



**National Forest Monitoring Systems:
Monitoring and Measurement, Reporting
and Verification (M & MRV) in
the context of REDD+ Activities**





UN-REDD

PROGRAMME



The UN-REDD Programme is the United Nations collaborative initiative on Reducing Emissions from Deforestation and forest Degradation (REDD+) in developing countries. The Programme was launched in 2008 and builds on the convening role and technical expertise of the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP). The UN-REDD Programme supports nationally-led REDD+ processes and promotes the informed and meaningful involvement of all stakeholders, including Indigenous Peoples and other forest-dependent communities, in national and international REDD+ implementation.

National Forest Monitoring Systems: Monitoring and Measurement, Reporting and Verification (M & MRV) in the context of REDD+ Activities

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Acronyms

| | |
|-------------------|---|
| AD | Activity Data |
| AFOLU | Agriculture, Forestry and Other Land Use |
| CDM | Clean Development Mechanism |
| CO ₂ e | Carbon Dioxide equivalent |
| COP | Conference of the Parties of the UNFCCC |
| C&I | Criteria and Indicators |
| EF | Emission Factors |
| FAO | Food and Agriculture Organization of the United Nations |
| FCPF | Forest Carbon Partnership Facility |
| FRA | Global Forest Resources Assessment |
| GHG | Greenhouse Gas |
| INPE | Brazilian Space Agency |
| IPCC | Intergovernmental Panel on Climate Change |
| IUCN | International Union for Conservation of Nature |
| ITTO | International Tropical Timber Organization |
| JI | Joint Implementation |
| LULUCF | Land Use, Land-Use Change and Forestry |
| MECNT | Ministry of Environment, Conservation of Nature and Tourism of the Democratic Republic of Congo |
| M & MRV | Monitoring and Measurement, Reporting and Verification |
| NFI | National Forest Inventory |
| NFMS | National Forest Monitoring System |
| PAMs | Policies and Measures |
| QA | Quality Assurance |
| QC | Quality Control |
| REDD+ | reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries |
| REL | Reference Emission Levels |
| RL | Reference Levels |
| SLMS | Satellite Land Monitoring System |
| SMF | Sustainable Management of Forests |
| UNCED | United Nations Conference on Environment and Development |
| UNDP | United Nations Development Programme |
| UNEP | United Nations Environment Programme |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UN-REDD | The United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries |
| WCS | Wildlife Conservation Society |



Executive Summary

This document builds on the brief paper presented at the 7th Meeting of the UN-REDD Programme Policy Board, held in Berlin, October 2011 (UNREDD/PB7/2011/13), which lays out ways to consider the REDD+ monitoring and information provision needs in the broader context of national development and environmental strategies, at the implementation level.

The purpose of this document is to describe the elements in National Forest Monitoring Systems (NFMSs) as they relate to REDD+ under the United Nations Framework Convention on Climate Change (UNFCCC), and to describe the UN-REDD Programme approach to Monitoring and Measurement, Reporting and Verification (M & MRV) requirements. This paper is presented in a series of sections discussing the various elements of relevant texts of the UNFCCC and the methodological recommendations of the Intergovernmental Panel on Climate Change (IPCC). This approach aims to allow the end-user to consider the implications of the implementation of REDD+ activities in distinct national contexts, and the various steps involved.

The future vitality of the world's forests and the globally significant environmental services they provide are increasingly under threat from human activities. Not only do these activities have negative impacts on biodiversity and hydrological services but they also contribute to global climate change. It is estimated that deforestation of tropical forests released around 1-2,000 Mt C/yr to the atmosphere during the 1990s, which corresponds to approximately 17 percent of annual anthropogenic greenhouse gas (GHG) emissions during the same period. This significant source of emissions is being addressed under the UNFCCC, through reduced emissions from deforestation and forest degradation (REDD), with the aim of lowering the contribution from the forestry sector. REDD became 'REDD+' with the addition of activities aiming to conserve, sustainably manage and increase forest carbon stocks.

REDD+ covers five activities, operationalised during the 16th Conference of the Parties (COP) to the UNFCCC in Cancun, Mexico, in Decision 1/CP.16, paragraph 70:

- Reducing emissions from deforestation;
- Reducing emissions from forest degradation;
- Conservation of forest carbon stocks;
- Sustainable management of forests;
- Enhancement of forest carbon stocks.

Decision 1/CP.16 is the outcome of international negotiations under the UNFCCC, which began in 1992 and have gradually been implemented since then through several steps, notably through the adoption of the Kyoto Protocol. The Kyoto Protocol sets legally-binding GHG Quantified Emission Limitation and Reduction Commitment (QELRO) for developed (Annex I) countries in recognition of their historical contribution to the current concentrations of GHGs in the atmosphere. The REDD+ activities constitute an important step to enhance mitigation of climate change through actions by developing countries.

The REDD+ activities aim to reduce GHG emissions from the forest sector in developing countries, supported by a fair positive incentives system for participating developing countries while applying the principles encouraged by the UNFCCC. As an established practice, the UNFCCC usually requests the Intergovernmental Panel on Climate Change (IPCC) to develop methodologies for estimating GHG emissions and removals based on sound science. These methodologies are then used by countries to compile data for their GHG inventories, which are then, following further guidance by the UNFCCC, reported to the UNFCCC Secretariat.

The gradual and cumulative nature of the negotiation process led to a series of Decisions relating to REDD+ activities over time that are a combination of principles, rules and modalities, including methodological guidance (e.g. Decisions 1/CP.13, 2/CP.13, 4/CP.15, 1/CP.16). The result of this fine-tuning process is a series of provisions including recommendations and requirements, both institutional and technical. According to Decision 1/CP.16, countries should implement REDD+ activities in three phases. Only in the third phase, when the NFMS must be fully operational, may a country receive positive incentives (performance-based) in accordance with future decisions of the UNFCCC.



This document also outlines the methodological proposals of the UN-REDD Programme to implement a NFMS that will allow country Parties to comply with the REDD+ requirements through a sustainable stepwise approach. The process should allow for incremental efforts to improve performance in recognition of countries' varied capabilities and national circumstances. Under the UN-REDD Programme approach, an NFMS can serve simultaneous functions: a 'monitoring' function and a 'Measurement, Reporting and Verification (MRV)' function. The key technical elements under each of these functions are explained.

The "monitoring" function of the NFMS is primarily a domestic tool to allow countries to assess a broad range of forest information, including in the context of REDD+ activities. The monitoring function can be implemented through a variety of methods and serve a number of different purposes, depending on national circumstances, but in the UN-REDD Programme context it focuses on the impacts and outcomes of 1) demonstration activities carried out during the second phase of REDD+ and 2) national policies and measures for REDD+ in the third phase of REDD+.

The MRV function for REDD+, on the other hand, refers to the estimation and international reporting of national-scale forest emissions and removals. It is based on three main components, or 'pillars': 1) the satellite land monitoring system (SLMS); 2) the national forest inventory (NFI); and 3) the national GHG inventory. The SLMS and the NFI pillars are used to provide inputs into the third pillar – the forest sector component of the GHG inventory. Countries must progressively develop and operationalize these three pillars over the three phases of REDD+, and align them with the monitoring function, so that by the third phase of REDD+ they have a fully functional NFMS.



Introduction

Climate change and forests

Anthropogenic climate change has become a scientific and political phenomenon without precedent. The United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol constitute two of the responses of the international community to address the challenges presented by climate change. To support these responses through sound scientific approaches, the Intergovernmental Panel on Climate Change (IPCC) was formed as the international scientific body responsible for assessing climate change science and providing methodological guidance on how to estimate greenhouse gas (GHG) emissions and removals through GHG inventories.

About 30% of the global land area is covered by forests, which provide a wide range of important products such as timber, fuel wood, paper, food and fodder as well as environmental and social services including the protection of soil and water resources, the conservation of biological diversity and the provision of livelihoods for an estimated 1.6 billion people (World Bank, 2004). Forests, like other ecosystems, are affected by climate change, but also influence climate and the climate change process. They absorb carbon in wood, leaves and soil, and release it into the atmosphere, for example when burned or when forest land is cleared. At the global level it is estimated that deforestation and forest degradation released around 1–2,000 Mt C/year during the 1990s, (Houghton, 2005), which represents around 17% of total annual anthropogenic GHG emissions (IPCC, 2007). It is estimated that the majority of deforestation and forest degradation takes place in developing countries (Gullison et al., 2007).

Objectives

As part of international climate change mitigation efforts and in the context of the implementation of the UNFCCC, developing countries are encouraged to undertake activities in the forestry sector to reduce GHG emissions, and conserve, enhance and sustainably manage forest carbon stocks. These are referred to as the REDD+ activities¹. The UNFCCC advises countries aiming to undertake REDD+ activities to follow methodologies for estimating GHG emissions and removals developed by the IPCC to be able to provide transparent and consistent information. However, the technical language used, and the range of issues addressed in UNFCCC decision texts, are sometimes difficult to understand.

This report aims to collate the UNFCCC decisions and international requirements which are relevant to national forest monitoring systems (NFMS) in the context of REDD+, and to provide a basis for the practical implementation of their dual functions of (i) monitoring and (ii) measurement, reporting and verification (from now on M & MRV).

This document is specifically targeted at developing countries aiming to undertake REDD+ activities following the decisions of the UNFCCC, drawing on experiences from UN-REDD Programme pilot countries. Each section of this report addresses a specific aspect related to the implementation of the NFMS, sets out the relevant international guidance and outlines actions which countries can take to begin implementation.

Figure 1 illustrates how this document sits in relation to the national arrangements and documents tested by the UN-REDD Programme as essential elements of the M & MRV approach.

This document begins by presenting REDD+ in the context of the UNFCCC and ongoing multilateral climate change processes, followed by an outline of the concepts of the NFMS's functions and their application within the UNFCCC framework. An overview of methodological requirements and guidelines is then set out. Finally, the document proposes concrete actions/recommendations which countries can take towards implementation following the proposed UN-REDD strategy.

¹ Reducing emissions from deforestation, reducing emissions from forest degradation, conservation of forest carbon stocks, sustainable management of forests, enhancement of forest carbon stocks.



