additional staff (from Rome or elsewhere) that provide technical backstopping. FAO's engagement includes the assessment and development of a methodology for measuring forest degradation. The methodologies being assessed for quantifying forest degradation make use of socioeconomic information/ data, including local-level wood demand and consumption to target degradation parameters.

2.2 Forest definition in Ethiopia

REDD+ MRV requires a forest definition to set the Forest Reference Emission Level and monitor changes. In 2002, Ethiopia submitted a forest definition to the UNFCCC to participate in the Clean Development Mechanism (CDM) of the Kyoto Protocol. In that definition, forests are covering a minimum area of 0.01 ha, with the potential to reach a height of 2 m in situ and having a crown cover of 10%.

In 2014, MEFCC[5] initiated a process to revisit the previous forest definition and develop a new one applicable for Ethiopia's REDD+ MRV. Following a series of discussions, a review of international and national definitions, and considering practical aspects, MEFCC adopted a new forest definition in February 2015 (MEFCC n.d.).

According to the new definition, a forest constitutes

> "Land spanning at least 0.5 ha covered by trees (including bamboo) attaining a height of at least 2 m and a canopy cover of at least 20% or trees with the potential to reach these thresholds in situ in due course (FDRE 2016, 2017c, 12).

This definition is different from the one Ethiopia uses in its National GHG Inventory, in its reports to the FAO Global Forest Resources Assessment and in the NFI undertaken by FAO. These documents used the definition of 10% canopy cover, minimum 0.5 ha area and a minimum of 5 m tree height (UNFCCC 2016). This is because the NFI began in 2013 before the new definition was in place. As noted in Ethiopia's FRL communication (FDRE 2017c), the new forest definition is primarily meant to allow the inclusion of the dryland forests, particularly the dense woodlands, which are threatened by large-scale agricultural expansion. Further, the official letter communicated by Ethiopia to the UNFCCC in January 2016 noted that "the new forest definition is proposed in light of the varied forest types, the potential of carbon stocks, the national capacity for MRV and the need for engaging local communities and benefit from forest carbon incentives" (FDRE 2016a).

2.3 Functions of REDD+ MRV

The establishment of a REDD+ MRV system is one of the critical features of Ethiopia's R-PP implementation process. As noted in Ethiopia's R-PP, the MRV system will enable the evaluation of anthropogenic emissions by sources and anthropogenic removals by GHG sinks resulting from forestry activities. On top of that, the MRV system should be developed in accordance with the relevant IPCC guidelines for national inventories of GHGs (FDRE 2011b). The R-PP outlined that Ethiopia's MRV system will have the following objectives/functions, illustrated in Figure 2 below.

5 At the time, the ministry was called the Ministry of Environment and Forest.

Table 3. Activities for establishing the MRV system and setting the national FRL.

Outputs	Activities
Output 1. Institutional arrangements and data management systems to support the national MRV system are in place and fully operational	• Establish a technical expert group on MRV. • Assess needs for training and capacity building. • Establish institutional arrangement for MRV implementation. • Assess existing data storage and management systems relevant for MRV. • Design and implement management solutions for critical elements of the MRV system. • Develop policy for internal and external data sharing. • Procure MRV equipment. • Procure IT consultant.
Output 2. National MRV institutions are capable of assessing historical forest cover change and monitoring AD	• Develop a national forest definition through analysis and consultation. • Train mapping institutions in remote-sensing techniques/analysis and open-source GIS software. • Develop a classification system for forest and other biomass-rich areas, prepare a basic land cover/land use map for REDD+ use and update the forest cover map. • Perform land-cover change assessment with accuracy assessment and assess potential trends, including acquisition of high-resolution images and other proxy data. • Establish and train an operational RS forest/land-use monitoring unit. • Develop a forest and land-use monitoring web portal to display REDD+ information. • Identify technologies to detect forest degradation.
Output 3. Enhanced capacity to carry out NFI in the context of REDD+, and information to improve carbon measurements on forest use and forest cover are produced	• Procure vehicle and field equipment. • Assess accuracy and relevance of existing data for REDD+ needs, notably for calculating EFs. • Compile and analyze other data to assess potential contribution for developing EFs and other MRV needs. • Test the relevance of proxy data to assess forest degradation EFs (e.g. fuelwood usage, small-scale farming, logging). • Provide training/workshops to field crews on field data collection, GPS/GIS usage for the NFI. • Provide training and support on field data compilation, quality control and analysis. • Support field work to establish permanent sample plot in key land classes areas, e.g. Oromia and key woodland areas. • Assess the relevance of socioeconomic and environmental NFI components and adapt, if relevant, to collect and provide information to address safeguards. • Analyze and combine field data from NFI with existing data to produce relevant forest information/analysis, including EFs for key land classes. • Support training in new research to improve biomass estimates.
Output 4. Enhanced capacities of governmental, research and civil society actors on MRV at the national and decentralized level	• Provide training and material to trainers on the basics of NFMS, MRV, field data collection and local-level mapping.
Output 5. National RL(s)/REL(s) and relevant policies are endorsed and linked to the National GHG Inventory process and policy framework	• Test and calculate different RL/RELs approaches and conduct an analysis of critical national circumstances for RL/RELs. • Undertake training on RL/RELs and facilitate a national dialogue to advance RL/REL(s) adoption and its policy application. • Provide training on LULUC/Agriculture, Forestry and Other Land Use (AFOLU) GHG inventories software, methods and UNFCCC reporting requirements for REDD+ in coordination with CRGE process.

Source: Adapted from FAO-Ethiopia TA Agreement (FAO-Ethiopia 2014).

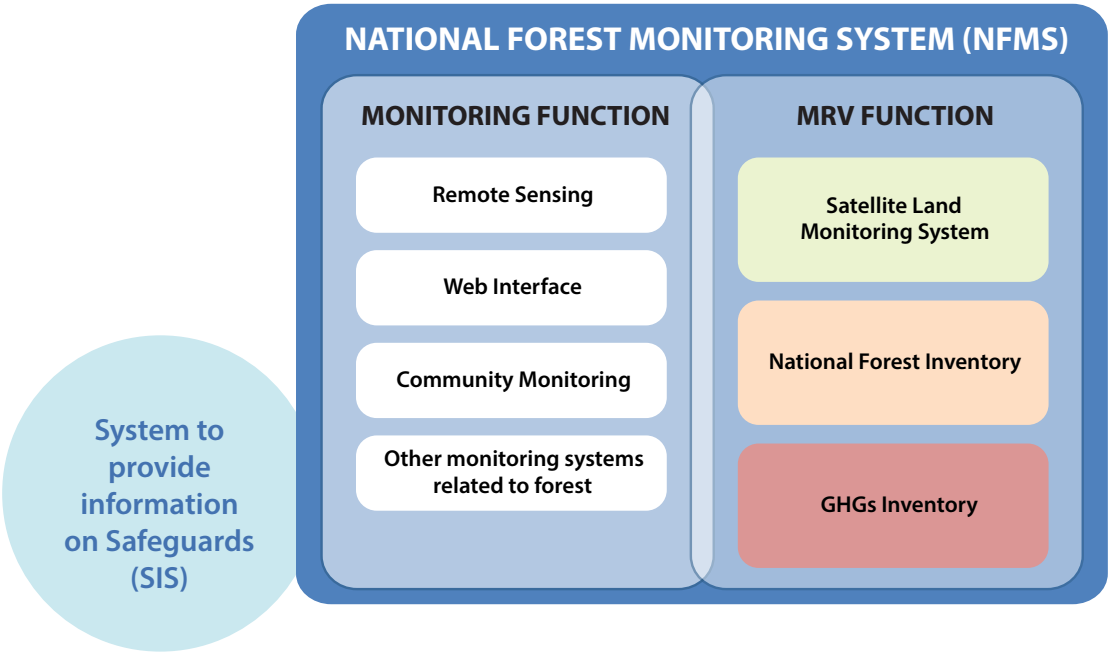

Figure 2. Functions of the National Forest Monitoring System.

Source: FDRE 2017a.

2.3.1 Monitoring

Monitoring in relation to REDD+ refers to monitoring the impacts of REDD+ policies and measures, and the collection, storage, analysis and dissemination of data (i.e. knowledge management). Monitored REDD+ results include biological diversity, protective and socioeconomic functions of forests, and legal and policy frameworks related to forests. Data come from a combination of remote sensing technologies (satellite-based monitoring) and land-based monitoring approaches. Ethiopia's National Forest Monitoring System (NFMS) includes a web portal for data uploading and sharing, and a system for monitoring other forest-related information. The types of information collected by the NFMS – mainly through its monitoring function – are determined along with the development of the REDD+ Safeguards Information System (SIS), which will integrate the information on non-carbon benefits (social, environmental) and the guidelines for information collection (Figure 2).

2.3.2 Measurement, reporting and verification

The MRV function for REDD+ refers to the estimation and international reporting of national-scale forest emissions and removals.

- **Measurement functions**: Measure forest area and forest area change (i.e. AD) with changes in forest carbon stock and forest carbon stock per unit area (i.e. EF). When combined, AD and EFs provide the basis for compiling the country's GHG inventory data. The measurement functions apply guidelines, rules and/or best practices for estimating the impacts of policies and measures that reduce emissions from deforestation and forest degradation. The guidelines will be designed to conform to the relevant international instruments or practices.
- **Reporting functions**: Establish standardized and consistent national reporting, and/or common reporting guidelines outlining how actions are reported, e.g. definitions, language, units, timing and report procedures.
- **Verification function**: Establish a process of (i) verifying performances including the entities responsible; (ii) reporting results; and (iii) adjusting reports related to reducing emissions from deforestation and forest degradation. The verification function in Ethiopia's case will be a two-step process. The first is internal monitoring and verification by the national MRV technical team composed of national experts at MEFCC, which will be submitted to the government for official endorsement. The second is international verification of methodologies by the UNFCCC, or a partner engaged in the REDD+ RBPs with

the Government of Ethiopia. The R-PP also proposed the development of community-based monitoring techniques as part of the national MRV system through the engagement of forest-dependent communities to ensure ownership and build understanding (FDRE 2013). AD should be updated every two years and EF should be recalculated every five years, starting in 2018. Area reforested and afforested will be included, and the first MRV monitoring report is planned for 2018. The MRV monitoring system has to be rolled out in nine regions and two administrative cities.

While reporting is the task of the government, workshop participants thought carbon buyers (and not the Ethiopian Government as is the case) should verify performance (see the verification function, previous page). The buyer will hire third-party verification, which bases their data on national data. Certain institutions can self-verify. There would be an accredited institution in the country to verify results in CDM/REDD+ projects, but that is still up to the buyer.

Ethiopia's R-PP assessed the country's forest monitoring capabilities and available data and emphasized the need for a dedicated effort in building technical and institutional capacity (FDRE 2011b). Based on this assessment, a roadmap for establishment of Ethiopia's REDD+ MRV system was initiated in 2013 by the Ministry of Agriculture, the Ministry of Environment and Forestry, and the Environmental Protection Authority with support from the Royal Norwegian Government and Wageningen University (FDRE 2013). The roadmap assessed the existing technical and institutional capacity, the gaps therein and the way towards designing a sustainable MRV system.

2.4 Components of the National Forest Monitoring System (NFMS)

As shown in Figure 2, the MRV function within the NFMS has three components: (i) Satellite Land Monitoring System (SLMS); (ii) the National Forest Inventory (NFI); and (iii) the National GHG Inventory of the forest sector; with the first two feeding the third one (FAO 2013). Countries are expected to progressively develop and operationalize these MRV components so that a fully functioning NFMS can be established at the third (i.e. RBP) phase of REDD+ (FAO 2013).

