ICIMOD Working Paper 2018/4

ICIMOD

FOR MOUNTAINS AND PEOPLE

Status of Measurement, Reporting, and Verification for REDD+ in the Hindu Kush Himalaya

About ICIMOD

The International Centre for Integrated Mountain Development (ICIMOD), is a regional knowledge development and learning centre serving the eight regional member countries of the Hindu Kush Himalaya – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan – and based in Kathmandu, Nepal. Globalisation and climate change have an increasing influence on the stability of fragile mountain ecosystems and the livelihoods of mountain people. ICIMOD aims to assist mountain people to understand these changes, adapt to them, and make the most of new opportunities, while addressing upstream-downstream issues. We support regional transboundary programmes through partnership with regional partner institutions, facilitate the exchange of experience, and serve as a regional knowledge hub. We strengthen networking among regional and global centres of excellence. Overall, we are working to develop an economically and environmentally sound mountain ecosystem to improve the living standards of mountain populations and to sustain vital ecosystem services for the billions of people living downstream – now, and for the future.

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ICIMOD gratefully acknowledges the support of its core donors: the Governments of Afghanistan, Australia, Austria, Bangladesh, Bhutan, China, India, Myanmar, Nepal, Norway, Pakistan, Sweden, and Switzerland.

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Status of Measurement, Reporting, and Verification for REDD+ in the Hindu Kush Himalaya

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International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, April 2018

Published by
International Centre for Integrated Mountain Development (ICIMOD)
GP Box 3226, Kathmandu, Nepal

ISBN 978 92 9115 603 0 (printed)
978 92 9115 604 7 (electronic)

Production team
Elaine Monaghan (Consultant editor)
Christopher Butler (Editor)
Dharma R Maharjan (Layout and design)
Asha Kaji Thaku (Editorial assistant)

Photos: Niroj Timalsina - cover, Nay Myo - p vi, Jitendra Bajracharya - p 21, Bhaskar Karky - p23

Printed and bound in Nepal by
Hill Side Press (P) Ltd., Kathmandu, Nepal

This publication is available in electronic form at www.icimod.org/himaldoc

Citation: ICIMOD (2018) *Status of measurement, reporting, and verification for REDD+ in the Hindu Kush Himalaya.* ICIMOD Working Paper 2018/4. Kathmandu: ICIMOD

Contents

Acronyms and Abbreviations

AD	Activity data
AFOLU	Agriculture, forestry, and other land uses
BUR	Biennial update report
CBD	Convention on Biological Diversity
COP	Conference of the Parties
DFPS	Department of Forests and Park Services
ERPD	Emission Reductions Programme Document
EF	Emission factors
FAO	Food and Agriculture Organization of the United Nations
FCPF	Forest Carbon Partnership Facility
FIMS	Forest Information Management System
FRA	Forest resource assessment
FREL	Forest reference emission level
FRL	Forest reference level
FSI	Forest Survey of India
FSMP	Forestry Sector Master Plan
GHG	Greenhouse gas
GHG-I	Greenhouse gas inventory
GIS	Geographical Information System
GPG	Good practices guidance
ha	Hectares
HKH	Hindu Kush Himalaya
ICIMOD	International Centre for Integrated Mountain Development
IPCC	Intergovernmental Panel on Climate Change
ISFR	India State Forest Report
IUCN	International Union for Conservation of Nature
KCA	Key calagory analysis
LULC	Land use land cover
LULUCF	Land use, land use change, and forestry
MoEA	Ministry of Economic Affairs
MoEFCC	Ministry of Environment, Forests and Climate Change
MRV	Measurement, reporting, and verification
MSS	Multispectral scanner system
NFI	National forest inventory
NFMS	National forest monitoring system
PFI	Pakistan Forest Institute
QA	Quality assurance
QC	Quality control
REDD	Reducing emissions from deforestation and forest degradation
REDD+	Reducing emissions from deforestation and forest degradation, conservation and enhancement of forest carbon and sustainable forest management
R-PP	Readiness preparation proposal
SLMS	Satellite land monitoring system
t/ha	Tonnes per hectare
TWG	Technical working group
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WWF	World Wide Fund for Nature