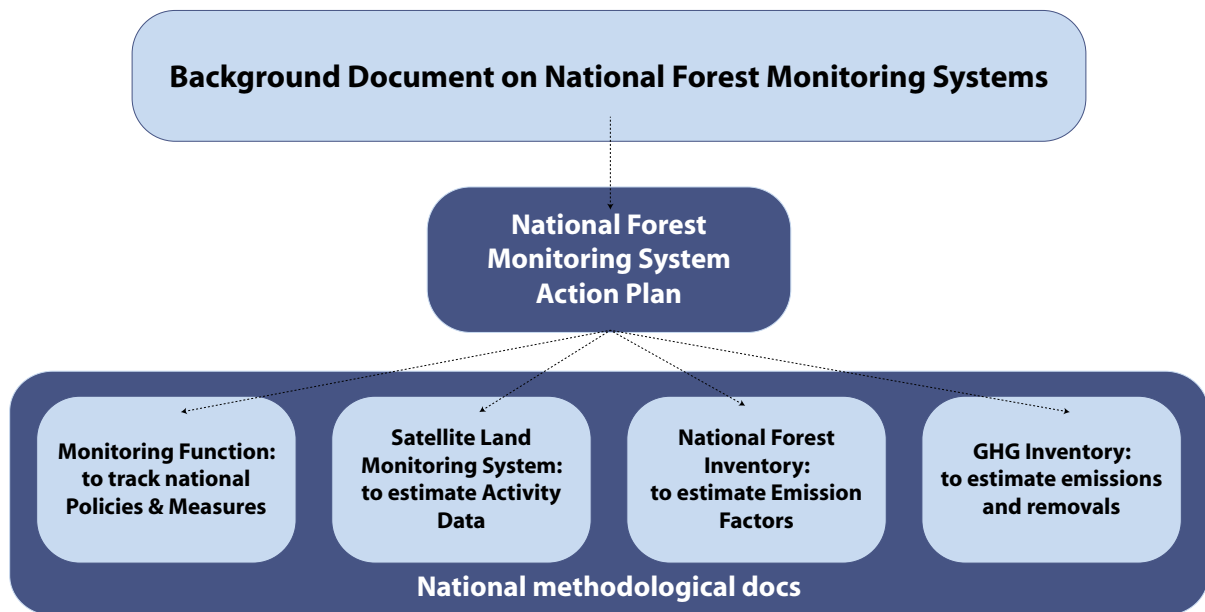


Figure 1. Relationship of this Background Document on National Forest Monitoring Systems with the national methodological arrangements for M & MRV



Concepts under the United Nations Framework Convention on Climate Change (UNFCCC)

The UNFCCC

The UNFCCC is one of the three international multilateral agreements on the environment that emerged from the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil, in 1992. The ultimate objective of the UNFCCC is to stabilise GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system (UNFCCC, Article 2). The UNFCCC entered into force on 21 March 1994, and as of May 2001, there are 195 Parties (194 countries plus the European Union). Parties to the Convention have been meeting every year since 1995 at Conferences of the Parties (COP) to assess progress and enhance the implementation of the Convention to better respond to the climate change challenges identified by the IPCC.

The Convention text sets out how Parties can respond and adapt to climate change, and sets out commitments in Article 4 that Parties agree to follow in order to reach the Convention's ultimate objective. The first of the Article 4 commitments is the need share national GHG data using comparable methodologies:

"All Parties, taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances, shall:

1(a) Develop, periodically update, publish and make available to the Conference of the Parties, in accordance with Article 12, national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, using comparable methodologies to be agreed upon by the Conference of the Parties"

The Convention makes reference to a group of 37 industrialized country Parties listed in Annex I of the Convention (1992). Together: *"the developed country Parties and other Parties included in Annex I commit[ting] themselves specifically as provided for in the following* (Art. 4, paragraphs 2 and 3, 1992):

... shall adopt national policies and take corresponding measures on the mitigation of climate change, by limiting its anthropogenic emissions of greenhouse gases and protecting and enhancing its greenhouse gas sinks and reservoirs;

shall communicate ... detailed information on its policies and measures ... as well as on its resulting projected anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol ... with the aim of returning individually or jointly to their 1990 levels these anthropogenic emissions of carbon dioxide and other greenhouse gases not controlled by the Montreal Protocol".

The Convention also makes reference to Annex II Parties, which are committed as follows (Article 4, paragraphs 4 and 5, 1995):

"The developed country Parties and other developed Parties included in Annex II shall provide new and additional financial resources to meet the agreed full costs incurred by developing country Parties in complying with their obligations under Article 12, paragraph 1;

Box 1: Categories of Parties to the UNFCCC

The Convention divides countries into three main groups according to differing commitments:

Annex I Parties include the industrialized countries that were members of the OECD (Organization for Economic Co-operation and Development) in 1992, plus countries with economies in transition (the EIT Parties), including the Russian Federation, the Baltic States, and several Central and Eastern European States.

Annex II Parties consist of the OECD members of Annex I, but not the EIT Parties. They are required to "take all practicable steps" to promote the development and transfer of environmentally friendly technologies to EIT Parties and developing countries.

Non-Annex I Parties are mostly developing countries. Only countries in this category can participate in REDD+ activities.

... shall also assist the developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects;

... shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention".

Parties not listed in Annex I are developing countries and referred to as 'non-Annex I' Parties. The Convention explicitly recognises developed countries' greater contribution to anthropogenic GHG emissions, and therefore to atmospheric GHG concentrations, by introducing the principle of "common but differentiated responsibilities", with Principle 1 of the Convention stating that: *"... developed country Parties should take the lead in combating climate change and the adverse effects thereof"*.

Moreover, the Convention text recognises the development challenges faced by non-Annex I countries and calls upon developed country Parties to support non-Annex I Parties to meet their commitments under the Convention. In this context, paragraph 7 of Article 4 sets out:

"The extent to which developing country Parties will effectively implement their commitments under the Convention will depend on the effective implementation by developed country Parties of their commitments under the Convention related to financial resources and transfer of technology and will take fully into account that economic and social development and poverty eradication are the first and overriding priorities of the developing country Parties".

When it was established, the UNFCCC did not set legally binding targets or limits on GHG emissions for the Parties. However, it was soon obvious that, without targets, its effectiveness was limited. The Kyoto Protocol was therefore set up as the tool for enhancing the implementation of the UNFCCC, setting binding emissions reductions targets for Annex I Parties (see Box 2). The Kyoto Protocol entered into force in 2005, and its first five-year commitment period was established for 2008–2012.

Though the emphasis of emissions reductions efforts has to date been on Annex I Parties – notably through the implementation of the Kyoto Protocol – recent decisions of the UNFCCC, in particular Decision 1/CP.16 adopted in Cancun in 2010, indicate that non-Annex I Parties could also play a role in mitigation activities in any future global climate agreement. The REDD+ activities are an example of how developing countries could contribute to climate change mitigation, through activities in the forest sector.

Box 2: The Kyoto Protocol

The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997, and entered into force on 16 February 2005. The rules for the implementation of the Protocol were adopted at COP7 in Marrakesh in 2001, referred to as the 'Marrakesh Accords'.

The main feature of the Kyoto Protocol is that it sets a legally binding target for 37 industrialized countries, as well as for the European Community, to reduce GHG emissions by an average of 5 percent against 1990 levels over the five-year period 2008–2012.

While the Convention **encourages** industrialized countries to stabilize or reduce GHG emissions, the Kyoto Protocol **commits** Annex I country Parties to do so (through a legally binding instrument). Recognising that developed countries are primarily responsible for the current atmospheric GHG levels as a result of over 150 years of industrial activity, the Kyoto Protocol places a heavier burden for action on developed countries under the principle of 'common but differentiated responsibilities'. In addition to targeting national measures for reducing GHG emissions, the Kyoto Protocol provides countries with an additional tool for achieving their objectives through three flexibility mechanisms:

- Trading of Assigned Amount Units (AAUs), allowing Annex I country Parties to exchange emission allowances among themselves;
- Clean Development Mechanism (CDM) through which developed countries can fund emissions reductions projects in developing countries, while contributing to technology transfer;
- Joint Implementation (JI) which is similar to CDM but the emission reduction projects are implemented in Annex B countries. (Annex B countries are Parties to the UNFCCC that have committed to limitation or reductions of emissions under the Kyoto Protocol).

The Kyoto Protocol is considered an important first step towards a global GHG emissions reduction effort and provides some good elements for inclusion in any future international agreement(s) on climate change. Nevertheless, the first commitment period of the Kyoto Protocol is due to expire in 2012, and a second commitment period has been agreed by Parties at COP 17 in Durban. The length of this second commitment period of the Kyoto Protocol, and the Parties who will take part to it, remain to be decided. In addition, a new climate framework, including specific mechanisms for mitigating further climate change, is under consideration and is scheduled to begin in 2020. The UNFCCC REDD+ decisions are the result of considerations under the Ad-Hoc Working Group on Long Term Cooperative Action (AWG-LCA) on how developing countries can contribute to global mitigation efforts in the forest sector. REDD+, therefore, does not fall under the Kyoto Protocol second commitment period, but rather under the broader discussions on the overall enhancement of the implementation of the Convention.



Concepts of forest Monitoring and Measurement, Reporting and Verification under the UNFCCC

There are no specific definitions of the monitoring and MRV concepts under the UNFCCC. This section provides a practical approach for implementing a national forest monitoring system based on the Convention text.

Monitoring

The working definition for "monitoring" applied in this document is: the need for periodic information on the results obtained through national policies and measures, as per Article 4.2, paragraphs a) and b) of the Convention:

"In order to promote progress to this end, each of these Parties shall communicate, within six months of the entry into force of the Convention for it and periodically thereafter, and in accordance with Article 12, detailed information on its policies and measures referred to in subparagraph (a) above, as well as on its resulting projected anthropogenic emissions by sources and removals by sinks of greenhouse gases."

Measurement – Reporting – Verification (MRV)

MRV can be interpreted as the means to address countries' commitments to collect and share information on the progress of the implementation of provisions and/or commitments of Parties, according to Article 4.1 (a) of the Convention, to:

"Develop, periodically update, publish and make available to the Conference of the Parties, in accordance with Article 12, national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, using comparable methodologies to be agreed upon by the Conference of the Parties."