2.4.1 Satellite Land Monitoring System (SLMS)

The SLMS is a set of Geographic Information System (GIS) and remote sensing technologies and ground-based monitoring procedures to collect and assess the changes in forest areas over time. SLMS provides valuable information on the outcomes of REDD+ demonstration activities in the REDD+ implementation phase (GFOI 2013). The availability of open-source satellite images (e.g. Landsat) improved the resolution and accuracy of forest area change assessment (Zhu et al. 2012; Devries et al. 2015). These technologies enabled forest change analysis at a specific location with smaller temporal scales (e.g. annual) (Kennedy et al. 2010). In subsequent years, additional monitoring systems (PRODES and DETER) of the Brazilian Space Agency (INPE) and Global Forest Watch were operationalized in the tropics (Hansen et al. 2013; WRI 2014). Ethiopia uses these systems for assessing forest-cover changes.

Ethiopia's forest-area change is calculated by comparing two multi-temporal stacks from Landsat imagery datasets for the years 2000 and 2013 in combination with sample data from Google Earth. These are used to determine the extent of forest and forest-area change, and establish the accuracy level of Landsat maps. For determination of FRL, Ethiopia considered two types of land-use changes: from non-forest to forestland as forest gain, and from forest to non-forest land as forest loss. Forest-area change was adjusted using a stratified random sample, using visually interpreted high temporal and spatial resolution satellite imagery (FDRE 2017c).

According to workshop participants, SLMS includes forest and non-forest land-cover maps (2000–2013) and forest change. The forest change data were used for the FRL reported to the UNFCCC.

2.4.2 National Forest Inventory (NFI)

The NFI uses a set of procedures/protocols that include remote sensing and ground-based data collection on forest resources. When properly designed, this will yield data on forest carbon stocks and changes that are relevant for estimating emissions, removals and EFs. Inventory teams conduct repetitive and randomly sampled data collection, which are then submitted to the national level. In its NFI, Ethiopia took great care to create a

suitable forest inventory sampling design that fits the country's situation and need for forest information (FDRE 2017c).

Based on the guidance from a series of stakeholder consultations, a stratified systematic cluster sampling was employed. The stratification procedure used agro-ecological zonation (mainly using elevation and climate factors) along with the potential vegetation map of Ethiopia (Friis et al. 2010) and the land-use/land-cover map of WBISPP (2004). The procedure yields five strata (Strata I to V), each with a characteristic vegetation type and altitudinal ranges across the country.

Depending on the carbon stock of each vegetation stratum, a variable sampling distance and plot coordinates were determined using a grid generator. Each sampling plot (250 m x 50 m size for trees with dbh ≥ 10 and 20 cm), subplots (for trees and shrubs dbh 10 cm ≤ 20 cm) and transects (20 m for fallen deadwood diameter ≥2.5 cm) were laid within sampling units of 1 km^2. Global allometric data sets and secondary data in the national dataset were reviewed for measuring the precision of the NFI biomass carbon estimate. The calculations for EFs are based on the land-use sections of each sample unit classified as forest. Grid size and number of sampling units are summarized in Table 4.

According to workshop participants, data collection started in 2013 at the national level. In 2017, regional inventories were piloted, and data collection was based on remote sensing. There are several statistical mechanisms to select which above ground biomass models (allometric equations and diameter/height models) are best for Ethiopia. These indexes support the decisions on which model fits better with existing data from NFI collected in the sampling plots. There have been two training events to support the model selection. For the time being, the selected model for the above ground biomass is the pantropical model of Chave (Chave et al. 2014). The REDD+ Secretariat was planning to develop allometric equations for dominant forests in Ethiopia by working with the Ethiopian Environment and Forest Research Institute, but this has not yet materialized. There are other options, e.g. call in an expert to improve the pantropical model in use. With about 500 species of trees, using species-specific allometric models may not be practical. Below- ground carbon pool is based on the default factors proposed by IPCC (2006). The only in-country data, unpublished, are based on a wood-density study by a consultant who uses global estimates of wood density adapted to Ethiopia-specific data.

There is a plan to integrate bamboo and plantations into the NFI. After completing NFI, the government plans to collect data within five years where there are forest plantation and bamboo forests in the regional states of Tigray; Amhara; Oromia; Southern Nations Nationalities and Peoples' Regional States (SNNPR); and Benishangul-Gumuz. Regional experts will carry out the NFI activities. Federal experts will be involved in quality assurance and training.

A data collection manual has been prepared for the NFI and updated for NFI intensification. Forestry technicians from federal and regional levels have been trained across the regions. The Ethiopian NFI is a land-use inventory, the plots are located systematically and the data collected in every land use and land cover, not only in the forest. Also, the NFI has been designed using the old definition of forest. For these reasons, an NFI intensification has been done recently (in 2017, after the NFI). It aims to provide more detailed information just in the forest strata and therefore to improve the EF quality. A quality assessment group regularly went to the field to assess the quality of data collected based on data from surveyors as part of the capacity building of the surveyors. These quality assessments were gradually stopped as capacity was strengthened. Another group of technicians was

Table 4. Summary of sampling in Ethiopia's NFI.

Stratum	Grid size (degree)	Designation based on forest type	# sampling units
I	¼ x ¼	Natural forest, plantation and bamboo	107
II	½ x ½	Acacia-Commiphora woodland	135
III	½ x ½	Combretum-Terminalia woodland	137
IV	½ x ½	Dry Afromontane forest	232
V	1 x 1	Arid and semi-arid scrublands	20

Source: FDRE 2017c, Table 11.

trained for data entry and cleaning. Data collected from the field were entered in the FAO Open Foris platform and analyzed to obtain the EF by using Open Foris Calc and other specific statistical software. The combination of the EF and the AD produced the country's FRL, subsequently submitted to the UNFCCC (FDRE 2017c).

Since 2016, the Wondo Genet College of Forestry and Natural Resources (WGCF-NR) at Hawassa University has developed an MRV curriculum as part of three MSc programs on smart-climate agriculture, renewable energy, forest resource assessment and monitoring. The REDD+ Secretariat is benefiting from this capacity building program. The first batch of students finished the course and is ready to conduct field studies to complete theses on MRV-relevant problems collected by WGCF-NR from regional REDD+ coordinators (e.g. studies on the use of allometric equation). Advisors from MEFCC will be engaged with the students in addition to the university supervisors. As the theses are demand-driven and done in collaboration with MEFCC, graduate students' thesis research is financially supported by the university, and research outputs will have a directly positive impact on MRV development in Ethiopia.

2.4.3 Greenhouse gas (GHG) inventory

GHG inventory across sectors (agriculture [crop and livestock], power, forestry, industry, transport and buildings) have been using IPPC's Tier 1 approach.[6] This is nationally coordinated by the GHG Reduction Verification Directorate, which is part of the Environment wing of MEFCC. The directorate is also responsible for reporting of the GHG inventory internationally and for collecting data from all the CRGE sectors.

Due to limited horizontal communication within MEFCC, there was a mismatch between approaches since the forestry GHG inventory was already based on Tier 2.[7] This will be incorporated in the next national communication. However, there is no clear understanding of how to integrate the Tier 2 data from the forest sector with Tier 1 data from other sectors. It becomes a matter of finding a protocol on how to integrate the REDD+ data into international communications. This would entail, for example, agreeing on the data that will be reported to UNFCCC, and the methods for integrating data generated from the national forestry MRV system. There is an annual GHG inventory and a new GHG inventory reporting framework to make it easier to do international communications annually. This framework follows IPCC emission categories, as specified in the 2006 IPCC guidelines on national GHG inventory (IPCC 2006). Line ministries related to these categories (e.g. energy, agriculture, livestock) signed Memorandums of Understanding with MEFCC in July 2017 to upload AD and EFs. At the time of writing, a memo is still needed from MEFCC directorates to agree on one single kind of reporting system.

The GHG inventory is a tool for reporting to the UNFCCC Secretariat on anthropogenic forest-related GHG emissions by sources and removals by sinks. In Ethiopia, the GHG inventory is coordinated by the GHG Reduction Verification Directorate within MEFCC. GHG inventory for the forest sector will use ADs for deforestation (annual forest loss) and afforestation (annual forest gain) calculations. ADs by Landsat image analysis are updated biannually, and EF is calculated from the NFI and updated every five years. Harmonization of methodologies for other AFOLU sectors and REDD+ MRV and the method to be used in the biannual updated report and National Communication (NC) have yet to be developed. The GHG Reduction Verification Directorate is part of the Environment wing of MEFCC (Figure 5). It coordinates and harmonizes GHG data collection, and reports to the UNFCCC.

In compliance with the Good Practice guidance on quality control/quality assurance, Ethiopia has provided the UNFCCC with an estimate of forest loss and forest gain (and forest cover), which is corrected for the map bias. Sample point data were used to identify classification errors. The sample data help verify whether the classification is correct or incorrect at the location of the sample points. To quantify and report uncertainty, Ethiopia also calculates and reports on confidence intervals around the adjusted area estimates, which provide an indication of the precision of the estimate (FDRE 2017c).

6 According to FAO (2013, 21) "**Tier 1** methods use default EF data provided by the IPCC. This tier level is appropriate for countries where national data are scarce or absent and default values for EFs are used."

7 According to FAO (2013, 21) "Tier 2 can use a similar methodological approach as Tier 1 but applies EFs that are specific to the country or the region for the most important land-use categories, usually allowing the use of more disaggregation on the AD."

2.5 REDD+ spatial data collection

Scope: Activities, pools and gases included

Ethiopia's REDD+ MRV is based on five interrelated spatial data sets: *Land Use Land Cover (LULC) mapping*; *forest/non-forest mapping*; *forest area change* (AD); *forest carbon stock assessment;* and *forest reference levels*. The LULC mapping determines the spatial extent of forests and helps in producing a forest/non-forest map based on the new forest definition. Based on this map, forest-area change detection was assessed for an historical reference period (2000–2013). Meanwhile, forest carbon stock assessment was done, through the NFI, for above ground, below ground and dead wood biomasses. All this information is combined to develop a national FRL. The scope of REDD+ activities follows a step-wise approach based on national capacity and data availability. At this point, Ethiopia submits baselines for emissions from deforestation and carbon removals from afforestation/reforestation (A/R) (FDRE 2017e). Carbon dioxide (CO_2) will be the only GHG monitored, from three carbon pools: above ground, below ground and dead wood (FDRE 2017e).

2.5.1 Land use/land cover (LULC) change mapping

The MEFCC has created a map of land use/land cover for the year 2013 using a supervised classification of Landsat data (MEFCC 2013). This map is used to determine a baseline extent of the forests in the FRL by aggregating the 16 land-cover categories into forest and non-forest (Figure 3). The creation of the LULC map involves acquiring Landsat imagery (www.glovis.usgs.gov) for images with less than 3% cloud cover, with data acquisition dates from March – December 2013. LULC classes were identified based on past mapping experiences of the Woody Biomass Inventory Strategic Planning Project (WBISPP 2004) and the prevailing ground situation of the country from the experience of forestry experts. Representative areas of interests (AOIs) were collected for each of the LULC classes using Google Earth (FDRE 2017c).