Executive Summary

The initiative known as Reducing Emissions from Deforestation and Forest Degradation, Conservation and Enhancement of Forest Carbon and Sustainable Forest Management (REDD+) focuses on avoiding deforestation and forest degradation, conserving and sustainably managing forests, and enhancing forest carbon stocks. Over the last few years, REDD+ activities in developing countries have resulted in actions that need to be fully measured, reported, and verified. The role of measurement, reporting, and verification (MRV) grew remarkably after the Cancun Agreements (2010) and is now an integral part of REDD+ implementation. Establishing robust and transparent national forest monitoring systems (NFMS) and developing national forest reference levels (FRL) are two prerequisites of REDD+ implementation to ensure a reliable, transparent, and credible MRV system.

This study examines the status of MRV in REDD+ Himalayan countries (Bhutan, India, Nepal, Myanmar, and Pakistan). In common with other REDD+ readiness activities, MRV is gaining momentum in all countries, but progress and stage of development vary. Countries such as Bhutan, Nepal, Myanmar, and Pakistan are planning to establish NFMS, whereas India already has well-established mechanisms to monitor forests. On the other hand, Nepal submitted its FRL in 2017, while other countries are still preparing theirs.

NFMS are composed of satellite land monitoring systems (SLMS), national forest inventories (NFI), and greenhouse gas inventories (GHG-I). The availability of historical data of land use and forest cover is not consistent across the region; rather, it varies from country to country. For instance, forest cover data of India are available from 1987 at 2-year intervals. Similarly, recent data of forest inventory of India and Nepal are available, whereas Bhutan, Myanmar, and Pakistan are in the process of analysing their inventories and data. A continuous, well-functioning NFMS depends on the existing inventory system; available and accessible data; the technical and financial capacity to collect data; and the human capacity to process, report, and verify data. A qualitative analysis showed that India has an adequate capacity to run regular NFMS and that the other regional countries have some limitations. Despite these limitations, they also have good practices such as community involvement in MRV in Nepal and the OneMap system in Myanmar. OneMap system aims to create of an online open access spatial data platform on land.

We recommend a regional platform to exchange knowledge between the partner countries for developing transparent, comprehensive, comparable, consistent, and accurate REDD+ MRV through fostering regular learning–sharing meetings, workshops, and training sessions; publishing through a regional framework; creating a manual of guidelines for good practice; and coordinating, cooperating, and collaborating on emerging issues.

Key Messages

Establishment of a REDD+ MRV system

The establishment of a clear and well-recognized institutional framework is obligatory if sustainable and effective REDD+ MRV is to be ensured, and this should be accompanied by favourable policy design and decisions. While formulating policies and designs for an MRV system, focus should be on measurement and estimation; these require technical solutions relating to collection or generation of activities data, followed by estimates and uncertainty assessment. The system should also include quality assurance (QA) and quality control (QC) processes, and comprehensive documentation and archiving. Moreover, an MRV system should function in such a way that countries can participate in results-based payments through REDD+. For this to happen, reporting and verification are vital and the process should follow the sequence: (i) submission and technical assessment of the forest reference emission levels (FREL) and FRL; and (ii) reporting and technical analysis of emissions and removal associated with REDD+ activities, consistent with the FRL and FREL.

Capacities of NFMS

The capacities of the NFMS of REDD+ Himalayan countries were analysed on the basis of six major points: inventory; basic information (available and accessible data); technical and financial capabilities; capacity for processing (analysing) information; human capacity for the preparation of reports; and human and technical

capacity for verification. Different countries have diverse NFMS capacities. For instance, capacities development is needed in Bhutan and Myanmar in all six areas for SLMS, NFI, and national GHG-I, whereas the scenario is different in the case of India. India has adequate capacities for SLMS, NFI, and national GHG-I but is inadequate at the subnational level. Similarly, the capacities of Nepal need to be enhanced in NFI and national GHG-I. In Pakistan, the human capacity for report preparation is sufficient for SLMs, NFI, and national GHG-I. However, data availability and technical and financial capabilities for SLMS and human and technical capacity for NFI are in inadequate in Pakistan.