Annex I Parties can meet their MRV commitments by compiling and submitting information to the UNFCCC Secretariat, including:

- National Inventory Report (NIR),
- GHG data in Common Reporting Format (CRF) tables, which standardize the way in which this information is compiled, and
- National System for the National GHG Inventory under the Kyoto Protocol, which contains details of their national institutional arrangements.

This allows the UNFCCC Secretariat to assess their overall performance in terms of mitigating climate change. Nevertheless, prior to the adoption of the Bali Action Plan at COP 13 (Bali, 2007), non-Annex I Parties did not have any specific mitigation commitments. In terms of MRV, all Parties under the Convention must report on their current and envisaged strategies to implement the Convention (Articles 4.1 and 12) through National Communications (NCs). In accordance with the principle of "common but differentiated responsibilities" under the Convention, the requirements of these NCs, in terms of their contents and submission periods, are different for non-Annex I Parties and Annex I Parties.

Under the Bali Action Plan (Decision 1/CP.13), developed and developing country Parties alike agreed to enhance their action on mitigation of climate change, notably by implementing "*measurable, reportable and verifiable nationally appropriate mitigation actions*" (NAMAs). This agreement triggered negotiations on MRV for NAMAs undertaken by non-Annex I Parties, resulting in guidance under decisions 1/CP.16 (Cancun, 2010) and 1/CP.17 (Durban, 2011). Although much remains to be decided on MRV for REDD+, it is clear that current and future MRV guidance for NAMAs is relevant for REDD+ activities, as underlined in Decision 1/CP.16: [MRV for REDD+ activities must be] "*consistent with any guidance on measuring, reporting and verifying NAMAs by developing country Parties agreed by the COP, taking into account methodological guidance in accordance with decision 4/CP.15*".

REDD+ Activities and their Implementation

REDD+ in UNFCCC decisions

As part of international efforts to mitigate climate change, REDD+ aims to provide positive incentives to developing countries for activities that reduce GHG emissions and that enhance forest carbon sinks in the forest sector. In addition to reducing emissions from deforestation and degradation, the REDD+ negotiations have evolved to include the conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks. This wide scope was agreed upon to allow broad non-Annex I Party participation, based on differing national circumstances.

Negotiations on REDD+ can be traced back to the 11th session of the UNFCCC COP, Montreal (2005), where it was raised as an agenda item that later initiated a two-year process under the UNFCCC's Subsidiary Body for Scientific and Technological Advice (SBSTA), including several technical workshops on the issue. This led to the introduction of REDD+ as part of the Bali Action Plan at COP 13 in 2007, as follows: "*reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries*" (Decision 1/CP.13). Decision 2/CP.13 also provided some early methodological guidance. Figure 2 illustrates the timeline of UNFCCC discussions on REDD+.

This process was strengthened and consolidated during the COP 15 meeting of the UNFCCC in Copenhagen in 2009, during which several principles and methodological guidelines were defined through the adoption of Decision 4/CP.15 entitled "*Methodological guidance for activities relating to reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries*".

Parties at COP 16 in Cancun, December 2010, adopted Decision 1/CP.16, section C of which covers "*Policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries*". The five activities under REDD+ are defined for the first time in Decision 1/CP.16, paragraph 70, which reads as follows:

"Encourages developing country Parties to contribute to mitigation actions in the forest sector by undertaking the following activities, as deemed appropriate by each Party and in accordance with their respective capabilities and national circumstances:

- a. Reducing emissions from deforestation;
- b. Reducing emissions from forest degradation;
- c. Conservation of forest carbon stocks;
- d. Sustainable management of forests;
- e. Enhancement of forest carbon stocks."

Initial methodological guidance in relation to MRV for REDD+ was provided at COP 15, Copenhagen (2009). Decision 4/CP.15, paragraph 1(d) "**Requests**" Parties to:

"...establish, according to national circumstances and capabilities, robust and transparent national forest² monitoring systems and, if appropriate, sub-national systems as part of national forest monitoring systems that:

- i. Use a combination of remote sensing and ground-based forest carbon inventory approaches for estimating, as appropriate, anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks and forest area changes [*Monitoring and Measurement*];
- ii. Provide estimates that are transparent, consistent, as far as possible accurate, and that reduce uncertainties, taking into account national capabilities and capacities; [*Reporting*]
- iii. Are transparent and their results are available and suitable for review as agreed by the Conference of the Parties;" [*Verification*].

² "Taking note of, if appropriate, the guidance on consistent representation of land in the Intergovernmental Panel on Climate Change Good Practice Guidance for Land Use, Land-Use Change and Forestry."



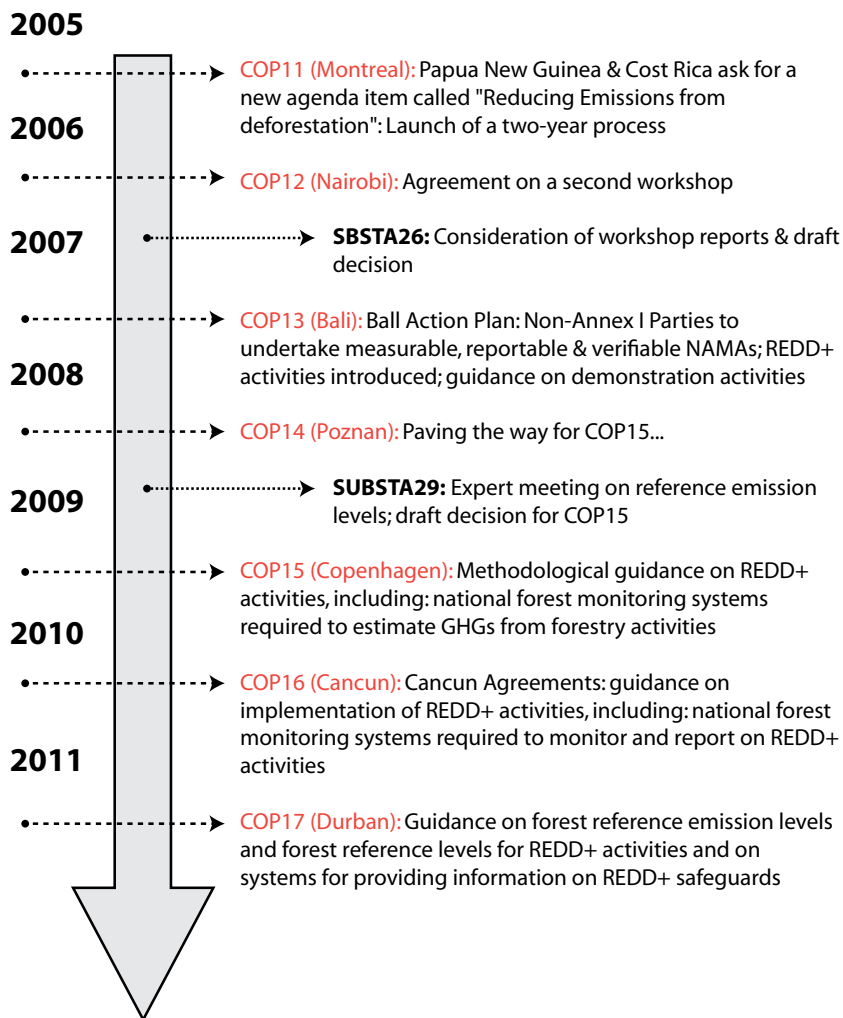


Figure 2. Progress of REDD+ discussions from COP 11 to COP 17

This decision establishes that country Parties must develop a national forest monitoring system (NFMS), which is the specific focus of this document. To achieve this, Decision 4/CP.15, paragraph 1(c) specifies that countries must follow the most recent methodological recommendations issued by the IPCC, as adopted or encouraged by the COP, as a basis for estimating the sources of anthropogenic GHG emissions, their removal by sinks, and for measuring carbon stocks and changes in forest area. In this way, emissions estimates will be based on comparable, methodological approaches. A country's NFMS should also be used for data and information collection, such as information on historical forest cover changes, to inform the assessment of national or sub-national forest reference emission levels and/or forest reference levels (RELS/RLs) (see Box 3). In this way, the NFMS will form the link between historical assessments and current/future assessments, enabling consistency in the data and information to support the implementation of REDD+ activities in countries.

REDD+ activities: An overview

The five REDD+ activities set out by Decision 1/CP.16 are: reduction of emissions from deforestation; reduction of emissions from forest degradation; conservation of forest carbon stocks; sustainable management of forests; and enhancement of forest carbon stocks. REDD+ activities can also be separated into two broad categories, as follows:

- **Change in land use**, for example:
 - Reducing* change from forest land > cropland (deforestation);
 - Promoting* change from cropland > forest land (enhancement of forest carbon stocks);
- **Change within the same category of land use**, for example:
 - Reducing* change in forests from no timber extraction > sustainable timber extraction (degradation);
 - Promoting* change in forests from unsustainable timber extraction > sustainable timber extraction (SMF and enhancement of forest carbon stocks);
 - Promoting* change in forests from sustainable timber extraction > no timber extraction (conservation and enhancement of forest carbon stocks).



Box 3: Forest Reference Emission Levels/Reference Levels (RELS/RLs)

Forest Reference Emission Levels and Reference Levels (RELS/RLs) are benchmarks for assessing countries' performance in implementing REDD+ activities. Countries implementing REDD+ activities under the UNFCCC will need to develop their RELS/RLs and submit them to the UNFCCC. These will then be used to measure the effectiveness of each country's policies and measures related to REDD+.

The first UNFCCC guidance on RELS/RLs was provided in Decision 4/CP.15, which recognised that RELS/RLs should be transparent, take historical data into account, and be adjusted for national circumstances. Subsequently, decision 1/CP.16 identified national RELS/RLs as an essential prerequisite for Parties aiming to undertake REDD+ activities, with subnational RELS/RLs as a possible interim measure. The most recent guidance on RELS/RLs emerged from COP17 in Durban (2011), indicating that:

- 1) RELS/RLs should be consistent with records of forest emissions and removals as contained in countries' national GHG inventories;
- 2) Parties should submit information explaining how their RELS/RLs were developed, including how national circumstances were considered;
- 3) Parties should consider a step-wise approach to the development of RELS/RLs to enable the incorporation of improved data and methodologies; and
- 4) RELS/RLs should be updated periodically in order to account for new knowledge and trends.