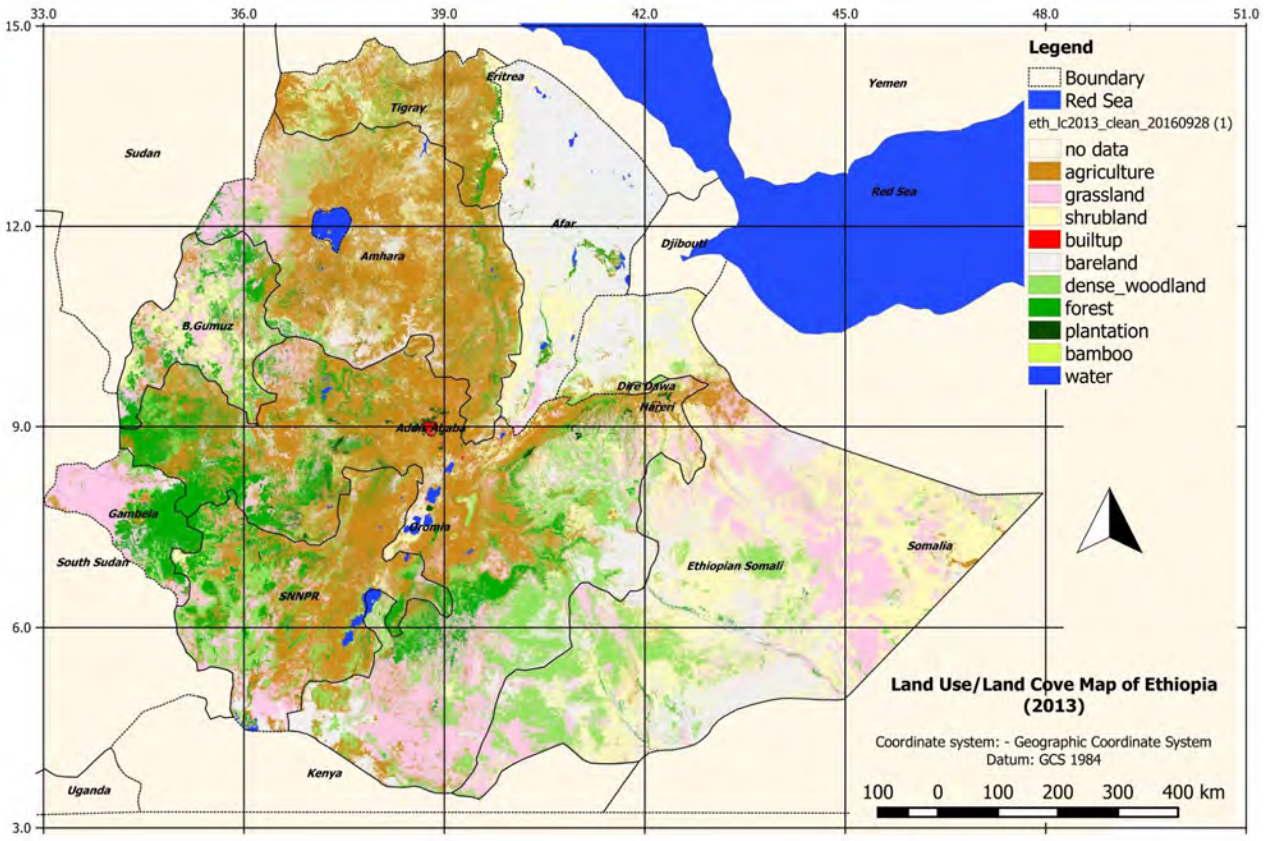

Figure 3. Land use/land cover map of Ethiopia (2013).

Note: 11 categories are shown. "Forest" consists of high forest and riverine forest.

Source: FDRE 2017c.

2.5.2 Forest/non-forest map

Among the land-cover categories in the 2013 LULC map (i.e. Figure 3), MEFCC considers four of them as the forest class: high forest and riverine forest, dense woodland, plantation and bamboo (FDRE 2016). The remaining seven categories (agriculture, shrubland, grassland, built-up, bare land, water and no data) are aggregated into the non-forest class (Figure 4). This classification is based on the new forest definition, which includes dense woodlands and bamboo. According to this map, Ethiopia has a forest cover of 15.5% (17 million ha) (FDRE 2017c).

2.5.3 Forest-area change (activity data/AD) generation

The AD for deforestation and afforestation was assessed as the average of annual forest loss and forest gain in hectares in 2000 and 2013. Satellite imagery was combined with sample data from Google Earth observations to determine the spatial extent of forest and forest-area change. The AD, referred to as adjusted change areas estimates, consists of new estimated areas for each class of forest change (i.e. forest loss, gain, stable forest and stable non-forest). An error matrix was created to correct for map bias (FDRE 2017c).

Forest gain and loss are detected through the SLMS (Section 3.4.1). The proposed approach by Ethiopia follows the Global Forest Observations Initiative (GFOI), guiding principle 1, for remote sensing (GFOI 2013). This detects changes by comparing a series of images rather than comparing maps generated from images. The training dataset to develop the supervised classification is based on the Global Forest Change product (Hansen et al. 2013). This is carefully assessed and validated by

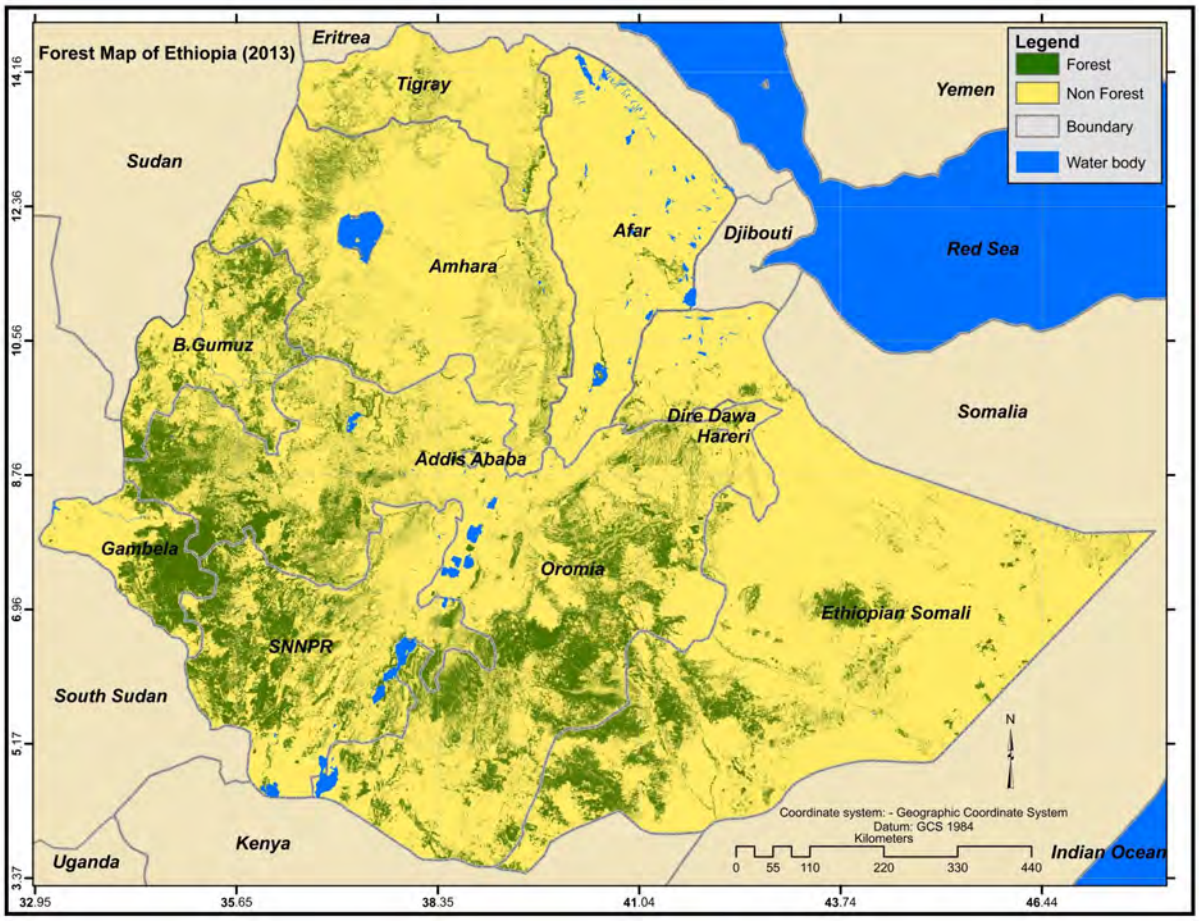

Figure 4. Wall-to-wall forest map* using Ethiopia's current forest definition.

* Figure 3 depicts the LULC map based on 16 LULC classes. The map in Figure 4 is produced by aggregating the 16 LULC classes into 2 (forest and non-forest). A forest includes plantation, natural forest, woodland and bamboo, whereas non-forest includes all other LULC classes.

Source: FDRE 2017c.

visual assessment using higher resolution imagery. Sets of images were compiled for two periods (1997–2003 and 2010–2015) to complete a single best pixel mosaic for each multiple temporal initial and final time period. With the Random Forest (RF) classifier algorithm, validated training points were used to train and directly classify loss, gain and stable classes from the mosaicked Landsat images at the national scale. Manual editing was done on the first semi-automated product by delineating false and missed changes using QGIS to correct the change detection (FDRE 2017c).

2.5.4 Forest carbon stock assessment and emission factors

Forest carbon stock is assessed for three carbon pools (above ground, below ground and dead wood) in four biomes (moist Afromontane forest, dry Afromontane forest, Combretum-Terminalia dry forest, and Acacia-Commiphora dry forest) (FDRE 2016). Forest carbon stock for a given carbon pool and biome is measured in tonnes of carbon (tC) and calculated using the following equation:

> Forest carbon stock (tC) = woody biomass density (tonne biomass/ha) x carbon fraction (tC/tonne biomass) x carbon density (tC/ha) x forest area (ha)

The EF is the average annual change of forest carbon stock across time for each biome and carbon pool, in tC/year. This implies that, at the minimum, data on forest area across two periods of time need to be collected. In Ethiopia's case, the periods assessed are 2000 and 2013.

Above ground biomass: The following parameters were used to calculate above ground biomass in carbon stock: "diameter at breast height (dbh), tree height, a wood density factor and a carbon fraction. The dbh and height parameters are measured in the field. A carbon fraction of 0.47 has been applied, which is the default value for wood in the tropical and subtropical domain as recommended by IPCC" (IPCC 2006).

Below ground biomass: Below ground biomass (BGB) was calculated based on the above ground biomass and applying conversion factors proposed by the 2006 IPCC guidelines (IPCC 2006) for each relevant ecological zone. Tropical shrubland (with a BGB conversion factor of 0.4) and tropical mountain systems (with a BGB conversion factor of 0.27) are the two most relevant ecological zones in Ethiopia.

Dead wood: The de Vries formula (de Vries 1986) was used to estimate the volume of dead wood per hectare. It requires data from the NFI because the formula uses the length of the transect (L) and the log diameter (d) at the point of intersection. Two decomposition classes were recorded for dead wood particles to take into account decomposition: sound and rotten. For each cubic meter of dead wood, it is assumed they have 90% and 50% of the wood density of living tree, respectively.

> Sound dead wood biomass = deadwood volume X 90% X wood density

> Rotten dead wood biomass = deadwood volume X 50% X wood density

In order to represent all forest types, in the first phase of analysis, the allometric equation developed by Chave et al. (2014) was used to convert field measurements into above ground biomass estimates. These estimates result in values closer to the average biomass estimates for the different forest types from a review of secondary sources (e.g. theses, published and unpublished papers). An analysis of the basic wood density of 421 indigenous and exotic tree species growing in Ethiopia was conducted to improve biomass estimation using country-specific wood density equation (Chave et al. 2014). This analysis is used to determine the most appropriate wood density estimate for Ethiopia.

The overall average wood density for all species is 0.612 g/cm^3 (or 0.612 tonnes/m^3). This is comparable to the global average value and that of tropical Africa. The minimum value of wood density was 0.262 for *Moringa* species, and the maximum was 1.040 g cm^{-3} for *Dodonaea angustifolia*.