South–south learning platform

South–south cooperation and learning enables countries to mutually learn and benefit from each other, assuming they have similar conditions, bottlenecks, and opportunities for development, and it is a powerful regional cooperation tool to foster REDD+ preparedness in the Hindu Kush Himalayan (HKH) region. Maintaining this platform could help in the development of a common methodology and shared understanding of the REDD+ MRV system. Some activities resulting from this cooperation, such as the development of a regional protocol and framework, guidelines, and a manual for the REDD+ MRV system, would be helpful in promoting a strong voice in climate negotiations in this region. Countries could also exchange expertize in performing MRV in order to achieve more reliable and accurate results.

1. Introduction

1.1 Background

Forests cover around 30% of the Earth's land surface, and account for nearly 4 billion hectares (ha) (UNFCCC, 2015). The importance of forests for life on Earth cannot be overlooked. They provide valuable ecosystem services and goods, serve as habitats for a wide range of flora and fauna, and hold a significant standing stock of global carbon. According to the United Nations Framework Convention on Climate Change (UNFCCC), the total carbon content of forests in 2005 was estimated at 638 giga tonnes, which is more than the amount of carbon in the entire atmosphere (UNFCCC, 2015). These forests, however, are increasingly threatened as a result of deforestation, fragmentation, climate change, and other stressors that can be linked to human activities, and are quickly being lost. Deforestation, mainly conversion of forests for agriculture activities, has been increasing at an alarming speed for the past few decades. The loss of forest results in immediate release of the carbon stored in trees as CO_2 emissions. According to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), reducing or preventing deforestation is the mitigation option with the largest and most immediate impact on carbon stock in the short term (IPCC, 2007).

The concept of 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 (REDD+) has emerged and grown remarkably in recent years. REDD+ is a policy instrument with the potential to address GHG emissions and help in climate change mitigation. The Paris Agreement (COP 21, Article 5) was reached at the Conference of the Parties (COP) in 2015. This placed REDD+ in a new post-2020 framework, encouraging Parties to take action to implement and support REDD+ activities in developing countries because of the significant role REDD+ will play in the global endeavour to keep increases in global temperature below 2°C.

The Food and Agriculture Organization of the United Nations (FAO) has summarized the aims of the five REDD+ activities as: (i) reducing GHG by slowing, halting, and reversing forest loss and degradation; and (ii) increasing removal of GHG from the Earth's atmosphere through the conservation, management, and expansion of forests. It is pertinent to highlight the importance of managing forests sustainably, which generally refers to bringing the rate of extraction into line with the rate of natural growth to ensure near-zero net emissions over time.

Because very little about the MRV functions of REDD+ is known and practised in the HKH region, the objective of this report is to compile and present the pertinent data, efforts, and progress of related entities in five countries of the HKH — Bhutan, India, Myanmar, Nepal, and Pakistan. The data were collected from participants of the partner countries in the regional workshop on the subject held in Naypyitaw, Myanmar, on 24–28 October 2016. Other secondary information has also been accessed from various sources (e.g., technical reports, workshop documents, and relevant internet pages) and incorporated. The report will help REDD+ practitioners and development organizations to compare country capacities and assess their gaps in the context of REDD+ MRV in the HKH region. This will, subsequently, help in planning and executing capacity-building programmes in these countries.

1.2 Elements of MRV in REDD+ Implementation

UNFCCC requires all REDD+ participating countries to establish reliable, transparent, and credible systems to measure, report, and verify changes in forest carbon stocks. Such systems are prerequisites for claiming carbon credits under REDD+ schemes. MRV for REDD+ is a set of activities to measure, report, and verify the achievement of reducing anthropogenic forest-related GHG emissions through REDD+ activities (Box 1) periodically, legitimately, accurately, comprehensively, consistently, and transparently.