The cumulative guidance indicates that RELS/RLs should be developed with strong links to the NFMS, ensuring consistency in the approaches to the collection and use of data.

REDD+ in three phases

Given the technical and procedural complexity involved in the implementation of REDD+ activities, Parties agreed that this should be done in three phases, as set out in Decision 1/CP.16, paragraph 73:

"Decides that the activities undertaken by Parties [...] should be implemented in phases, beginning with the development of national strategies or action plans, policies and measures, and capacity-building, followed by the implementation of national policies and measures and national strategies or action plans that could involve further capacity-building, technology development and transfer and results-based demonstration activities, and evolving into results-based actions that should be fully measured, reported and verified"

The importance of national circumstances for the implementation of REDD+ activities, in the context of the phased approach, is also recognised in Decision 1/CP.16, paragraph 74:

"Recognizes that the implementation of the [REDD+] activities ... including the choice of a starting phase as referred to in paragraph 73 above, depends on the specific national circumstances, capacities and capabilities of each developing country Party and the level of support received"

Phase 1

Phase 1 includes all of the efforts required to define a national REDD+ strategy, including the policies and measures (PAMs) that a country will need to implement in the context of REDD+ activities, and the consequent capacity building needs. This phase also includes the definition and selection of the 'pillars' underpinning the NFMS (see section 5) and the testing and selection of methodologies for reliable, robust and transparent national M & MRV functions. Phase 1 is often referred to as 'REDD+ Readiness'.

An important part of this phase is national capacity building, to give Parties the knowledge and technical abilities necessary to enter Phase 2. This includes practical training on the pillars of the NFMS and development of the necessary systems and infrastructure to implement them.

Phase 2

Phase 2 entails implementing demonstration activities to test and refine the methodologies, action plans and PAMs defined during Phase 1. Demonstration activities should focus on establishing whether the PAMs can produce positive and measurable results in terms of GHG emissions. They can focus on monitoring and reporting at the sub-national level as an interim measure, as specified in Decision 1/CP.16, paragraph 71(c), and be used to trial potential NFMS methodologies, such as the collection of forest inventory data. Phase 2 can also be considered a part of 'REDD+ Readiness', as it is still part of a country's efforts to prepare for full implementation of REDD+ activities.



Box 4: What are the practical implications of monitoring and MRV for REDD+ activities in a developing country?

Parties aiming to undertake REDD+ activities are encouraged to:

- Set up a robust and transparent NFMS comprised of both a monitoring function and an MRV function;
- Ensure that REDD+ activities, policies and measures are results-based, by using an NFMS;
- Measure the anthropogenic sources and removals (by sinks) of GHG emissions in the forest sector, including changes in forest carbon stocks, and changes in forest area;
- Minimize uncertainty by providing transparent, coherent, comparable, consistent and accurate estimates of GHG emissions and removals associated with REDD+ activities;
- Maximize transparency, by making the results of these measurements available for international appraisal, as agreed by the COP;
- Follow the most recent methodological recommendations provided by the IPCC, as adopted or encouraged by the COP.

Awareness raising, capacity building and technology transfer may continue throughout Phase 2, particularly for technical elements that do not need to be fully operational until Phase 3, such as the national forest inventory and satellite remote sensing. It is desirable, however, that the monitoring function of the NFMS be operational in Phase 2, in order to evaluate the outcomes of demonstration activities and to provide information on land use and land use changes to assess whether they are 'results-based' (i.e. resulting in net positive outcomes), as required by Decision 1/CP.16, Appendix 1, paragraph 1(j). This will generate feedback on the performance of the demonstration activities, allowing methodologies to be refined where necessary to improve performance.

Phase 3

During Phase 3 ('national implementation'), the monitoring function should ultimately be extended to cover the entire national territory so that the country can assess the impacts of PAMs at the national level (see section 5.4.1), and to address the issue of displacement of emissions (leakage). Monitoring, in the context of REDD+, will allow countries to assess the performance of particular PAMs. Monitoring for REDD+ could support the distribution of positive incentives by identifying where particular PAMs have resulted in net positive outcomes.

The monitoring function will build national expertise in remote sensing, which is an essential tool to generate Activity Data (AD) for the MRV function (see section 4.1.1). The monitoring function could also provide additional geospatial data and information to help the countries improve their national communications and biennial update reports to the UNFCCC.

Box 5: Development of an NFMS over the three phases of REDD+

Phase 1:

- Define the national REDD+ strategy;
- Identify national circumstances that will have implications for the readiness phase, including for the development of RIs/RELS;
- Identify national PAMs and action plans that are available and those that need to be adapted or created for REDD+, and develop legal frameworks to support them;
- Strengthen the necessary national capacities for developing and implementing demonstration activities, PAMs and action plans;
- Define the 'pillars' (see section 5.4) of work of the NFMS;
- Design REDD+ demonstration activities;
- Design the NFMS and begin institutional and technical capacity building on relevant elements, including the national forest inventory and GHG inventory, to allow for measurable, reportable and verifiable emissions and removals estimates (MRV elements) due to REDD+ activities.
- Comprehensive assessment of existing capacities and capacity building needs, in the context of REDD+, including human, financial and technical aspects.

Phase 2:

- Implement the national strategy, and associated legal and policy frameworks;
- Implement demonstration activities with a national or sub-national scope, with the aim of assessing the impacts of REDD+ PAMs;
- Build up the necessary technology and capacities to effectively carry out the demonstration activities;
- Implement a monitoring system to assess the outcomes of demonstration activities;
- Test and refine methodologies for MRV in parallel with demonstration activities at specific sites.
- Initiate operation of the NFMS and refine methodologies as necessary.

Phase 3:

- Scale up demonstration activities to the national level, based on tested methodologies;
- Scale up the monitoring system to assess the outcomes of particular national PAMs;
- Identify measurable, reportable and verifiable emissions and removals resulting from REDD+ activities, for inclusion in the reporting to the UNFCCC.

In Phase 3, the MRV function of the NFMS will be fully operational, resulting in national estimates of GHG emissions and removals from the forest sector, in line with IPCC and COP guidance. This will allow countries to measure the aggregate mitigation performance of REDD+ activities at a national scale (in terms of tCO₂e/year), using a combination of remote sensing and ground-based forest carbon inventory (Decision 4/CP.15, paragraph 1(d)). This performance should be reported to the UNFCCC Secretariat as part of Parties' national communication and biennial update reports, or any other channels agreed by the COP. Subsequently, reporting of mitigation performance will be facilitated by the UNFCCC, which will allow an external appraisal of the data and methods by international experts, as decided by the COP (see section 4).



Methodological Guidance for National Forest Monitoring Systems

Monitoring of REDD+ activities

As outlined above, parties to the UNFCCC are committed to share information on their mitigation and adaptation policies and measures, and on the results they obtain through their implementation. To report these results, each country should collect information that allows a comprehensive assessment of the outcomes, including carbon stocks and other relevant information that a country may need to fulfil the information requirements under the UNFCCC. Monitoring for REDD+ can go beyond the assessment of carbon, and may include other elements such as forest health; biological diversity; productive, protective and socio-economic functions of forests; and legal and policy frameworks related to forests. Much of this information could be relevant for addressing and respecting some of the safeguards³ outlined in Appendix 1 of the Cancun Agreements (Decision 1/CP.16). The monitoring system for REDD+ could therefore contribute to the national system to provide information on the REDD+ safeguards (as listed in Annex 1 of Decision 1/CP.16) as well as for purposes not directly related to REDD+, such as reporting requirements under other Conventions.

For the monitoring of REDD+ activities, countries can define their own specific methods, criteria and indicators to reflect their particular national circumstances. Monitoring may include the monitoring of indicators that could be used to track the implementation of a specific REDD+ PAM. For example, if a country develops a specific policy or measure for the sustainable management of forests (one of the five REDD+ activities), a potentially useful indicator to be monitored is the annual volume of timber harvested. This indicator is not directly related to carbon, but it is clear that this information, when combined with data on trends on forest biomass, could indicate whether the country is succeeding in implementing its measures on sustainable forest management. The NFMS is therefore a key tool for demonstrating whether REDD+ activities are results-based in terms of both mitigation and wider impacts on the forestry sector.

The monitoring function of the NFMS is primarily a domestic tool to allow countries to assess the results of REDD+ activities, as implemented by different stakeholders and institutions. For example, the monitoring tools can be used by a country to develop a cost effective and equitable resource allocation (or 'benefit distribution') system such as the 'Amazon Fund' in Brazil. Brazil's pioneering Amazonian monitoring system, based on satellite remote sensing, was an effective precursor to monitoring for REDD+. This system allowed the country, for the first time, to assess forest cover changes across the Amazon, and therefore to allocate forestry law enforcement resources accordingly.

Monitoring for REDD+ could be based on new tools (e.g. a monitoring system based on satellite remote sensing, as in Brazil) or on monitoring tools that already exist within the forestry sector, or a combination of the two. For example, to monitor PAMs related to sustainable management of forests, countries may already have in place a team of field inspectors that certify logging operations: with relatively few alterations, this system could be used for REDD+ to assess the impact of a measure (e.g. reduced impact logging) on forest biomass. Therefore, an important methodological exercise that countries should undertake in relation to monitoring for REDD+ is the harmonization of existing forest monitoring tools and their integration with new tools.

The development of monitoring tools should also be harmonized with the development of MRV capacities, given the considerable synergies between the two functions of the NFMS. The development of monitoring tools builds important experience and capacity in a country towards the establishment of a complete and accurate national GHG inventory for the LULUCF sector. In this way the development of the monitoring system will support the development of the MRV function. For example, a country's capacity to assess land tenure could easily be leveraged to build capacity for assessment of land use and land use change across its national territory.