According to FDRE (2017a), Ethiopia's EF is estimated based on the full carbon stock in above ground biomass, below ground biomass and dead wood for forests in the different biomes. The removal factor for forest gain is estimated as the inverse of the EF, assuming full average carbon stock for each hectare of gain detected. Taking into account the age structure in the forest would be too complicated. Further, the removals from early forest growth may be overestimated if it is assumed

Table 5. Biomass figures used for EF calculations.

Biomes	Above ground biomass		Below ground biomass		Dead wood	
	tonnes/ha	95% CI	tonnes/ha	95% CI	tonnes/ha	95% CI
Acacia-Commiphora	39.99	47.71	19.67	27.74	0.37	0.83
Combretum-Terminalia	61.66	26.20	18.72	7.53	1.31	0.78
Dry Afromontane	115.32	64.61	31.14	18.35	2.58	3.79
Moist Afromontane	197.83	49.77	53.62	21.96	2.26	0.95

Source: FDRE 2017c.

that the full carbon stock is removed from the atmosphere when a gain is detected. The latter may be compensated by the fact that remote sensing introduces a delay in providing data on gains.

2.5.5 Forest Reference Level determination

Ethiopia's FRL follows the guidance provided by the UNFCCC (Decision 12/CP.17), the guidelines for information on reference levels (Decision 12/CP.17) and the latest IPCC guidance (UNFCCC 2016, 2017). Ethiopia submitted the first version of its FRL to the UNFCCC in January 2016. This submission was reviewed by a technical assessment committee and verified by the UNFCCC for transparency, completeness and compliance with IPCC and UNFCCC requirements (UNFCCC 2016, 2017).

Subnational FRLs emanate from the national FRL for consistency. The national FRL construction follows a step-wise approach. In an interim period, it was based on national AD and subnational EF from the NFI in Oromia, which was using the same biomes used later for the national EFs. National-level data on EF were developed with the NFI data available in the interim period (2016/2017). Finally, project-level activities were integrated into an accounting and incentive scheme of larger jurisdictions (regional and national).

The proposed national FRL to UNFCCC covered the historical reference period 2000–2013. It includes *net* forest emissions by considering two REDD+ activities: reducing emissions from deforestation (deforestation) and the enhancement of forest stocks (afforestation). Forest degradation was identified as a significant source of emissions as noted in the CRGE strategy. The current FRL submission does not consider forest degradation because of limitations related to data accuracy, reliability and consistency on forest degradation at a national scale. This may change in future FRL development. The FRL covers the entire national territory of Ethiopia incorporating all forests in the country. The gain and loss are obtained by multiplying the loss/gain/forest areas in hectares in each biome by the overall correction in the map, e.g. forest loss per biome is multiplied by a factor calculated from bias-corrected forest area (1,192,559 ha) divided by the area of forest loss (372,188 ha) = 3.18 (FDRE 2017c). The correction in the map is error correction of map bias. This uses sample reference points to verify whether map estimates are correct.

Ethiopia submitted the first version of its FRL to the UNFCCC in January 2016. The submission was reviewed and resubmitted before it was accepted (UNFCCC 2016, 2017). Ethiopia submitted the following reference levels: gross national emission from deforestation of 17.8 $MtCO_2e$/year and net emission (considering afforestation or enhancement of forest carbon stocks) equivalent to 4.7 $MtCO_2e$/year (UNFCCC 2017). The current FRL is valid for at least five years and may be improved or revised periodically (at least every five years) and resubmitted to incorporate new or improved data that may be available (FDRE 2017c).

The availability of additional data from ongoing research on land-use change by Ethiopian Environment and Forest Research Institute (e.g. in Bonga and Chilimo in the south and southwest) may supplement the effort to refine the methodological approach. In addition to deforestation and afforestation/reforestation, Ethiopia's intention is to account for emissions from forest degradation. The inclusion of forest degradation in the performance measurements of the REDD+ interventions at the national and subnational levels depends on the availability of a reliable assessment approach. For this, a new

Table 6. Three components of the FRL.

FRL component	Data source	Forest definition
The extent of forest area	LULC map from 2013, produced by EMA	Forested areas > 0.5 ha, height ≥ 2 m, canopy cover ≥ 20%
AD (average annual forest loss and gain between two periods)	SLMS of satellite images from 2000 and 2013	
EF	NFI	Forested areas > 0.5 ha, height ≥ 5 m, canopy cover ≥ 10%

family of satellites (Sentinel-1) will be used to extensively assess and quantify forest degradation at national and lower scales. According to workshop participants, it is still unclear how to align Sentinel-1 data with the old family of satellites to know if the differences are due to real forest-cover change, or to a change in the resolution/data source. Moreover, as noted by workshop participants, the trend is to go from forest-based emissions/removals to a more comprehensive carbon accounting with a gradual inclusion of emissions from other land uses across the landscape. Ethiopia needs to gradually account for livestock emissions and establish a baseline in the next few years.

One aspect of ensuring consistency in the national MRV system is related to the methodological consistency between FRL development and GHG inventory. The national FRL is based on various data sources and forest definitions. Table 6 summarizes the three components of the FRL (extent of forest area, AD and EF).

Due to the change in forest definition and in methodological approaches, the 2017 FRL and the 2012 GHG inventory are inconsistent. Future GHG inventory reporting will seek to consider these changes in the technical annex to biennial update reports to the UNFCCC (FDRE 2017c).

3 REDD+ MRV system framework

Section 3.1 reviews national arrangement for decentralization and institutionalization of REDD+ MRV functions.

Ethiopia follows a federal arrangement with nine regional states and two city administrations constituting the federation. Subnational REDD+ programs are well advanced in four regional states; Gambella regional state has recently initiated a fifth subnational program. The framework for the institutionalization of REDD+ MRV outlines a decentralized management arrangement with defined roles and responsibilities of different entities at the federal, regional and local levels. Accordingly, a national MRV unit (Forest Resource Inventory and Demarcation Directorate) is the crucial federal entity responsible for producing, verifying and disseminating forest statistics (AD, EF, ER) and oversees overall REDD+ MRV activities. At the subnational level, four regional states are establishing a regional MRV laboratory (housed in the regional MEFCC bureaus). The regional MRV entities are responsible for leading local-level data collection, compilation and reporting back to the federal MRV entity.

3.1 REDD+ MRV institutional arrangement

3.1.1 General framework

The MRV implementation framework creates an institutional arrangement for sustaining a functional MRV system at national and regional levels. It defines the roles and responsibilities of the institutions delivering national data on emissions or removals in the forest sector (MEFCC 2017). Ethiopia's REDD+ MRV function is decentralized at the federal and regional levels and engages stakeholders from within and outside of MEFCC (e.g. EMA, WGCF-NR and other research institutions). This institutional arrangement is illustrated in Figure 5.

All MRV entities at the federal and regional levels (e.g. MEFCCC and other MEFCC institutions at both levels) are permanent institutions. They are largely MEFCC structures at the federal level (i.e. departments within MEFCC) and regional level (i.e. regional MEFCC authorities including *woreda* offices). Entities such as the National REDD+ Secretariat and its regional counterparts (REDD+ Coordination Units) provide MRV technical support and/or serve as incubation units for regional MRV capacity, which will be absorbed into the government structure. Both the National REDD+ Secretariat and regional counterparts are project-based. They are intended to work toward supporting the REDD+ implementation capacity of the permanent institutions. More overall implementation capacity of permanent institutions is planned in the coming years (MEFCC 2017). By the same token, the links that connect a temporary institution with a permanent institution will disappear as the temporary institutions dissolve over time.

Workshop participants explained that existing policies and development programs (e.g. CRGE) provide space for MRV activities. However, there are no binding legal frames to facilitate implementation of MRV activities. The revised 2007 Forest Proclamation (still being developed at the time of the workshop) should consider the following issues: community-based forest registration, corruption, conflict among different laws, and mandates and accountability.[8] This new law should look into the definition of different forest types, participatory MRV, benefit sharing, forest certification and charcoal production. Limitations in law enforcement are visible and need to be improved. Insufficient budget, limited awareness at all levels and lack of common understanding of MRV activities among stakeholders and agencies need to be addressed.

8 Since the time of the workshop the revised forest law has been approved by the federal parliament.

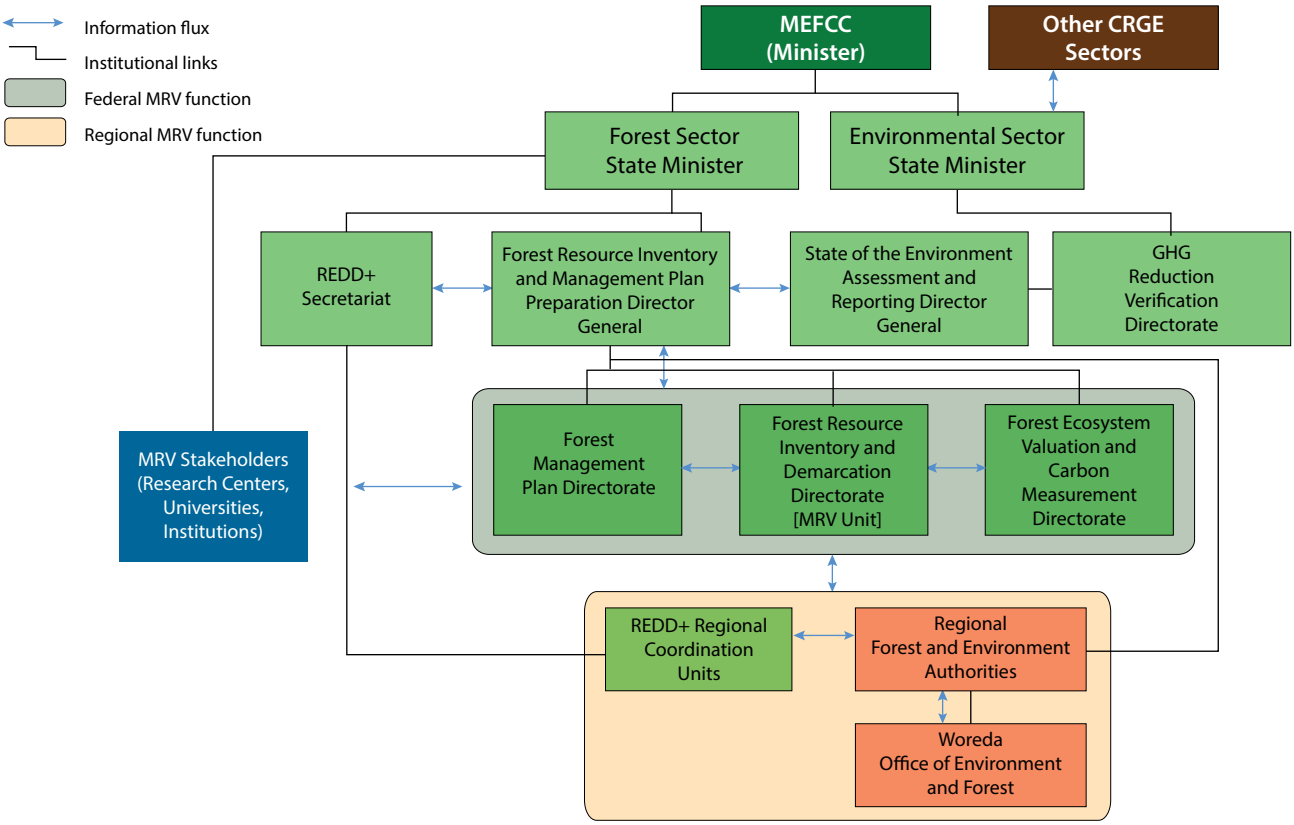

Figure 5. Current institutional arrangements for the national REDD+ MRV in Ethiopia.

Source: MEFCC 2017.