Box 1: **Mitigation actions (REDD+ activities)**

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

Measurement

Measurement is the process of estimating anthropogenic forest-related emissions by sources and of removals by sinks; forest carbon stocks; and changes in forest carbon stocks and forest area after implementation of REDD+ activities, following the guidelines from the IPCC. Since 1996, the IPCC has published methodological guidance to estimate GHG-I for reporting to the UNFCCC. A summary of these guidelines is presented in Table 1 (GFOI, 2016).

Table 1: **IPCC guidelines to estimate greenhouse gas inventories**

IPCC guidance document	Description
Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1996)	First guidelines agreed for use under UNFCCC
Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2001)	Provides good practice guidance to implementing the 1996 revised guidelines. Covers all sectors except land use, land use change, and forestry. Introduces the definition of good practice retained by all subsequent guidance and guidelines
Good Practice Guidance for land use, land use change, and forestry (IPCC, 2003)	Extends good practice guidance to include land use, land use change, and forestry
2006 IPCC Guidelines for National Greenhouse Gas Inventories ((IPCC, 2006)	Consolidates and updates previous guidance. Uses the same methodological framework as GPG2003. Combines agriculture and land use into a single sector (AFOLU)
2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (IPCC, 2014a)	Fills gaps, extends 2006GL, and updates emission/removal factors including on wetlands and drained soils
2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (IPCC, 2014b)	Provides guidance in support of the LULUCF accounting rules agreed for LULUCF for the second commitment period of the Kyoto Protocol

AFOLU, agriculture, forestry, and other land uses; GPG, good practices guidance; IPCC, Intergovernmental Panel on Climate Change; LULUCF, land use, land use change, and forestry; UNFCCC, United Nations Framework Convention on Climate Change

Reporting

Reporting on GHG emissions as the outcome of REDD+ performance entails a country compiling and making available data and statistics to the UNFCCC in its national communications. According to UNFCCC (2010), reporting must follow the following principles as a minimum (Table 2).

Table 2: **Principles of reporting**

Principles	Descriptions
Consistency	Systematic and consistent approach to measurement
Transparency	Open and easily accessible for review, check, and re-check, as well as for verification
Comparability	Methodology must be replicable and usable to produce comparable results
Completeness	Procedure should be comprehensive in respect to data, data sources, sampling methods, data collection and analysis
Accuracy	The level of accuracy and uncertainty of data must be known and declared

The REDD+ implementing countries are expected to report these estimates in a transparent and timely manner to the UNFCCC Secretariat, through an annex to their biennial update reports.

Verification

This refers to the process of independently checking the accuracy and reliability of reported information or the procedures used to generate information. This verification is done by a totally independent and external review. Decision 14/CP.19 (UNFCCC, 2013) envisioned a two-member technical team with experts from both developed and developing countries for the verification of submitted data and information. The experts in the team are to include land use, land use change, and forestry (LULUCF) specialists who will examine:

- the accuracy of the results;
- consistency in methodologies and definitions, comprehensiveness in information between the assessed reference level and the results of the implementation of the REDD+ activities;

- consistency of the data and information provided in the technical annex with the guidelines provided by UNFCCC; and
- the extent to which the information is transparent, consistent, complete, and accurate.

1.3 REDD+ MRV in Climate Negotiations

MRV is not a completely new process, and has been carried out for many years around the world. The concept was, however, emphasized further after it was more comprehensively introduced into international climate change discussions in the Bali Action Plan in 2007 (Decision 1/CP.13). Since then, MRV has become essential in climate negotiations as the primary performance tracking tool of anthropogenic GHG emissions, and of mitigation actions and their effectiveness.

The MRV system in REDD+ was mainstreamed in Decision 1/CP.16, also known as the Cancun Agreements, which proposed mitigation actions (see Box 1) for the forestry sector and suggested the implementation of results-based actions that should be fully measured, reported, and verified (UNFCCC, 2010). The agreement also requested countries aiming to implement REDD+ activities to develop:

- a national strategy or action plan;
- national FREL and FRL;
- a robust and transparent NFMS; and
- a system to provide information on safeguards.