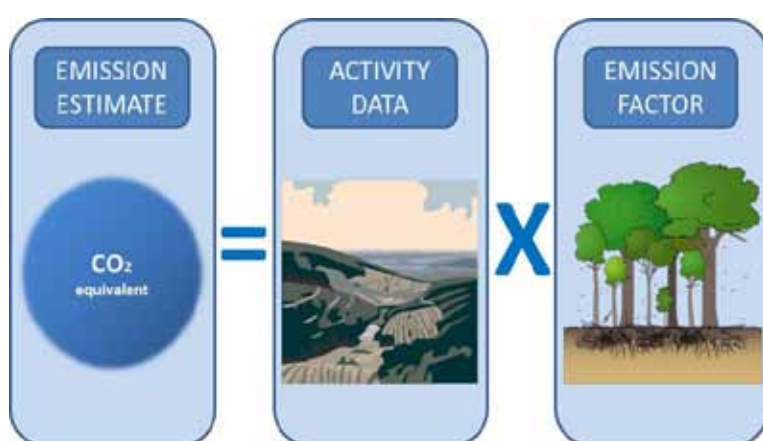
³ For implementing the five REDD+ activities, the appendix refers to the following seven safeguards (see Appendix I Decision 1/CP.16 paragraph 2 for full details): (a) actions to be consistent with national forest programmes and relevant international conventions and agreements; (b) transparent and effective national forest governance structures; (c) respect for the knowledge and rights of indigenous peoples and members of local communities; (d) full and effective participation of relevant stakeholders; (e) actions are to be consistent with the conservation of natural forests and biological diversity; (f) actions to address the risks of reversals and; (g) actions to reduce displacement of emissions.

Methodological approach under the IPCC Guidance & Guidelines

To implement Parties' commitments under Article 4, paragraph 1(a), of the Convention text (see section 2.1), the COP requested the IPCC to develop guidance and guidelines that would result in a methodological framework for "comparable methodologies". The IPCC methodological framework mainly applies to the MRV function of the NFMS, however they could be applied to the monitoring function as well to ensure consistency in estimations, for example to directly estimate emissions reductions for a demonstration activity rather than relying only on proxy indicators or measurements.

The first IPCC guidelines for national GHG inventories, published in 1996, contained an incomplete methodology for assessing the land use sector. To address this, in 2003 the IPCC adopted a revised set of good practice guidance for the Land Use Change sector, based on comprehensive land use classes which can represent the entire territory of a country (IPCC, 2003). This document helps countries to carry out complete and accurate GHG inventories, and to minimize uncertainty as far as possible.

This section presents the key concepts and elements of the methodological guidance and guidelines of the IPCC for the development of GHG inventories. Countries are advised to take these into consideration when developing the MRV function of their NFMS for REDD+ activities under the UNFCCC. When following the IPCC's Good Practice Guidance (IPCC, 2003) or the Guidelines for National GHG Inventories (IPCC 2006), the simplest methodological approach consists of combining information on the extent of human activities (called 'activity data' – AD) with coefficients that quantify emissions or removals per unit activity (called 'emission factors' – EFs) (Figure 3).



Elements of the equation

Activity Data

According to the IPCC's Good Practice Guidance for Land Use, Land Use Change and Forestry (GPG LULUCF) (IPCC, 2003), AD is defined as data on the magnitude of human activity resulting in emissions or removals taking place during a given period of time. In the LULUCF sector, data on land area, management systems, lime and fertilizer use, are examples of AD. The IPCC proposes three 'Approaches' (IPCC, 2003, 2006) to generate AD when referring to land identification, which are not presented hierarchically and are not mutually exclusive. National entities responsible for GHG inventories should select an approach according to national circumstances and capabilities.

Figure 3. Methodological approach of the IPCC: Emissions = AD x EF

Approach 1 represents land use area totals within a defined spatial unit, which is often defined by administrative borders, such as a country, a province or municipality. Only net changes in land use area can be tracked within the boundaries of the spatial unit through time following this approach. Consequently, the geographical location of each land use change is not known, and the exact changes that occur between land uses cannot be ascertained.

Approach 2 provides an assessment of both the gross and net losses or gains of the surface area for the categories of specific land uses and allows the determination of areas where these changes take place. This approach includes information on the conversions between categories, but tracks these changes without spatially-explicit data (i.e. the location of specific land uses and land-use conversions are not known).

Approach 3 is characterized by spatially explicit observations of land use categories and land use conversions, often through sampling at specific geographical points and/or complete ('wall-to-wall') mapping.

In summary: "Approach 1 identifies the total change in area for each individual land use category within a country, but does not provide information on the nature and area of conversions between land uses. Approach 2 introduces tracking of land-use conversions between categories (but is not spatially explicit). Approach 3 extends Approach 2 by allowing land use conversions to be tracked on a spatially explicit basis" (IPCC 2003, 2006).

Each approach can be applied uniformly to all areas and all categories of land use in a country, or several methods can be applied to different regions or categories, or at different time intervals, as long as consistency in the time series is maintained. In all cases, and in line with IPCC guidance, a country must characterize and document all the land areas. Respecting good practice during implementation will improve the precision and accuracy of estimates.

The use and analysis of satellite data allows a country to meet the reporting requirements indicated in Approach 3 for the representation of lands following IPCC LULUCF GPG (IPCC, 2003) and/or the Agriculture, Forestry and Other Land Use (AFOLU) Guidelines (IPCC, 2006). The approaches used for the representation of land area should follow the following principles:

- *Adequate, i.e., capable of representing land use categories, and conversions between land use categories, as needed, to estimate carbon stock changes and GHG emissions and removals;*
- *Consistent, i.e., capable of representing land use categories consistently over time, without being unduly affected by artificial discontinuities in time series data;*
- *Complete, i.e., all land within a country should be included, with increases in some areas balanced by decreases in others, recognizing the biophysical stratification of land if needed (and as can be supported by data) for estimating and reporting emissions and removals of GHGs;*
- *Transparent, i.e., data sources, definitions, methodologies and assumptions should be clearly described.*

Emission Factors and Tiers

An EF is defined either as the average emission rate of a given GHG for a given source, relative to units of activity, or the average carbon stock increase, in the case of net removals.

Estimations of emissions and removals can be obtained in different ways. Therefore, the IPCC has classified the methodological approaches in three different 'Tiers', which vary according to the growing quantity of necessary information and the degree of analytical complexity (IPCC, 2003, 2006).

"A tier represents a level of methodological complexity. Usually three tiers are provided. Tier 1 is the basic method, Tier 2 intermediate and Tier 3 most demanding in terms of complexity and data requirements. Tiers 2 and 3 are sometimes referred to as higher tier methods and are generally considered to be more accurate."

Progressing from Tier 1 to Tier 3, in general, represents a reduction in the uncertainty of GHG estimates through an increase in the complexity of measurement processes and analyses.

Tier 1 methods use default EF data provided by the IPCC (including on the Emissions Factor Database (EFDB⁴)). This tier level is appropriate for countries where national data are scarce or absent and default values for EFs are used.

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.

At **Tier 3** higher order methods are used, including models and inventory measurement systems tailored to address national circumstances, repeated over time, and driven by high-resolution AD and disaggregated at the sub-national to fine-grid scales. These higher-order methods provide estimates of greater certainty than lower tiers and, for the LULUCF sector, have a closer link between biomass and soil dynamics.

4 <http://www.ipcc-nggip.iges.or.jp/EFDB/main.php>

IPCC concepts related to Land Use, Land-Use Change & Forestry (LULUCF)

The 'managed' land proxy

A country will only have to estimate and report on changes in carbon stocks (emissions and removals) where these changes are induced by human activities. The IPCC therefore suggests the use of the 'managed' land concept as a proxy for human induced emissions and removals in the LULUCF sector. When human activities are carried out on land that had previously not been used (i.e. 'unmanaged land'), it immediately becomes classified as 'managed' land.

Land use categories

Once a country has divided its managed from its unmanaged lands, it will have to further subdivide its national territory among the six land use categories defined by the IPCC for reporting through a GHG inventory (IPCC, 2003, 2006): Forest Land, Cropland, Grassland, Wetlands, Settlements and Other Land⁵. These categories can subsequently be subdivided to reflect national circumstances.

Box 7: Regarding land use categories, a country should:

- Divide the national territory between managed and unmanaged lands;
- Subdivide its national managed land into the six land-use categories and 12 sub-categories, as defined by the IPCC;
- Determine if national circumstances justify more detailed subdivisions within these categories or sub-categories.

The five carbon pools that describe the carbon cycle and carbon fluxes

The IPCC identifies five carbon pools: (i) above-ground biomass (AGB); (ii) below-ground biomass (BGB); (iii) dead wood; (iv) litter (DOM); and (v) soil organic matter (SOC), which can be measured and reported as part of national GHG inventories. When submitting their national GHG inventories, Parties are encouraged to report on as many of their significant carbon pools as possible, according to national circumstances. Regardless of which pools they select, countries should remain methodologically consistent.

The carbon cycle includes changes in carbon stocks due to both continuous processes (i.e. growth and decay) and disturbance events (such as harvest, fire, insect outbreaks, land use change and other events). Continuous processes can affect all forest carbon stocks year after year, while disturbance events cause emissions (and in rare cases uptake) and redistribute ecosystem carbon in specific areas (i.e. where the disturbance occurs) at the time of the event. It is therefore important that the methodology selected to measure changes in carbon stocks is able to collect data for both continuous and discrete processes (cf. IPCC, 2006).

⁵ See IPCC, 2003 Ch.3 or IPCC, 2006 Vol. 4, Ch. 2 for a description of each category.



The UN-REDD Strategy for National Forest Monitoring Systems

The United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation (UN-REDD Programme) is a partnership between the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP). The Programme was launched in September 2008 to assist developing countries prepare and implement national REDD+ strategies, and builds on the convening power and expertise of the three agencies.

The programme works at the national and global levels to support the development and implementation of national REDD+ strategies and international consensus-building on the REDD+ process.

Within the UN-REDD Programme, FAO provides technical support to countries, including for the development of credible and cost effective NFMSs, managing forests sustainably, and for addressing and providing information on some of the REDD+ safeguards, e.g. helping to strengthen national capacity on governance, including relevant legal frameworks, policies and institutions. At the international level, FAO/UN-REDD aims to share knowledge and support the development of common approaches, principles and guidelines related to REDD+, including on NFMSs.

The UN-REDD NFMS Strategy aims to build the technical capacity of institutions in developing countries on issues and technical elements relating to NFMSs. The implementation of UNFCCC REDD+ decisions is at the heart of the approach, taking into account national circumstances and capacities.