3.1.2 Actors and roles: Ministry of Environment, Forest and Climate Change (MEFCC), now Environment, Forest and Climate Change Commission (EFCCC)

National-level MRV: MEFCC (now EFCCC) is the most important MRV actor at the federal level. Until October 2018, MEFCC was divided into two state ministries representing two different sectors: forest, and environment and climate change. Each sector produces one of two main carbon reports submitted to the UNFCCC: the forest sector is in charge of the FRL, while the environment and climate change sector is in charge of the GHG Inventory. The following description is a snapshot of the ministry as it was structured before October 2018.

Under the forest sector of MEFCC, REDD+ MRV at the national level is coordinated by the General Directorate (GD) of Forest Resource Inventory, Demarcation, and Management Plan Preparation Directorate General of MEFCC. The directorate oversees producing, verifying and disseminating forest statistics. It emphasizes AD, EF, emission reduction and all the forest-related activities at the national scale. Once MRV at the regional level becomes functional, the directorate general will also organize, collect and process the data coming from the regions. The information flow in the system will be ensured by sharing data, training materials, guidelines and reports. A National MRV Unit has been established and will verify all the data coming from the regions and will report to the GD at MEFCC. The GD leads, integrates and monitors implementation of regular and project plans of the three directorates. It also liaises with the State Minister of Forest Sector and REDD+ Secretariat, reporting to both on the status of regular program and project activities. This structure will ensure a top-down approach (national–local) for consistency control, and a bottom-up approach (local–national) for data flow.

At the national (federal) level, three directorates relevant to MRV functionalities were established under the GD for Forest Resource Inventory, Management Plan Preparation of MEFCC:

- The Directorate for Forest Resource Inventory and Demarcation is responsible for a significant

part of the MRV activities for REDD+. It analyzes forest data and forest monitoring of national forest resources. It uses ground inventory and remote sensing techniques, prepares forest maps, generates information on forest changes at regular time intervals, and estimates EFs and AD.

- The Directorate for Forest Management Plan prepares forest management plans based on information from the Directorate for Forest Resource Inventory and Demarcation.
- The Directorate for Forest Ecosystem Valuation and Carbon Measurement evaluates forest ecosystem services, measures carbon from forest pools and estimates emissions/removals statistics. It also updates the national FRL and supervises or supports the regional government bodies in preparing regional FRLs, supervised by the national REDD+ Secretariat. In June 2016, MEFCC institutionalized the federal MRV unit, which includes the functions of forest monitoring and sustainable forest management. This MRV unit is part of the Forest Resource Inventory and Demarcation Directorate.

Under the environment and climate change sector of the MEFCC, the GHG-Reduction Verification Directorate is responsible for reporting the National GHG Inventory. In the past, the GHG-Inventory report for the forest sector was prepared without alignment with the definition of forest. Now, the GHG-Inventory it is aligned with the new definition. In future reports, the estimates related to the forest sector will thus be changed because there is a better institutional linkage between the relevant directorates under the forest sector and the environment and climate change sector.

Regional-level MRV is planned to be led by the regional bureaus related to the forest, and environment and climate change sectors. Each region may have different institutional structures, and will formalize a defined institutional setup within five years (i.e. by 2022). Meanwhile, the Regional REDD+ Coordination Units (RRCUs) support the institutional and technical functions of the regional MRV (Figure 5). The RRCUs are temporary institutions composed of a focal point (i.e. the regional REDD+ coordinator) and two technicians. This temporary institution will allow regions to support and monitor REDD+ activities while they institutionalize and formalize the regional MRV structure and functions. A regional MRV unit will be responsible for: (i) conducting regional-level forest inventory operations (clean, store and analyze field data according to the national standard/guideline); (ii) regularly collecting and organizing primary and secondary data on AD and EF from lower levels; (iii) recruiting relevant personnel; and (iv) training staff at lower governance levels, such as at the *woreda*[9] and project levels.

Each *woreda* will have one MRV focal person within the MEFCC *woreda* offices. There are already REDD+ coordination units in four regions that eventually will have their focal persons at the *woreda* level. The *woreda* MRV focal person will: (i) organize MRV-related data collected by different actors (e.g. NGOs, academia, research, government office and communities) in the *woreda*; (ii) compile and communicate data and information to regions (RRCUs); (iii) undertake field data collection missions, as required, to contribute to the regional and national MRV database; and (iv) support field and spatial data collection efforts by regional and federal MRV entities (MEFCC 2017).

3.1.3 Actors and roles: Other stakeholders

The roles of stakeholders outside of MEFCC in REDD+ MRV are defined through inter-institutional arrangements via the State Minister of the Forest Sector in MEFCC. Stakeholders communicate directly with the national MRV Unit at MEFCC.

MRV Task Force: The National MRV Task Force consists of government, NGOs, civil society organizations and research institutions. This task force guided the national REDD+ readiness process, particularly FRL and MRV development (i.e. capacity building, institutional setting), and will remain engaged in national REDD+ implementation. Workshop participants noted that initially the task force met whenever there was a milestone. The meetings happened less regularly after the national FRL was submitted. The task force meetings are now called only on demand, e.g. when a revision of the FRL is needed, or if some reporting/deliverable deadline needs to be met. Such meetings should be regular to update all stakeholders about where the MRV system stands. Now that MEFCC focuses more on REDD+ implementation, the Program Implementation Team meets once a month. The institutional arrangement in Figure 5 does not

9 *Woreda* (district) is a lower administrative unit that consists of several *kebeles* (i.e. subdistricts) within a region.

indicate whether the National MRV Task Force will be retained as part of the institutional framework for REDD+ MRV implementation. In fact, the roles and responsibilities of other key stakeholders will be defined through inter-institutional arrangement via the State Minister for the Forest Sector (MEFCC 2017).

Communities: Despite being an important stakeholder group, the MRV institutional framework seems to overlook the role of local communities in MRV. This is a gap in the current institutional arrangement. Section 4.4 discusses the potential role of local communities through participatory MRV approaches.

Universities and research institutions: Wondo Genet College of Forestry and Natural Resources (WGCF-NR) from the University of Hawassa will be the primary national university providing capacity building for GIS, remote sensing, botany, forestry and forest management at the federal and regional levels. WGCF-NR is also the technical partner for MRV implementation and supports the country's MRV systems through short- and long-term training to ensure in-country MRV capacity (WGCF-NR 2013, 2016a, 2016b, 2016c).

The capacity building is part of the college's project entitled "National MRV capacity building project", financed by the Norwegian government.[10] The project has four outputs: a) building national human capacity to carry out MRV activities (long-term: MSc and PhD training) and short-term training; b) putting in place an infrastructure for MRV training at WGCF-NR; c) establishing an MRV capacity center at WGCF-NR; and d) establishing community seed stands and a tree seed center at WGCF-NR (WGCF-NR 2013).

So far, short-term training on GIS and remote sensing applications in forestry has involved trainees mainly from the government. Most were experts from MEFCC (federal and across all regional states). Participants also included some trainees from the Ministry of Agriculture and Natural Resources, and the Ethiopian Mapping Agency (EMA) (Table 8). Recently, the college and MEFCC have been discussing how to create a strong alignment between the MRV projects and national needs.

10 www.hu.edu.et/hu/index.php/news/412-review_workshop.html

Other government agencies: The EMA has been involved in estimated AD since the beginning. The agency's laboratories, useful for testing methodologies, train large groups. The EMA is also a repository for satellite images of different resolutions. The collaboration between MEFCC and EMA can help sustain MRV functions, quality of AD reports and partnership for the same goal. EMA will elaborate and update the national LULC map.

Private sector and NGOs: The private sector and NGOs are not formally included in the institutional framework of MRV (MEFCC 2017). They are implicitly included whenever they are a source of data. For example, the MRV focal points at the *woreda* (i.e. subdistrict) level collect MRV-relevant data from NGOs, academia and research institutions within the *woreda*.

International development partners: International development partners have contributed significantly to the development of MRV. These partners include notably the Norwegian, UK and German aid agencies, the World Bank (e.g. through FCPF and the BioCarbon Fund) and the UN-REDD Programme. Their role includes providing technical assistance; funding for staffing, research and equipment, monitoring and evaluation; and facilitating learning across countries.

3.2 Human and financial resource needs

Workshop participants explained that capacity relates to the existence of an MRV system aligned to international requirements with an efficiently structured organization, and a skilled and motivated work force with good management skills and MRV technical capacity (e.g. GIS, remote sensing, NFI). The participants also explained that MRV activities are not only about having expertise in different fields. They are also about collective action among different stakeholders, which is essential. Institutional capacity to implement MRV activities and bring stakeholders to collaborate on MRV issues is inadequate. So far, partnership among potential stakeholders is weak and focused on government agencies. A vertical and horizontal collaboration among all government bodies and NGOs (e.g. EMA, MEFCC, Ministry of Agriculture, Central Statistics Authority and community-based organizations [CBOs] is essential for successful operation of MRV activities.

Some workshop participants also mentioned the need for capacity to keep the flow of information through federal, regional, zonal and *woreda* structures. They viewed human capacity in a broader scope, including knowledge in resource inventory, forestry, remote sensing and GIS, communication, socioeconomic aspects of MRV, participatory MRV, social/environment safeguards, the law, land tenure and land administration, and forest carbon. Material facility is also needed, including equipment, computers and vehicles. The organization conducting MRV activities needs an adequate budget.

Ethiopia has planned to address capacity gaps/challenges in the next four years and fully operationalize the country's NFMS/MRV system. For this, a financial budget of about USD 4 million is allocated as part of the MEFCC's REDD+ Investment Proposal (2017–2020). This was approved and financed by the Royal Norwegian Government through the bilateral REDD+ agreement between Ethiopia and Norway (FDRE 2017d). According to the plan, the allocated budget will cover costs related to MRV personnel at all levels, national- and regional-level MRV operations, generation of AD and EFs, improvement and reporting, staff training, web-portal development and external technical support (FDRE 2017b).

The government prepared a document on the MRV implementation framework (FDRE 2017b). It takes stock of the available and needed units and the human resource capacity, particularly under the forestry sector at the federal and regional levels (Figure 6). In 2018, the national MRV unit at MEFCC comprises eight forestry and remote sensing experts and one coordinator. Since 2013, training has boosted the unit's implementation capacity to produce national forestry statistics. In February 2016, MEFCC created an ad hoc team to undertake MRV activities. In June 2016, it institutionalized the MRV unit under its business process re-engineering, which provides a stable national forest monitoring structure. Regional- and *woreda*-level MRV capacities are expected to be built in the coming five years (as of mid-2017) in at least four regions.

Apart from the capacity building as part of FAO's technical engagement, international organizations such as the World Bank's FCPF, UN-REDD and GOFC-GOLD have offered MRV-related training.