Furthermore, MRV on results-based actions to receive results-based finances was highlighted in Decision 2/CP.17 (UNFCCC, 2011). At CP.18 in Doha, technical issues regarding MRV (Box 2) were discussed by the Subsidiary Body for Scientific and Technological Advice.

MRV modalities were adopted in Decision 14/CP.19 in Warsaw under the Warsaw Framework for REDD+ (UNFCCC, 2013). The major agreements in MRV modalities were

Box 2: **MRV issues**

- How to design national forest monitoring systems
- How to create an appropriate MRV framework for results-based payments
- How to link the MRV framework with national reference levels
- The need for additional guidance on designing REDD+ safeguards
- The drivers of deforestation

- measuring, reporting, and verifying anthropogenic forest-related emissions by sources and removals by sinks and forest carbon stocks. Change in forest carbon stock and forest area resulting from the implementation of REDD+ activities should be consistent with the methodological guidance provided in Decision 4/CP.15 and any guidance on the MRV of nationally appropriate mitigation actions by developing country Parties as agreed by the COP;
- data and information used by Parties in the estimation of anthropogenic forest-related emissions should be transparent, and consistent over time and with the established FREL and FRL;
- results of REDD+ activities implementation measured against the FREL and FRL should be expressed in tonnes of CO_2 equivalent per year;
- data and information should be provided through a technical annex to the biennial update reports, underlining that the submission of the technical annex is voluntary and in the context of results-based payments;
- that two additional LULUCF experts should be included in the technical team of experts for the international consultation, and analysis of results-based actions reported in a technical annex to the biennial update reports. These LULUCF experts will develop a technical report on their analysis of the technical annex and identified areas for technical improvement; and
- that results-based actions that may be eligible for appropriate market-based approaches which could be developed by the COP may be subject to any further specific modalities for verification.

Of the four requirements of the Cancun Agreements, the development of FREL and FRL, and NFMS are directly connected to the MRV system. MRV must also be integrated with the development of a country's REDD+ strategy, and should be linked to decision-making and enforcement, to better enable adaptive management and policy implementation at the national as well as subnational level.

1.4 Developing FRL and FREL for REDD+ Implementation

FREL and FRL (see Box 3) are benchmarks for assessing the performance of REDD+ activities in an implementing country.

In line with Decisions 4/CP.15 and 1/CP.16, Decision 12/CP.19 defines the modalities for FREL and FRL (UNFCCC, 2013), which should:

- be expressed in tonnes of CO_2 equivalent per year;
- maintain consistency with national GHG inventories;
- submit information and rationales on the development of FREL and FRL;
- make a transition to national FREL and FRL in those countries using subnational FREL and FRL as an interim measure;
- make FREL and FRL information available on the UNFCCC REDD internet platform; and
- agree on a stepwise approach.