The UN-REDD NFMS Strategy aims to combine the experiences acquired through international REDD+ initiatives (such as the UN-REDD Programme and the Forest Carbon Partnerships Facility (FCPF)) with forestry monitoring experiences from individual countries. One of the successful examples to date is the collaboration that FAO and the Brazilian Space Agency (INPE) have forged to support UN-REDD countries to develop their own satellite forest monitoring systems and for promoting and carrying out capacity building activities on satellite remote sensing. This collaboration builds upon the experience of Brazil, which is currently the only country producing annual deforestation statistics for its REDD+ demonstration activity in the Amazon, and represents one of the most successful South-South collaboration initiatives to date.

Guiding Principles of the UN-REDD NFMS Strategy

Three important principles underpin the UN-REDD NFMS Strategy:

- a. National ownership:** Countries, based on their national circumstances and development priorities, need to exercise full control over the entire NFMS development process, assuming full responsibility for the implementation and effective operation of their NFMS from Phases 1 to 3 of REDD+. International partner organizations and foreign institutions will be limited to providing support in technology transfer, technical capacity building and the development of institutional capacities;
- b. Building on existing systems and capacities:** One of the key principles is to build on existing capacities, programmes and initiatives in the country, region, and/or at the international level for the implementation of NFMSs.
- c. Consistency with the UNFCCC process:** Countries need to fully integrate REDD+ activities and their NFMS in accordance with their UNFCCC commitments, as well as their national policy and legislation;

To address the three principles, and in order to establish a learning process with well-defined steps and results the NFMS must:

- a. Be robust, transparent, and aim to be implemented at the national level**, with subnational monitoring systems as a potential interim measure;



- b. Be in line with **relevant decisions of the UNFCCC on REDD+**, notably decisions 4/CP.15 and 1/CP.16, and all other subsequent decisions adopted by the COP;
- c. Be **relevant for the phased approach** for REDD+ activities as set out by the UNFCCC (Decision 1/CP.16, paragraph 73).

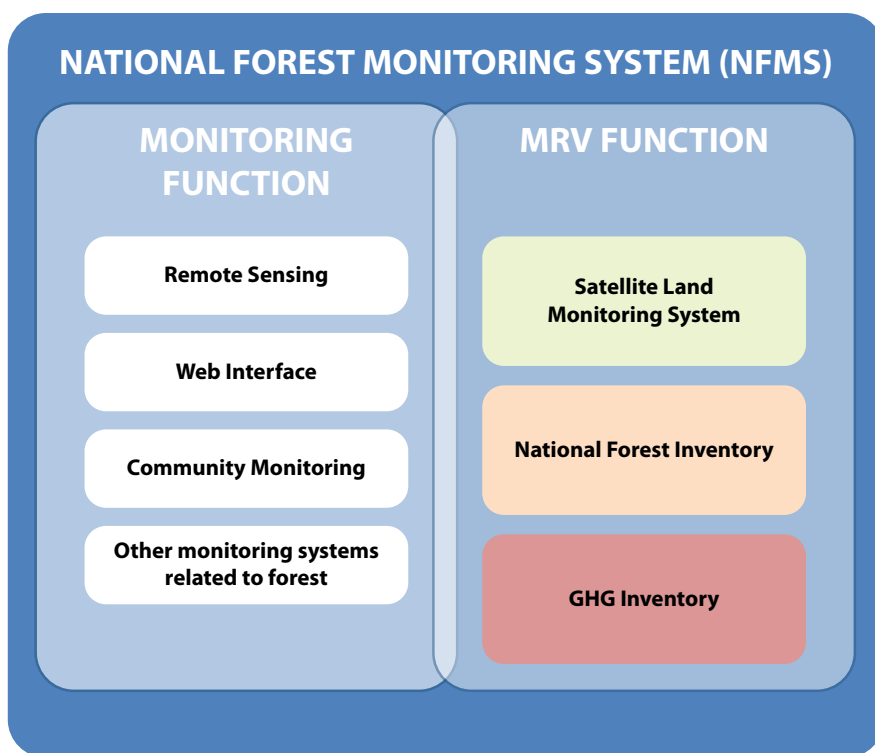
The monitoring function and the pillars of the UN-REDD NFMS Strategy

The UN-REDD NFMS Strategy is built on three 'pillars' that support the development of REDD+ NFMSs under the UNFCCC. This approach is based around the methodological equation proposed by the IPCC (i.e. *emissions (E) = activity data (AD) x emission factors (EF)*).

Each element of this equation represents a pillar of work, while the monitoring function will be nationally specific, and it could encompass both REDD+-specific and non-REDD+ needs. The focus, however, should be on two REDD+-specific monitoring aspects:

1. Monitoring to assess the performance of REDD+ demonstration activities in Phase 2
2. Monitoring of the performance of national REDD+ PAMs in Phase 3.

It is important to acknowledge that the performance of REDD+ activities, policies and measures can be assessed both through direct monitoring of emissions stocks/removals and indirectly through a series of proxy indicators (e.g. forest canopy changes, forest certification schemes, etc.);

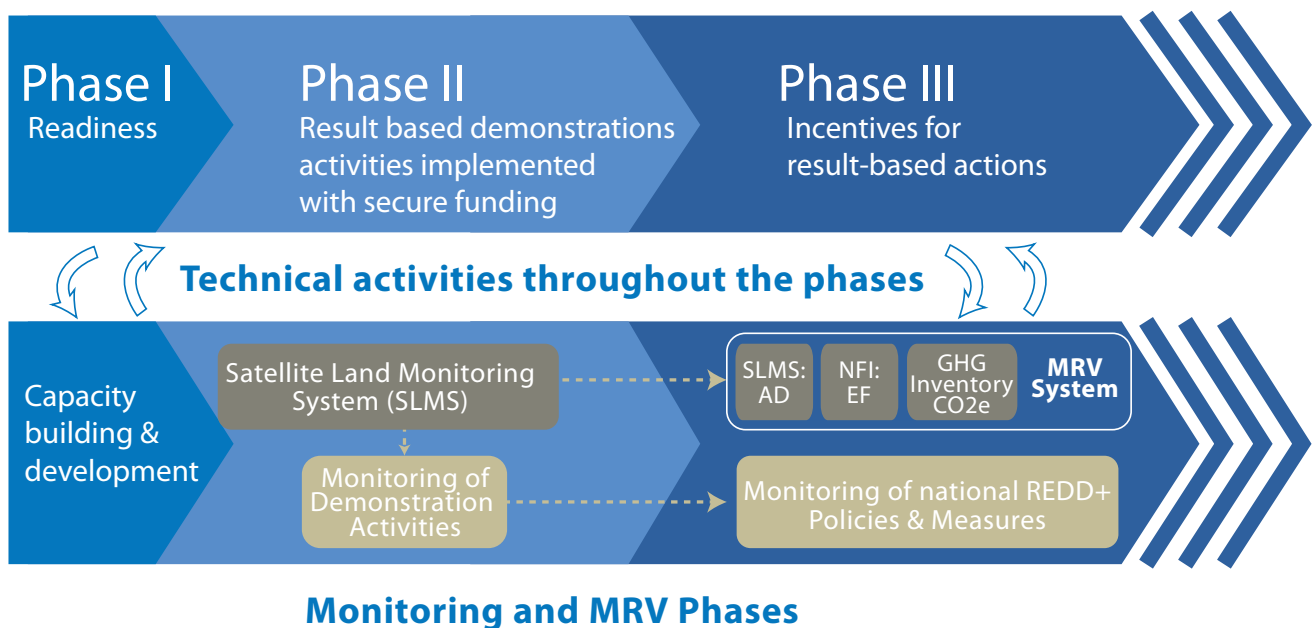


The three technical pillars or building blocks of the NFMS that are essential to support its MRV function can be described as follows:

- **Pillar 1: A Satellite Land Monitoring System (SLMS)** to collect and assess, over time, the Activity Data (AD) related to forest land (equivalent to AD in figure 3);
- **Pillar 2: National Forest Inventory (NFI)** to collect information on forest carbon stocks and changes, relevant for estimating emissions and removals and to provide emissions factors (EF in figure 3);
- **Pillar 3: A national GHG Inventory** as a tool for reporting on anthropogenic forest-related GHG emissions by sources and removals by sinks to the UNFCCC Secretariat (Emissions in figure 3).

Figure 4. Approaches and tools to fulfil the functions of the National Forest Monitoring System

These pillars could support the implementation of a NFMS (Decision 1/CP.16 paragraph 71(c); Decision 4/CP.15 paragraph 1(d)), with the dual functions of monitoring and MRV for REDD+. Figure 4 illustrates these dual functions of the NFMS. Within the *Monitoring Function* box are listed several illustrative examples of the types of monitoring approaches a country might select to meet its monitoring needs and to suit the national context, while under the *MRV Function* the pillars of the UN-REDD NFMS Strategy are listed. It is important to note that remote sensing and up to some extent the NFI can be used as an approach both for yielding activity data for MRV as well as for meeting broader monitoring needs. Pillars 1 and 2 could also be relevant for the monitoring function, while pillar 3 is particularly relevant for the MRV function.



Monitoring and MRV Phases

Figure 5. Phased implementation of the NFMS

The three pillars of the NFMS can be developed along the three phases for REDD+ described in Decision 1/CP.16, allowing for the implementation of results-based demonstration activities in Phase 2 and the full MRV of performance of REDD+ activities in Phase 3 (Figure 5). Following this strategy, each phase aims to strengthen capacities and prepare for the next phase, resulting in a degree of overlap between phases, notably in terms of capacity building. In Phase 2, monitoring for REDD+ becomes operational, through the SLMS and other relevant proxies. The transition into Phase 3 is achieved by monitoring REDD+ activities at the national level, a National Forest Inventory (NFI) to produce EFs and a LULUCF GHG inventory. Monitoring for REDD+ should be developed throughout the REDD+ Phases as follows.

Phase 1 involves the planning and development of tools for the Monitoring function for REDD+. It includes the selection of technical systems, capacity building and technology transfer, and the testing of methods, while defining national REDD+ policies, measures and institutional arrangements, and developing an action plan for the NFMS.

In **Phase 2** the implementation of the national REDD+ policies and measures may lead to results-based demonstration activities, i.e. resulting in measurable positive outcomes. In order to assess these outcomes, monitoring of demonstration activities is required. Monitoring during Phase 2 will also provide information on land use and land use changes over areas where demonstration activities are being implemented, and allow the SLMS to be tested and refined prior to its full national implementation;

In **Phase 3** monitoring for REDD+ will ultimately be expanded to cover the national territory to assess the outcomes of REDD+ activities being implemented and thus which PAMs are truly results-based. The fully developed REDD+ monitoring system could also be the basis for the distribution of positive incentives, by aiming to distribute resources based on results achieved at the scale of individual activities.