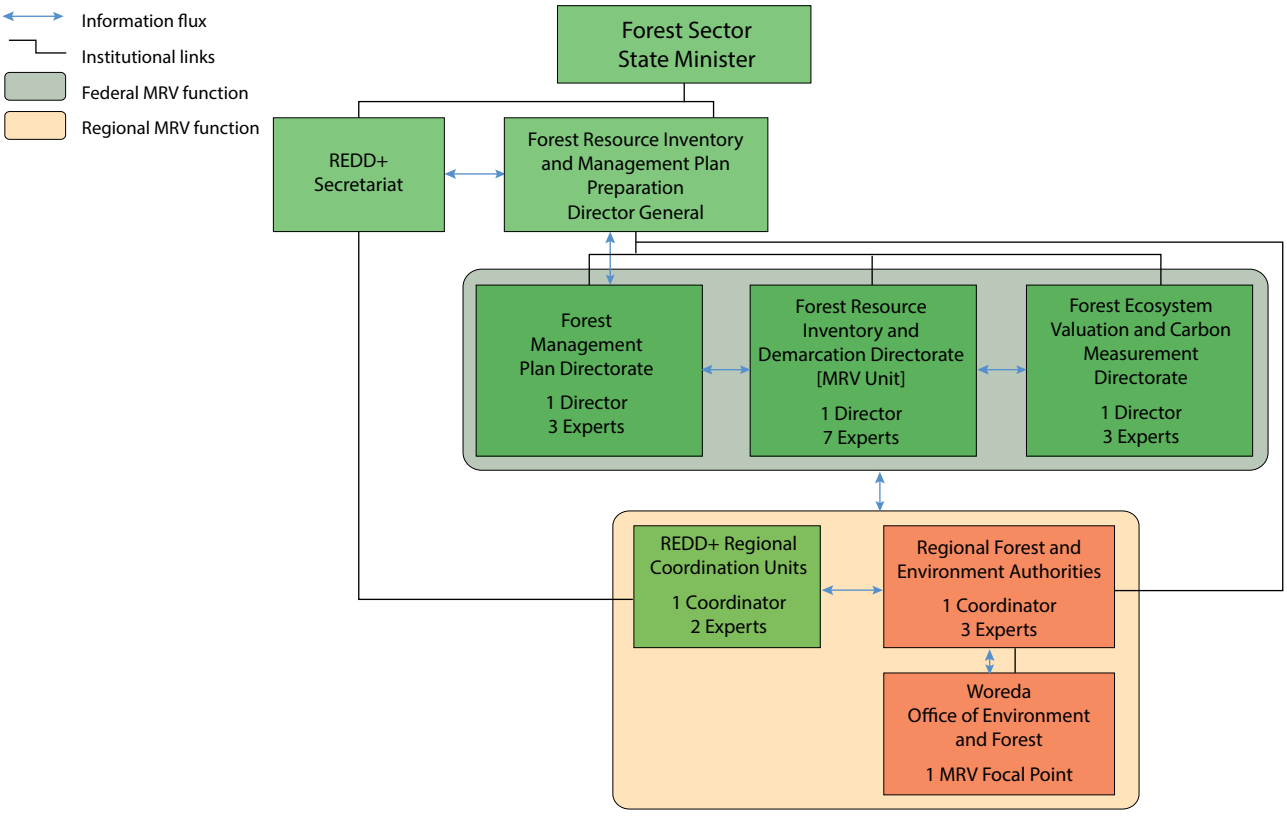

Figure 6. MRV institutional and staff requirements.

Source: MEFCC 2017.

A 'training of trainers' on MRV techniques was conducted in September 2016. It involved a range of relevant stakeholders, including MEFCC, EMA, NGOs, Ministry of Agriculture and Natural Resources, and experts from other African countries (GOFC-GOLD 2016). Additional short-term and long-term training are being undertaken by WGCF-NR at the University of Hawassa as part of the college's national MRV capacity building program. WGCF-NR is the first college in the country offering forestry training, and remains Ethiopia's premier forestry education institution. The current MRV capacity building in WGCF-NR was funded by a project with bilateral support from the Government of Norway. A plan for continuous capacity building in the coming years is outlined in the recent REDD+ Investment Proposal financed by the Government of Norway as part of the REDD+ partnership agreement between Ethiopia and Norway (FDRE 2017b).

The required human resources are sufficient for the national and regional REDD+ coordination units, but not for regional forest and environment authorities and *woreda* offices. According to workshop participants, there is moderate technical capacity at the federal level; there are experts who can run the MRV system, for example, by monitoring deforestation. The issue here is to sustain this capacity by improving collaboration with other stakeholders, such as universities, research institutes and the EMA.

Capacity to monitor deforestation is moderate at the federal level and low at the regional level. However, it has improved in the four pilot regions because of the establishment of MRV facilities and recruitment of MRV experts. The in-country capacity building efforts implemented so far have yielded encouraging results. For example, the MRV unit at the federal level is gradually taking over from international experts in training regional experts on regional FRL preparation, GIS and RS and other topics (Table 5). Nonetheless, turnover of trained staff is a significant challenge for sustaining a functional system both at national and regional levels.

3.3 National spatial data infrastructure (SDI)

Ethiopia's MRV roadmap identified the need to develop national SDI in developing a functional national MRV system (FDRE 2013). An SDI is a set of policies, standards and procedures under which organizations and technologies interact to improve the efficiency of using, managing and producing spatial data (Ryttersgaard 2001). In the context of REDD+, SDI refers to the technologies used to generate spatial data, IPCC methodologies for data generation and processing, policies on data generation and management, and the institutional framework for MRV (Cheung et al. 2014).

Ethiopia's SDI will require policies for managing MRV data, including constructing a database and a metadata catalog, and relevant manuals and guidelines. Ethiopia also needs procedures for data collection and data-sharing protocols, and tools (e.g. hardware and software) for collecting, processing, storing and accessing spatial data. Moreover, it also encompasses the spatial data (i.e. LULC, AD, national forest cover) and the institutional framework that governs the working relationship and responsibilities of different MRV actors across vertical and horizontal levels (Cheung et al. 2014).

3.4 Participatory MRV (PMRV) approaches

Community-based monitoring in REDD+ MRV is necessary to sustain forest monitoring activities, and can potentially reduce monitoring costs without compromising data quality (Pratihast et al. 2013; Boissière et al. 2014, 2017b; Hawthorne et al. 2016). Engaging local experts (e.g. forest rangers) in data monitoring with satellite technologies can improve monitoring results (DeVries et al. 2016). These findings suggest the potential benefits of integrating data generated at the community level into regional or national REDD+ MRV. In their review of the literature on PMRV, Hawthorne et al. (2016) reported that PMRV projects have been implemented in tropical countries (with differing frequency). Most of these projects focused on developing community-based measurement and monitoring, but with limited piloting of participatory reporting and verification.

Ethiopia's R-PP underlines the need to explore and test participatory monitoring approaches that engage local communities (Section 3.3.2). Several PFM projects in Ethiopia developed participatory inventory techniques where community members become involved in activities such as tree surveys

and measurements. Community involvement in forest monitoring helps build ownership over the process and can improve trust between local communities and REDD+ project proponents and local government (FDRE 2011b). The role of *woreda* forestry experts in forest monitoring data integrated with Landsat Time Series (LTS) can be valuable in detecting deforestation and forest degradation, as is the case in the Kaffa Biosphere Reserve (DeVries et al. 2016). The draft National REDD+ Strategy reiterated the importance of community-based MRV in enhancing local ownership of the process and as a cost-effective approach (FDRE 2017a).

A community-based MRV system is ready for implementation by Ethio Wetlands and Natural Resources Association (EWNRA), a local NGO with many years of experience in PFM. EWNRA drafted a guideline on the procedures of community-based monitoring and reporting, and the approach was discussed with stakeholders. The guidelines are technical, focusing on how communities should assess carbon sequestration. This aims to align the PMRV with the National Forest Inventory protocol and reporting procedure. However, the reasons and ways to engage local communities in MRV are still missing from the guidelines. For example, the document does not mention that participating in MRV may burden communities by taking them away from their daily livelihood activities. EWNRA's PMRV piloting in selected forested landscapes in the southwest helps the national system draw lessons and best practices for scaling up community-based MRV system (EWNRA n.d.).

Despite being identified as an integral part of Ethiopia's national MRV system (FDRE 2011b, 2017a), the REDD+ strategy and the framework for the institutional arrangement for REDD+ implementation do not provide a clear direction on community-based MRV. This is particularly evident in the recent institutional REDD+ implementation framework document. It mentions neither EWNRA's initiative nor any other activities in participatory MRV.

The workshop showed that three issues need to be considered in community participation: an effective safeguard system, benefit-sharing mechanisms and participation of local people. These will be discussed in the following sections.

3.4.1 Social safeguards

The Safeguards Information System (SIS) was drafted following World Bank guidance and shared with safeguard specialists from UNEP. There is abundant documentation on the SIS for the implementation phase in Ethiopia. At the federal level, there are different tools, mechanisms and standards:

- Strategic Environmental and Social Assessment (SESA) is already implemented to identify environmental and social risks, and their mitigation strategies. Foresters/experts on environmental impact at regional levels prepared questions to be asked locally regarding these risks. They will collect data and transfer them to the federal level.
- Environment and Social Management Framework (ESMF) also aims at mitigating risks. ESMF is now implemented at the pilot level in afforestation/reforestation.
- Resettlement Policy Framework (RPF) considers how to minimize risks associated with REDD+ through resettlement programs.
- Process Framework (PF) is prepared in the case of protected areas.

According to the workshop participants, SIS guidelines have been developed, but the system is not yet in place (Table 7). The SIS will be using an online system to link local to federal levels. The platform will involve government experts, but workshop participants believe it should also include other actors (e.g. voluntary lawyer). REDD+ implementation based on PFM usually has its own safeguard system. There is already a farmer council within the PFM structure that deals with safeguard issues.

In Oromia, six safeguard coordinators collect information about safeguards in the REDD+ pilot sites. At the regional level, there are also environmental and social safeguard specialists. The confidence of farmers in this system is built through a Free, Prior and Informed Consent (FPIC) mechanism. FPIC is used to inform communities about the REDD+ process, including during the implementation phase. It is, therefore, a continuous process. The first FPIC is the most important. It is based on the consent of the majority, but captures the views of the minority. The C of FPIC is understood as "Consultation" rather than "Consent" because otherwise it is perceived as too difficult to implement.

Table 7. REDD+ Safeguard/SIS milestones.

Year	REDD+ Safeguard/SIS Milestones
2013	October: Terms of Reference: SESA Consultation and Participation Task Force established
2015	February: Ethiopia's REDD+ Safeguard instruments (SESA, ESMF, RPF, PF) preparation launched
2016	March: National consultation and participation plan prepared March: National Grievance Redress Mechanism (GRM) prepared December: Ethiopia's REDD+ Safeguard instruments (SESA, ESMF, RPF, PF) preparation finalized
2017	March: Ethiopia's REDD+ Safeguard instruments (SESA, ESMF, RPF, PF) disclosed December: Ethiopia's REDD+ Safeguard Information System (SIS) drafted (Version 1.1)

Source: https://reddplusethiopia.wordpress.com/safeguards/ and personal communication with Eyob Tenkir (Environmental Safeguard Specialist at the REDD+ Secretariat).

A Grievance Redress Mechanism (GRM) is planned, but is not in place yet. Grievances will be reported through an online platform from *kebele* to federal levels to be addressed in the courts at these different levels. Farmers can go first at the lowest level through the farmer council for their grievance, who will then report to the *kebele* level. If the farmers are not satisfied by the resolution of the conflict, they can go directly to the *woreda*, which is administratively higher than the *kebele*. In Oromia, a grievance system is already in place (OFLP 2017). This grievance system was used once in Bale in a resettlement case. Even with a grievance system in place, it may take many years for a grievance to be addressed.

3.4.2 Benefit-sharing experiences in Ethiopia

Ethiopia has some experiences in developing benefit-sharing mechanisms (BSM) for carbon benefits. An example is the Humbo Ethiopia Assisted Natural Regeneration Project, a CDM project in the SNNP region, southwest Ethiopia. Between 2009 and 2011, the project delivered 73,138.49 tCO2e in emission reductions (Tefera 2013). Proceeds from sales of Certified Emission Reduction credits have been shared with seven community organizations since 2009. Funds were allocated to each organization according to the carbon sequestered from forests planted/protected by each community in a given year, and managed by the community organizations for community development purposes (Chorito 2015). All of the proceeds from the sales of carbon credits are distributed locally, as part of a consensus with these communities. The project is managed by World Vision Ethiopia. Carbon credits were purchased by funds from the Canadian Government via the World Bank's BioCarbon Fund.

At the project level, data on carbon-sequestrated, and environmental and social benefits, are locally available generally at the *kebele* level. The data, reported to the federal level, can be used to develop a baseline and to identify beneficiaries. To date, BSM has been mostly developed in Oromia. However, the federal level is developing a legal directive for regions to apply BSM and align it with national policies.