Box 3: **FREL/FRL terminology**

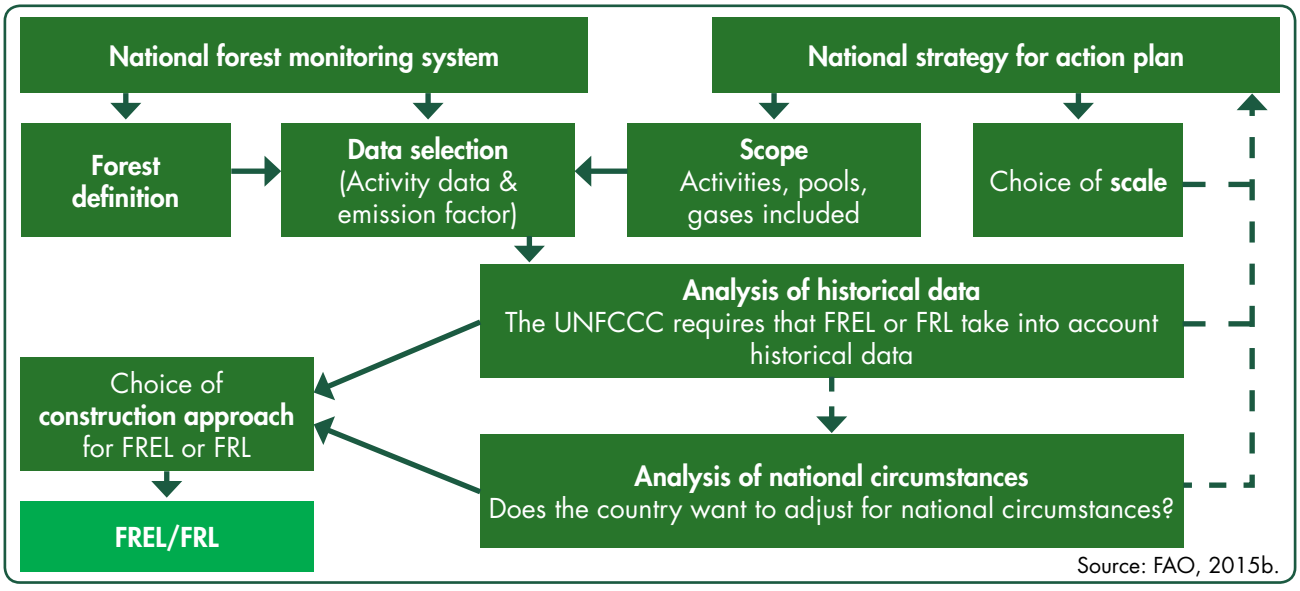
- UNFCCC decisions: FREL and FRL definitions not clarified; both 'FREL' and 'FRL' used.
- UN-REDD programme: FREL includes only emissions from deforestation and degradation, whereas an FRL includes both emissions by sources and removals by sinks; thus it also includes enhancement of forest carbon stocks (FAO, 2014).

The stepwise approach enables developing countries to improve FREL and FRL over time by incorporating better data, improved methodologies, and—where appropriate—additional carbon pools (e.g., above-ground biomass, belowground biomass, dead wood, litter, soil organic carbon, and wood products). It also suggests that FREL and FRL development may start with simple and (possibly) uncertain data (Step 1), leading to use of more complex data and a rigorous uncertainty analysis (Step 3) (Herold et al. 2012).

Decision 13/CP.19 adopted guidelines and procedures for the technical assessment of submissions on FREL and FRL, and briefly discussed technical procedures, team composition, and timing of submissions. For instance, technical assessment should be conducted on a yearly basis by a team of LULUCF experts selected from the roster of experts and coordinated by the UNFCCC Secretariat.

FAO (2015b) has proposed the possible simplest flow for FREL and FRL construction (Figure 1), illustrating the strong connection of FREL and FRL with NFMS and national strategy or action plans. For example: the definition of a forest should be the same in FREL and FRL and in the GHG-I. Similarly, data selection may depend upon the activity data available and on their emission factors, as well as on choice of scope. National strategy or action plans should guide the selection of scope through which a country is trying to implement REDD+.

Figure 1: **Flowchart showing FREL and FRL construction**



FREL, forest reference emission level; FRL, forest reference level

Analysis of historical data and national circumstances may provide information on historical emissions through deforestation and forest degradation, together with their drivers, assisting countries in deciding their approach to FREL and FRL construction.

1.5 NFMS

Forest monitoring provides the information necessary to support policies and decisions to conserve, protect, and sustainably manage forest resources; it is, therefore, a key issue in REDD+ policy and development. REDD+ is based on the premise of payments for mitigation results, and so in monitoring forests is critically important that measurements of emissions and removals are as accurate as possible, meaning they have low uncertainty (Angelsen et al., 2012).