Since the reduction of emissions from a forest area could lead to an increase in emissions elsewhere, the risk of 'displacement of emissions' or 'leakage' can also be addressed and monitored using remote sensing (UNFCCC, 2009). To support the country in detecting and addressing leakage at the national level (in contrast to leakage at the international level), monitoring for REDD+, through the SLMS, should make it possible to completely cover the national territory in order to detect leakage from one area or region to another. In addition, an SLMS allows the assessment of forest cover and forest cover change over time, which provides important information on the outcomes of REDD+ demonstration activities in Phase 2 and national policies and measures in Phase 3. In addition to remote sensing, ground-based monitoring approaches would likely also need to be utilized, including community monitoring.

Based on the above, Box 8 presents some points countries should assess when developing a NFMS and MRV strategy.

Box 8: What should countries consider when developing in practice a national forest monitoring system and MRV strategy?

Countries should determine if the M & MRV functions and the associated elements, in the structure recommended by the UN-REDD M & MRV strategy, is appropriate, and whether it is appropriate to adopt it, based on national circumstances. Therefore, a country must assess the:

- Pillars proposed and integrate them into the National REDD+ Strategy or Action Plan;
- Regional context to explore the feasibility of creating synergies at the regional level;
- Guiding principles recommended by the UN-REDD M & MRV strategy and make best use of them according to national circumstances and priorities;
- Guiding technical principles and how to address them according to the national circumstances and priorities.

Description of M & MRV functions in the UN-REDD strategy

The descriptions in Figure 6 illustrate the technical and practical aspects of NFMSs and the integration of the main elements of these functions. This is a general model that could guide the development and implementation of an NFMS.

The three pillars of the NFMS

Satellite Land Monitoring System (Pillar 1)

The second function of the NFMS, as set out by the UNFCCC, is the MRV function. The Measurement component of an MRV function is the most intensive, in terms of information and labour, comprising the collection of national area change data through a SLMS, implementation of a NFI, and compilation of relevant data and the estimation of emissions and removals through a GHG inventory for the forest sector. Pillar 1 concerns the collection of AD, i.e. data on land use and forest area change as a result of human activities, through a SLMS.

As described earlier, the SLMS will contribute information for the REDD+ monitoring function, but as an element under the MRV function, the SLMS involves extending the analysis of land cover and land cover change to the national level, in order to produce wall-to-wall AD.

Satellite remote sensing can be a useful and cost effective tool for collecting data on forest area changes. The UN-REDD NFMS Strategy promotes satellite remote sensing as a central tool for monitoring for REDD+, in the form of a Satellite Land Monitoring System (SLMS), combined with a web-GIS online dissemination portal. This remote sensing information (such as the location of forest and non-forest areas) can then be uploaded into a web-GIS portal, and made freely available over the Internet, thus promoting the transparency of the NFMS and facilitating the involvement of relevant stakeholders. As outlined above, FAO/UN-REDD have formalised their collaboration with Brazil's INPE to support developing countries to develop their Pillar 1 through the development and implementation of SLMS and web-GIS portals

When used to assess AD, the SLMS should be used to collected data on historical trends in land use change. Although little or no historical ground data sets exist for most developing counties, international satellite data archives allow the analysis of historical imagery dating back 20 years. The benefit of remote sensing, in addition to its ability to provide spatially explicit information and frequent temporal coverage, includes the possibility of covering large and possibly remote areas and/or regions. Remote sensing techniques should be adapted to be in compliance with the principles of consistency, completeness, comparativeness, accuracy and transparency, as recommended by the IPCC (IPCC, 2003). Remote sensing data should be used to measure annual changes in land use through a consistent methodological approach over time, which includes the assessment of historical rates of deforestation and degradation, in order to fulfil the needs of UNFCCC reporting.

With respect to the assessment of AD, the IPCC advises that countries should report accurately and comprehensively on the land area on which there is human activity – i.e. managed land. This representation of lands must also reflect historical trends in land use management that ensure that the estimates reported are transparent and comparable.



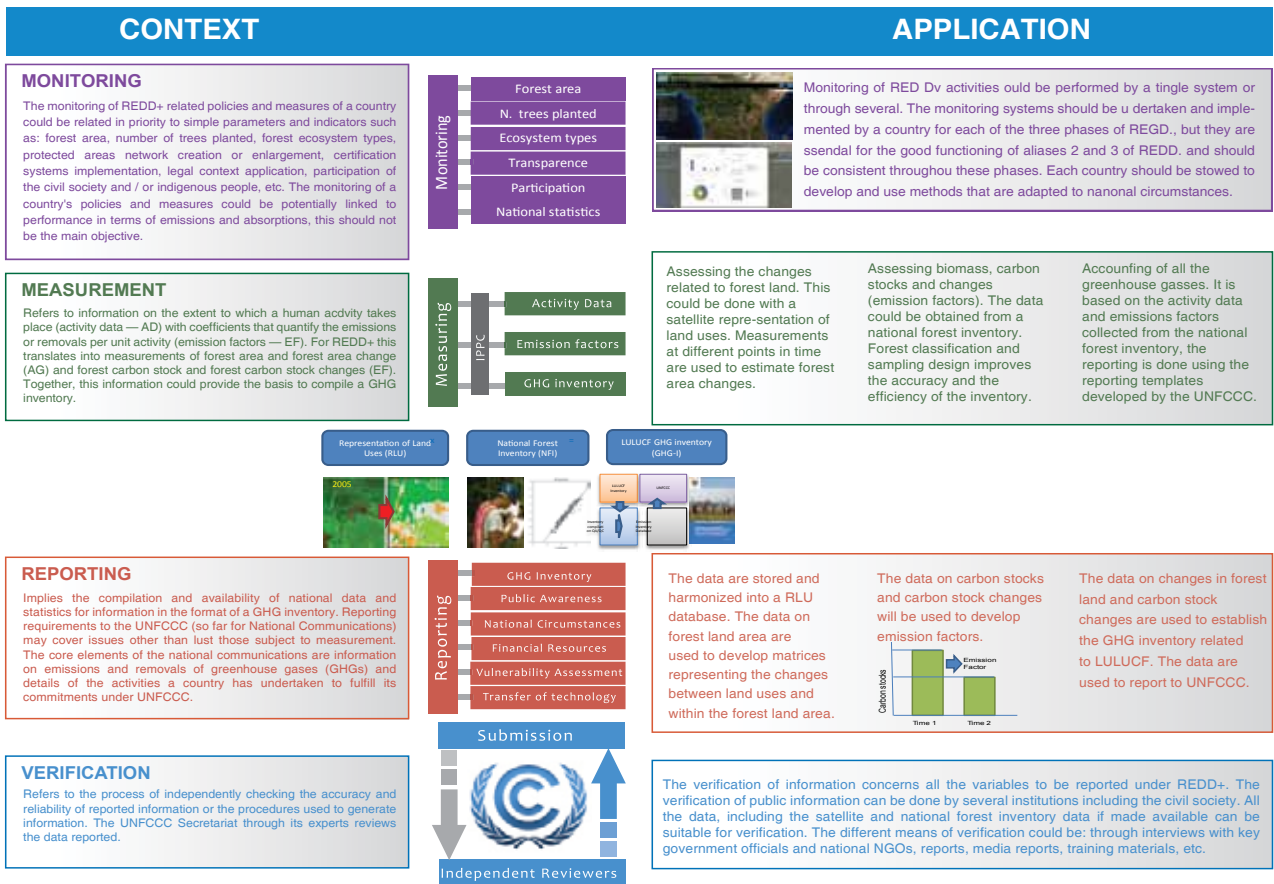


Figure 6. Descriptive context and applications of the M & MRV functions of the NFMS.

In the REDD+ context, AD refers to the area where the activity is taking place (and therefore where emissions and removals are expected). For example, in the case of deforestation, this should refer to the area of deforestation in hectares over a known period of time. In the case of forest degradation, AD refers to the area of forest land that remains forest land where a persistent loss of forest carbon stock (that translates into emissions) is occurring. In the case of the REDD+ activities of conservation of forest carbon stocks and sustainable management of forests, AD may, for example, refer to the area or change in area of forest under a conservation scheme or under a certified logging concession.

In summary, in order to measure and report on the results – in terms of GHG emissions and removals – of their REDD+ activities, following the recommendations of the IPCC, countries could develop a tool linked to remote sensing data to assess AD, defined under the UN-REDD NFMS Strategy as the SLMS. Within the UN-REDD NFMS Strategy, and with the support of INPE, this SLMS is seen as the first component of the "MRV function" of the NFMS.

National Forest Inventory (Pillar 2)

Under the UN-REDD NFMS Strategy, an NFI is considered an important tool for measuring forest carbon stocks and stock changes within the MRV function of the NFMS. The NFI allows a country to estimate anthropogenic GHG emissions and removals by sinks associated with forests because it includes field measurements that will allow the estimation of forest carbon stocks and changes, i.e. standing volume, necessary data for biomass expansion factors, and allometric equations. Ultimately, the NFI allows countries to calculate country-specific EFs for each relevant land use category, as well as sub-categories based on stratification of forest land.

In general, countries should aim to generate country-specific EFs through the implementation of their NFI and therefore be in a position to comply with Tier 2 reporting of their GHG inventory (see section 4). The starting point will depend on whether the country has already implemented a full NFI. For countries that have national-level data or an existing NFI, the challenge is to assess how and to what extent these data can be used for reporting to the UNFCCC Secretariat.

Box 9: Recommendations for the implementation of the Satellite Land Monitoring System

- Determine if the SLMS is part of the NFMS to be developed;
- Collect all the existing land cover data and satellite images and establish needs in terms of technology and capacities;
- Define the monitoring approach (i.e. type sensors, temporal and spatial frequency of forest data acquisition);
- Establish a clear and realistic roadmap for the development of the SLMS;
- Build up the required technology and the capacities needed for its sustainable implementation;
- Implement SLMS with the objective of producing measurable results.