The Oromia Forest Landscape Program is a jurisdictional (regional) REDD+ initiative under the BioCarbon Initiative for Sustainable Forest Landscapes program managed by the World Bank. It can receive up to USD 50 million in results-based payments (RBPs) for emission reductions for 10 years starting in 2018. These payments will be based on emission reduction performance (70%), forest cover (20%) and proxy indicators such as area afforested, or the number of PFM plans (10%). RBPs will be received at the state level, and then allocated to local actors. Oromia is divided into forest zones/blocks.[11] This system does not recognize project boundaries, but Oromia REDD+ Coordination Unit/MEFCC works closely with projects. Payments will be allocated to zone-level entities, and the zones will channel payments to communities and projects. According to their BSM document, 80% of RBPs will be allocated to communities and 20% to the government, after taking into account project running costs. Activities include plantations for non-timber and timber forest products. Payments will be allocated to forest blocks and paid according to performance. Each block shares the payment according to several indicators, including performance, area of forest, and size of the community within the block. The majority (70%) of the payment is based on performance.

11 A zone is an administrative level above the *woreda* and below the region.

The **Bale Mountain Ecoregion REDD+ Pilot** project is a PFM-based REDD+ project in the Oromia region. Between 2012 and 2017, it generated carbon credits from reducing 5.5 million tonnes of CO_2 equivalent of emissions (TÜV SÜD South Asia Pvt. Ltd. 2017). For this project, the criteria for how BSM works for communities are still unclear. However, credits are allocated in this way: 60% to local communities and 40% to government, out of running costs.[12] Criteria for CBOs' access to BSM are avoided deforestation, size of the forest, performance and population size (using the Organization Capital Assessment Tools). Each CBO member has a share of carbon benefits, which are progressively moved to the community level. The money goes first to the CBOs and is then shared with stakeholders and for development at the local level. When it comes to natural resources management, different rules apply for benefit sharing. For example, for conservation activities in Bale, 40% of funds go to the community, 45% to the local government and 15% to the federal government.

All benefits from the extraction of non-timber forest products go to the communities, while timber income is shared 80% for communities and 20% for the government. Timber products are mainly firewood (from dead wood) and wood for construction. Communities have more and more rights; they develop into associations to go to court in case of conflict. In SNNPR, there are legal examples of certification of use rights for some forests under PFM, which gives people confidence in the mechanism.

3.4.3 Participation of local communities in MRV

According to workshop participants, participation is seen as the engagement of local communities in forest management especially in PFM, identifying problems linked to decision making in REDD+ and designing methods/process for PMRV. In the PFM sites supported by EWNRA, information from the local level is shared with all stakeholders from local to federal levels. The federal government has produced PMRV guidelines, but not approved them yet.

The benefits of participating in MRV for communities are as follows:

- getting information about changes taking place in communities' forest-related activities and surrounding areas
- having a more transparent benefit-sharing mechanism, since the link between payment and achievements can be more transparent
- receiving wages from projects/NGOs when collecting data
- having pride in sustainable forest management through MRV
- building capacity and awareness on tree measurement, sampling and reporting land uses
- getting acknowledged as resource managers.

Through PFM in general, local arrangements between communities and project proponents are made in terms of participation and benefits from carbon payment and as a learning process. Technical support is coming from PFM project proponents or government, and control is in place at the PFM level to avoid cheating. Technical support includes the development of committees, management plans, bylaws, etc.

Ethiopia has plans to implement an MRV structure that is amenable to receiving reports from the local level. The current structure relies on *woreda* focal points to report data to the regional level. It is still unclear how communities contribute to and access this data flow. MRV labs at the regional level will manage the data. By 2018, they will be established in four REDD+ regions (Oromia, Tigray, Amhara and SNNPR). Procurement to establish the infrastructure for these regional labs is already done. Each region has two MRV specialists. Regional MRV units hosted by the regional REDD+ coordination unit run these labs. In future, they will be part of the MEFCC regional structure. In the meantime, they have their own roles and responsibilities, e.g. AD, EF at the regional scale. *Woreda* focal people will report to the regional level as a reporting system is being developed. Federal level provides technical backstopping.

12 At the time of writing, these verified carbon credits have not been sold.

4 REDD+ MRV system progress

4.1 Status of Ethiopia's NFM and MRV systems development and implementation

The status of Ethiopia's NFM and MRV systems can be summarized as of March 2018 in terms of (i) delivering crucial MRV functions; (ii) establishing institutional arrangements; and (iii) developing policies, guidelines and capacity.

4.1.1 Delivering crucial MRV functions

The NFMS was still under development in 2018. With the technical support from FAO, it has achieved several milestones:

- established an SLMS to track forest and land cover/land use change spatially
- conducted a LULC change analysis and produced a LULC map, including a forest and non-forest map (Figure 4)
- completed an NFI that is compliant with IPCC requirements for REDD+, with 550 sample units; the first report on the inventory is under preparation (FDRE 2017e)
- collected a range of information on forest conditions (e.g. stand structure and management), environmental problems (e.g. fire, erosion), human-induced disturbances and socioeconomic data (e.g. population, livelihood) during the National Forest Inventory
- generated forest carbon stocks or EF for four forest biomes using data from the NFI
- conducted a national forest cover change analysis or AD, using freely available Landsat imagery (Landsat 8) (FDRE 2017c)
- calculated and submitted the national baseline emissions/removals (FRL), using EFs and AD (FDRE 2017c)
- disaggregated the national FRL into sub-national (regional) FRLs for four REDD+ pilot regions (Oromia, Amhara, Tigray and SNNPR)
- collected data more intensively by regional experts on regional AD, to replace the national with regional EFs
- progressed toward completing Ethiopia's SIS.

4.1.2 Establishment of national REDD+ MRV institutional arrangements

- developed, also with FAO technical support, an institutional framework for REDD+ MRV implementation in June 2017 (FDRE 2017d), which (i) identifies the national MRV stakeholders, with defined/clarified roles and responsibilities; (ii) outlines the decentralization of functions from federal to regional levels; and (iii) describes the type of MRV data generated/processed at different levels and the channels of data flow
- engaged the federal MRV Task Force drawn from relevant federal-level actors, academic and research institutions, and NGOs (FDRE 2017d). In addition, the NFI planning and implementation process brought together stakeholders from federal and regional levels.

4.1.3 Development of policies, guidelines linked to NFMS/MRV and capacity building

Policies, manuals and guidelines for undertaking the NFI and for satellite and land-based monitoring have been developed, including:

- a new forest definition for REDD+ MRV purpose (FDRE 2017d)
- field manuals/guidelines for NFI field data collection, intensification and analysis (FDRE 2017e); these guidelines/protocols serve as a means for standardizing MRV data generation and ensuring consistency in methodological approaches (NFI Field Manual and NFI Data Analysis)
- a data-sharing policy that: (i) defines forest-related data-sharing needs with other actors involved in activities that affect forests and forest-related resources; and (ii) outlines the

roles and responsibilities of actors and data types that different federal-level actors generate and the data MEFCC need to access (MEFCC n.d.). The data-sharing policy indicated that depending on the type of data, access to forest-related data may assume either open access (with no authorization), access through agreements, restricted access or "shall not be disclosed" if it falls within the exemptions' clause under the Freedom of the Mass Media Proclamation No. 590/2008 (MEFCC n.d.)
- guidelines on online and offline data sharing on forest resources (MEFCC n.d.). These policies and guidelines are meant to define responsibilities, information flow processes and engagement of stakeholders. It is developed to strengthen the national arrangement on NFMS/MRV and ensure transparency.

4.1.4 Building human capacity and MRV facilities

Another critical activity was building the human resources and facilities for MRV. FAO's technical support to Ethiopia's MRV system was focused on building in-country MRV capacity through knowledge/skill transfer. This was done through training, or training of trainers and hands-on practical engagement (FAO-Ethiopia 2014). This includes the following:
- The numbers of trainees from different administrative levels and training days getting short-term training on selected MRV-relevant topics were provided to government employees, mainly MEFCC (federal and regional units), experts from the Ministry of Agriculture (regional units), academia (Addis Ababa University), parastatal institutions (Oromia forest and wildlife enterprise) and NGOs (FARM Africa) (Table 8).
- The MRV unit at MEFCC offered short-term training on GIS and RS, forest inventory, data cleaning and analysis, and activity data and FRL construction to national and subnational entities (Table 8).
- Federal-level forestry experts were directly engaged in the NFI field data collection and development of the national FRL.
- Federal experts provided FRL development training to regional experts from REDD+ pilot regions, which is an example of the level of MRV capacity built so far at the federal level (Heiru 2018). Similar training involving all the other regions (non-REDD+ pilot) was successfully concluded recently.
- WGCF-NR at Hawassa University provided short-term training under a project to improve MRV capacity building funded by the Royal Norwegian Embassy (Section 4.1.3.)

The MRV unit at MEFCC was equipped with software and hardware for data processing/analysis and for conducting training at local levels. A plan is underway to establish regional MRV units with all the facilities needed to be fully operational.[13]

4.2 Plans

One of the plans relevant to REDD+ MRV is improving measuring and monitoring of emissions from forest degradation through the use of new satellite data (Sentinel-1) for future inclusion in the national FRL. For that, Ethiopia will explore the definition of forest degradation and monitoring (FDRE 2017d).

Another plan is to improve the accuracy of classifying plantation and bamboo forests with the technical assistance of EMA and Oromia Forest and Wildlife Enterprise (FDRE 2017c).

As noted in Ethiopia's R-Package report, plans include building human resource capacity, piloting MRV capacity in four regional states and ensuring national/subnational MRV capacity through knowledge and skill transfer from FAO technical assistance (FDRE 2017e).

The national REDD+ registry will be available with all relevant information on REDD+ activities in Ethiopia (FDRE 2017e). Development of Ethiopia's Safeguards Information System (SIS) is also under construction (FDRE 2017e).

4.3 Challenges/opportunities for REDD+ MRV implementation success

Challenges and opportunities to MRV implementation in Ethiopia were identified during the workshop. Results in this section reflect the views of participants (Section 1.5: Methods and tools).

13 According to MRV Directorate of MEFCC, the plan was to recruit two MRV experts in each of the regional REDD+ units. Currently, each region has one MRV expert. Additional MRV experts will be recruited as the need arises.

Table 8. Short-term training on MRV topics offered by FAO/MEFCC/WGCF-NR.

	Federal level		Regional level	
	# trainees	# days	# trainees	# days
Capacity building by FAO				
NFI field data collection	14	7	33	7
Species identification	20	1	10	1
NFI quality control/quality assessment, sampling design	6	4		
Data entry and cleaning/cleansing using Open Foris and Collect Earth	6	5	12	5
NFI data analysis and calculation of EFs using open software (Calc, R-script, Saiku); rigorous training	6	12		
Biomass modeling (allometric models)	4	4		
General land classification and LULC preparation	22	2		
GIS/RS and AD – assessment of forest-cover change using Google Earth Engine – Application Interphase (GEE-API)	9	7	6	18
Remote sensing using ERDAS			24	12
GIS/RS and AD assessment of forest-cover change using Google Earth Engine – Application Interphase (GEE-API) – Rigorously continuous	4	15		
Construction of Forest Reference Level	4	4	6	15
Capacity building by MEFCC/MRV unit				
Forest Inventory	16	6	123	11
GIS & RS	27	12	18	8
AD production and FRL construction	6	20	18	20
Data cleansing and analysis	19	6	123	11
Capacity building by WGCF-NR				
Application of GIS/RS in forestry	11	7	63	7

Source: Personal communication with Antonello Salis (FAO).