For countries that do not have national data from an NFI, the challenge is to develop and implement a data collection methodology in line with IPPC guidance and guidelines. The NFI is usually based on a stratification of forest land (also recommended by the IPCC) in order to identify homogenous populations. Stratification potentially reduces the number of field measurements necessary per homogenous forest population, which then allows the production of a more cost efficient field inventory. Stratification will also facilitate the identification of predominant land uses in a country and to subsequently intensify the accuracy of efforts.

Almost all Annex I Parties that use an NFI to assess carbon stock changes for forest land (39 Parties out of 41), use more than one NFI – thus creating a time-series. Nevertheless, for REDD+ activities involving a change in land use, such as deforestation (i.e. change from forest land to non-forest land), one NFI could be sufficient to report on the changes of forest carbon stocks. Corroborated by auxiliary data on land use changes from the SLMS, a country can obtain information on different forest types, as well as on EFs for other land use categories (such as cropland, grasslands, etc).

For REDD+ activities resulting in intrinsic modifications, such as forest degradation and forest conservation (i.e. forest land remaining forest land), forest carbon stocks and changes will most likely have to be estimated by using information of at least two NFIs. They could also be partially estimated from using data from a single NFI, if this NFI can provide information that will allow producing data on the dynamics of forest carbon stock changes in combination with more sophisticated tools (i.e. models).

Box 10: Recommendations for National Forest Inventory implementation

- Determine if the NFI is a 'pillar' that it would like to use and develop;
- Define the approach to develop the NFI;
- Establish a clear and realistic roadmap including the steps to be taken;
- Build up the required technology and capacities needed;
- The national forest inventory should be designed to include the collection of the necessary data to assess forest carbon stock and stock changes but also additional multipurpose data that could be used to guide policies and measure;
- Design a national forest inventory to be sustainably implemented overtime (including for sampling design and biomass estimations).

National GHG Inventory (Pillar 3)

Countries are requested to estimate forest-related GHGs by sources and removal by sinks if they want to implement REDD+ activities under the UNFCCC (Decision 4/CP.15, paragraph 1(d) and (d)(i)).

Under the UNFCCC, the information disseminated through GHG inventories is the basis for assessing the progress on the implementation of the UNFCCC in achieving its ultimate objective (i.e. the COP can observe progress achieved by the Parties in fulfilling their commitments and of the Convention). GHG inventories may also be an essential link between science and policy though improving the information basis for scientific assessments.

The GHG inventory is the fourth 'pillar' of the UN-REDD NFMS Strategy. The GHG inventory is a highly useful tool to provide a good framework for estimating and reporting GHG emissions and removals for the forest sector. Within the GHG inventory emissions by sources and removals by sinks (using data on land use provided through the SLMS and data on carbon stock changes from the NFI), and uncertainty estimates are provided. The utility of this pillar for the country is that it will be the key tool to assess whether the implementation of REDD+ activities, policies and/or measures are resulting in measurable climate change mitigation.



Box 11: Recommendations for developing the GHG inventory

- Determine if the GHG inventory as proposed by UN-REDD is a 'pillar' that it would like to use and develop;
- Establish needs in terms of technology and capacities, including institutional arrangements to manage the GHG inventory process;
- Establish a clear and realistic roadmap setting out the steps to follow to develop a full GHG inventory for the forest sector;
- Build up the technology and capacities required for the implementation of an GHG inventory, including: adequate institutional arrangements, collection of information, archiving system;
- Implement the GHG inventory and produce concrete and measurable results.

The quality of the GHG inventory depends not only on the robustness of the results from the measurements made and the credibility of estimates, but also on the manner and method in which the information is collated and presented. The information must be documented following the reporting guidelines required by the UNFCCC, as decided by the COP. The IPCC methodologies should be used as the basis to generate information and estimates on anthropogenic GHG emissions and removals, Countries should aim to meet the five UNFCCC reporting principles: **Transparency, Consistency, Comparability, Completeness** and **Accuracy** when developing and reporting GHG inventory estimates. These principles are also relevant for the verification and assessment process that is independent of the GHG inventory.

Quantity Control and Quality Assurance for GHG inventories

It is important to be able to determine the quality of the measures taken in the field as well as the quality of the assimilation and analysis of data in order to be able to estimate the uncertainty of the process and improve future measures. The IPCC provides guidance for establishing Quality Control (QC) and Quality Assurance (QA) procedures for the GHG inventories (IPCC, 2003, 2006).

QC procedures are internal to the inventory preparation process, whereas QA consists of an external (independent) control procedure of the quality of reported estimates. The UNFCCC Secretariat, through its roster of experts, could carry out periodical reviews of the methods used and of the figures reported by countries in their national GHG inventories and through the biennial report review process. This could be seen as the Verification component of MRV function of the NFMS, and is separate to QA/QC procedures.

Box 12: Recommendations for the Quality Control and Quality Assurance

- Assess which internal procedures are necessary for gradually establishing the Quality Controls in order to comply with the IPCC recommendations on GHG inventories;
- Assess which procedures are necessary for establishing an independent viewpoint that will form the basis of Quality Assurance in order to comply with the IPCC recommendations on GHG;
- Consider implementing these procedures.



Box 13 shows a case study of how the Democratic Republic of Congo is the UN-REDD NFMS strategy.

Box 13: CASE STUDY: Applying the UN-REDD NFMS strategy in the Democratic Republic of Congo

In order to illustrate the bridge between theory and practice regarding the pillars, the case of the Democratic Republic of Congo (DRC) is presented here to provide interested countries with a concrete example of how the pillars are currently being applied in a UN-REDD pilot country.

The Monitoring Function

The DRC monitoring function was developed by the Government of DRC in collaboration with FAO and INPE in response to the decisions of the UNFCCC taken at COP16 in Cancun in December 2010 and launched at COP17 in Durban (<http://www.rdc-snsf.org/>). The aim of the DRC monitoring function is to address domestic and international monitoring needs and is the national tool to assess the country's REDD+ policies and measures. More specifically, it aims to: (i) report on results obtained through REDD+ demonstration activities, results-based actions and national policies and measures in the forestry sector; (ii) have a multi-purpose methodological approach to address monitoring needs for other relevant national or international processes beyond REDD+ (e.g. biodiversity conservation, sustainable management of forests, etc.); (iii) build on existing monitoring systems or system elements in the DRC; (iv) be developed to become an operational, permanent and independent long-term monitoring system as an integral part of the mandate of DRC's Ministry of Environment, Conservation of Nature and Tourism (MECNT) and its technical divisions.

Pillar 1: The Satellite Land Monitoring System

The preparation for the SLMS is well under way in the DRC. Five MECNT technicians have undergone intensive training courses in Brazil with INPE and in Rome with FAO. A computer laboratory for the DRC SLMS was set up in 2011. From April onwards, and supported by the UN-REDD Programme, these technicians will work full time under the guidance of an international consultant in Kinshasa to produce the first official national annual deforestation statistics based on the TerraCongo platform (based on the existing Brazilian TerraAmazon). A DRC forest mask has been developed at FAO headquarters to serve as a starting point for the MECNT technicians to assess the SLMS.

Pillar 2: The National Forest Inventory

The DRC NFI is under full development. Technicians in MECNT were trained in 2011 on forest carbon measurements through a collaborative partnership between MECNT, the International Tropical Timber Organisation (ITTO), the Wildlife Conservation Society (WCS) and FAO. With the support of the UN-REDD Programme, a pre-inventory methodology has been developed to assess the variability of carbon stocks in the major forest types where deforestation has historically (last 20 years) occurred. During the readiness phase, some 65 sites will be by teams of MECNT technicians. The field data will be collected in a centralised database and analysed by MECNT staff, supported by an NFI specialist based in MECNT (funded by the UN-REDD Programme). This work will serve as a basis to continue capacity development in MECNT and to develop a full NFI capable of measuring forest carbon stock changes.

Pillar 3: The Greenhouse Gas Inventory for LULUCF

Activities for the DRC LULUCF GHG inventory are under progress. A GHG inventory computer laboratory with GHG inventory software will be set up. An international GHG inventory expert (supported through the UN-REDD Programme) will spend 2.5 months training minimum three MECNT technicians on the data that needs to be collected and analysed for the GHG inventory. The Government of DRC aims to include the collected and analysed preliminary information in its third national communication to the UNFCCC.



Key Steps for developing National Forest Monitoring Systems

In line with the recommendations that emerged from UNFCCC COPs 15 and 16, the present document proposes an approach to practically implement the M & MRV functions of NFMSs in three phases.

Initially, readiness funds can provide countries with the necessary technical support for developing and implementing their NFMS that will encompass the M & MRV functions outlined in this document. Phase 1 will require the following activities at the national level:

- Enhance awareness of REDD+ under the UNFCCC, international technical guidance (UNFCCC and IPCC) related to REDD+ implementation, and the technical requirements and the functions of the NFMS;
- Create a comprehensive understanding of national capacities, capabilities and circumstances relating to the technical requirements of the NFMS, to ensure the NFMS builds on these;
- Strengthen national capacities to develop national REDD+ policies, measures and action plans;
- Define institutional arrangements for NFMS development and implementation, and develop nationally-appropriate REDD+ strategies, through a national action plan;
- Legally enact national REDD+ policies, measures and action plans;
- Define a strategy to develop and implement an SLMS for REDD+;
- Ensure the effective implementation of each pillar/component by acquiring technologies and operational systems, as well as the technical capacity to use and implement them; and test/refine the effectiveness of the systems.

Phase 1 should begin the process of capacity building for the technical elements required for the subsequent phases, in a contextual and practical manner, namely:

- Discussions on the design of national or sub-national demonstration activities that will serve as testing grounds for REDD+ implementation, monitoring and MRV methodologies (to take place in Phase 2);
- Develop, through bi- and multi-lateral funding channels, the necessary technology and capacities for effectively implementing demonstration activities in Phase 2;
- Develop a system for monitoring for REDD+ to assess the outcomes of demonstration activities in Phase 2;
- Extend tried-and-tested activities and methodologies gleaned from experiences with demonstration activities to the national level in the form of national policies and measures, to be implemented across countries in Phase 3;

The REDD+ action plans that countries develop should present the country's current state of preparation, the issues and capacity and knowledge gaps that remain to be resolved and assessed, and a road map to achieve their REDD+ objectives.



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