4.3.1 Challenges

This section highlights challenges related to technical capacity, institutions and resources in the current MRV system as discussed by workshop participants. It includes some recommendations on how to address the challenges.

Sectoral challenges:

- The forestry sector remained ignored until a ministry was established in 2013. As a result, the forestry sector is not organized yet to accommodate REDD+ MRV activities in a more effective and efficient manner. Therefore, MRV capacity at national and regional levels is still far from what is needed for a fully functional MRV system. Capacity in terms of human resources and logistics needs to be addressed, particularly in the regional and local levels for successful measurement, monitoring and reporting.
- Most of the problems related to MRV are located outside the sector. The four identified constraints include lack of coordination among relevant sectors (government agencies), organizational limitation in the forestry sector reflected in the MRV performance, weak feedback system and the shortage of skilled labor and financial resources.

Recommendations:

- MRV should be outside of MEFCC to consider the other concerned sectors: livestock, energy, water and agriculture.
- A new organizational structure should be in place to reflect the objectives of the forestry sector in general, and the role of forestry in the CRGE.

Technical challenges:

- Internet speed and stability to download/upload a large amount of data needed to perform remote sensing and other MRV-related tasks are often insufficient and unpredictable.
- It was difficult to distinguish the different types of landscapes in Ethiopia using Landsat images. The map produced reveals some of these weaknesses, some related to shadows due to topography.
- Despite its significant contribution to forest-related emissions, the current scope of MRV has not included forest degradation. Testing and developing cost-effective, robust and reliable methods for consistent measuring and monitoring of emissions from forest degradation is critical for including forest degradation in the national FRL. So far, forest degradation estimation has been piloted in 2017–2018 in small patches with good results for the dense forests.
- There is a web-portal and REDD+ registry that provides geo-referenced information on many REDD+ issues. Currently, this is not available for the public. This is a crucial gap to be addressed to ensure accountability and transparency of Ethiopia's MRV system.
- SIS exists only in Oromia, not yet in other regions. It will be therefore difficult to scale up because of the diversity of situations/contexts between the different regions. It takes time to build institutional capacity to develop a good SIS; Ethiopia REDD+ readiness is supposed to be finalized in June 2018.
- The national MRV system also needs to acquire information on land-use changes, information that is generally available at the local level or using remote sensing. Consequently, better coordination is needed between satellite images analysis and reports from the local level.

Recommendations:

- Work in a different system in the cloud where there is no need to download from a server. This mechanism is supported by FAO, as an Ethiopia-based alternative, but it is not available. The cloud data need to be backed up on a local server. There is an FAO platform for image processing called SEPAL that facilitates users to communicate to a super server, e.g. Amazon. This allows complex computation even using moderate levels of Internet connection.

Institutional challenges:

- The NFI needs a mechanism in place for logistics, budget, defining roles and responsibilities.
- Procurement for field sampling activity in NFI is challenging, leading to delays.
- High staff turnover in government organizations at both the federal and regional levels makes capacity building especially on PMRV a challenge because it takes time to learn how to engage with local communities properly.

Participation and safeguard issues:

- The level of government engagement (e.g. WGCF-NR whose involvement is only through the MRV Task Force) and non-government stakeholders is very much limited to consultation on the overall REDD+ process in general and their participation in the national MRV task force. Some stakeholders (e.g. EthioWetland, which is a REDD+ project proponent) are not members of the MRV Task Force and do not get information about the national MRV system.
- Despite acknowledgment by MEFCC of the necessity to involve local communities in REDD+ MRV to increase local awareness, social safeguards and participation, there is no action so far (2019).
- Although individual grievance is permitted, in the frame of PFM and through bylaws, the organization of communities in groups to manage the forests can make the individual grievance more difficult to express.
- Local communities and government are still not sufficiently informed about safeguards; they need to be involved in SIS. The use of a web platform for grievance limits the number of people having access to it. A GRM should, therefore, be based on traditional conflict resolution systems at the local level. At the national level, grievances are managed by MEFCC and the court.
- It is challenging to manage environmental safeguards with people near or in the forest sites under REDD+ because they are part of the drivers of degradation/deforestation.
- When FPIC is implemented, the C refers to Consultation rather than to Consent, which raises the issue of the validity of communities' engagement, and the right to resign from the project.
- Recognition of the community's user rights on forests under REDD+ only exists in some cases (e.g. Oromia and SNNPR). The challenge will be to scale up and adopt systems for the federal level.

Recommendation:
- Develop a mechanism to bring on board all relevant stakeholders to ensure their participation in decision making and effective coordination of relevant activities in the country.

Benefit-sharing issues:
- Activities are still in a pilot stage, but the danger is to raise expectations. The REDD+/ carbon credit payment mechanism needs to quickly become operational and not solely dependent on the UN system.
- Local people need to be informed about benefit-sharing mechanisms. At a higher level (national/international), an active policy is needed (and still lacking) to push donors to meet their commitments, within UNFCCC's Green Climate Fund.
- The federal level does not have a mechanism to regulate the fluctuation of the carbon market. Carbon prices (USD 5.00 per ton, or even less) are low in comparison with other forms of forest management (e.g. timber exploitation).
- In Oromia, BSM documents to be endorsed by the region are still under development. BSM still needs to be designed and put into practice, with a distribution of benefits horizontally according to performance. Currently, it rarely reaches the community level.
- The decision related to BSM is made at CBO and *kebele* levels. This situation can lead to conflict if no CBO exists at the local level.
- When REDD+ projects claim to use a BSM that gives 80% of the benefit to communities, it is most of the time net benefit. This implies most of the payment is consumed by implementation costs before reaching the communities.

Participatory MRV issues:
- There are no clearly defined roles and responsibilities of local communities in REDD+ MRV despite the indication of PMRV as a promising approach.
- Participatory mapping should comply with the federal mechanism. Should communities involved in MRV be considered as an institution or are they part of the system? If communities contributing to PMRV are an independent institution, then communication with the national system may be a challenge.
- Reporting protocol and data flow on reforestation and data reporting from communities are not yet established. Responsibilities of *woreda*-level MRV staff are not yet clarified. A mechanism is needed on how data should feed the national system. A single MRV system is planned for Oromia because there is one emission reduction agreement.

4.3.2 Opportunities

Notwithstanding the challenges mentioned in the above section, workshop participants acknowledged that Ethiopia's REDD+ MRV development process opened a gate of opportunities:
- Ethiopia's REDD+ MRV institutional arrangements are formal structures within the existing MEFCC structure with clear roles and responsibilities, which ensure government ownership. Ethiopia's endorsement of a framework for REDD+ MRV institutionalization is an important step forward, particularly in ensuring a sustainable system.
- There is relatively strong political buy-in of Ethiopia's REDD+ MRV development process. Ethiopia's CRGE strategy clearly outlines that addressing the negative impacts of climate change is at the top of the government's development agenda. It also makes clear that the vital role of the forestry sector in realizing these development objectives underpins the government's commitment.
- The development of a national MRV system through a collaborative arrangement between the government and FAO creates an opportunity for in-country REDD+ MRV capacity building and knowledge transfer that partly ensures sustainability of REDD+ MRV implementation. National MRV capacity building through the Wondo Genet MRV project will create an opportunity to build spatial data infrastructure at the university level, and human capacity development (PhD, MSc) will further ensure sustainability of MRV implementation in Ethiopia.
- The REDD+ MRV system development process creates an opportunity to lay the foundation for modernizing the forestry sector in Ethiopia by building the NFMS and national forest assessments and generating robust data about the sector. This is particularly important for realistic planning of

forest development activities and management of the forest resources of the country.
- The development of an MRV web portal (still under construction) can improve data transparency. This will allow MEFCC to share MRV data publicly (open access), with a portal that integrates data collected and processed by the national MRV lab. This will also include manuals and other documents.
- A system must be developed to better distribute benefits, and avoid or reduce transaction costs, so that more money can reach the communities.

5 Conclusions

Ethiopia's REDD+ program, embedded in the country's overarching CRGE strategy, has the goal of contributing to the objective of achieving zero net emission by 2030. Ethiopia implemented its national REDD+ readiness activities in the last four and half years (from January 2013 until June 2018). An essential component of Ethiopia's REDD+ program is the development and operationalization of the NFMS/MRV system for monitoring of REDD+ outcomes and result-based payments.

Ethiopia's REDD+ MRV design follows a national arrangement where the MRV unit develops and maintains the NFMS. The NFMS/MRV development followed the guidance provided by IPCC guidelines/good practice manuals and/or UNFCCC guidance on technical, institutional and good-governance aspects of REDD+ MRV. The REDD+ MRV system made significant progress in generating essential data relevant to REDD+, setting FRL and building capacity. Moderate progress was achieved in the areas of stakeholder participation, accountability and coordination. The overall assessment based on this review reveals that the national REDD+ MRV development and implementation process showed moderate to high progress.

Despite these achievements, operationalizing the REDD+ MRV system requires additional progress. Key areas are creating functional MRV units at different levels,[14] continuous capacity building, and creating effective stakeholder participation and a coordination platform. Lack of inclusiveness with regards to local-level stakeholders in the national REDD+ MRV system development process is a key challenge/gap.[15] Despite the crucial role of local people in forest monitoring, there is little tangible action either initiated or planned in enhancing their participation and integrating participatory MRV into the national MRV system framework. A few of the challenges that need to be addressed include ensuring sustainable financing through national ownership, developing incentives to maintain trained staff and avoid turnover, and enhancing in-country technical capacity to run and manage the system. Apart from these challenges/gaps, there are opportunities for successful NFMS/MRV implementation. The Ministry of Environment, Forest and Climate Change elaborated its plans for addressing the gaps and its plans for functionalizing the REDD+ MRV system. To this end, a multi-level MRV institutional governance framework is outlined with partly decentralized responsibilities that defines the roles of different actors.

The MRV workshop discussed in depth the gaps that need to be addressed for operationalizing Ethiopia's REDD+ MRV system. Participants emphasized the importance of improving stakeholder participation, coordination and multi-level governance.

14 Ethiopia's R-Package (REDD+ Readiness Process) was officially endorsed in September 2017 by the FCPF's participant committee. The committee acknowledged that Ethiopia's progress fulfills the minimum requirement for accessing REDD+ financing. In fact, as in other countries, the participant committee noted few activities that need to be finalized before June 2018. The country is about to launch an implementation phase (with bilateral support from the Government of Norway) in the coming months.

15 According to the workshop participants, the lack of, or low, participation is due to the slow progress in bringing in communities to the scene. This is due to the sluggish progress of the official organizational structure that should involve communities. The limitations in the PFM arrangement are also a challenge to be addressed, given this approach is expected to prioritize community participation.

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This Occasional Paper is a review of the development of Ethiopia's REDD+ MRV system, its national architecture and policies, progress made so far, and plans for the future. It is not a technical review of the current MRV system. We use published and unpublished literature on Ethiopia's REDD+ program, combined with in-depth interviews, and consultations of key MRV stakeholders (in the form of a workshop) from government, non-government and international organizations in Ethiopia. This paper is part of the Global Comparative Study (GCS-REDD+) conducted by CIFOR with funding from multiple donors.

Ethiopia has been implementing REDD+ readiness activities since 2012. Since then, Ethiopia has made significant progress in establishing a National Forest Monitoring System for the Measurement, and Reporting and Verification (MRV) of REDD+. Several milestones were achieved, including the acceptance of the Forest Reference Level by UNFCCC, and the completion of the National Forest Inventory. To ensure the credibility of MRV results, it is crucial that various reporting streams are consistent and linked with each other. Nevertheless, Ethiopia has yet to link REDD+ MRV with other GHG measuring systems. The country also needs to address the high turnover of trained experts and continued demand for additional capacity. Improving the participation of local communities and civil society in MRV is paramount in ensuring sustainability and accountability.

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