Establishment of an NFMS and subnational system (if appropriate) depends upon national circumstances and capabilities; it should, however, be robust and transparent. The provisions for NFMS in Decision 4/CP.15 (UNFCCC, 2010) are:

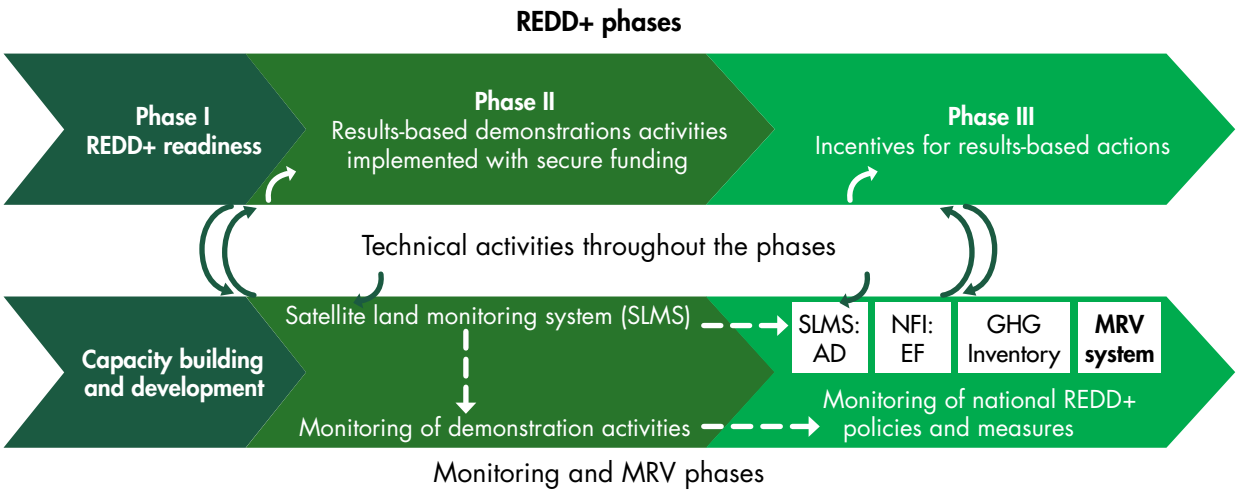
- Use a combination of remote sensing and ground-based forest carbon inventory approaches for estimating, as appropriate, anthropogenic forest-related GHG emissions by sources and removals by sinks, forest carbon stocks, and forest area changes.
- Provide estimates that are transparent, consistent, and as far as possible accurate, and which reduce uncertainties, taking into account national capabilities and capacities.
- Make procedures transparent and their results available and suitable for review as agreed by the Parties.

In line with this provision, Decision 11/CP.19 (UNFCCC, 2013) decided that NFMS should be guided by the most recent IPCC Guidelines and guidance adopted or encouraged by the COP. NFMS should provide data and information that are transparent, consistent over time, and suitable for the MRV of REDD+ activities, as well as consistent with decisions on nationally appropriate mitigation actions. The UNFCCC decided in 2013 that modalities for NFMS should:

- build upon existing systems, as appropriate;
- enable the assessment of different types of forests in the country, including natural forest, as defined by the Party;
- be flexible and allow for improvement; and
- reflect, as appropriate, the phased approach (begins with the development of national strategies or action plans, policies and measures, and capacity building; is followed by their implementation and possibly further capacity building, technology development, and transfer and results-based demonstration activities; and evolves into results-based actions that should be fully measured, reported, and verified).

As implementation of the NFMS is an integral part of a country's REDD+ policy, it should be designed with capabilities to regularly monitor and measure forest functions and thereby provide the necessary information for REDD+ MRV (Figure 2).

Figure 2: **Implementation phase of national forest monitoring system**



Source: FAO, 2013. SLMS, Satellite land monitoring system; NFI, National forest inventories; GHG, Greenhouse gas; AD, Activity data; EF, Emission factor

Three phases

Phase 1: Capacity building on, and design of, technical elements (e.g., SLMS, remote sensing, forest inventory); establishment of institutional arrangements; activity planning; design of demonstration (pilot) activities.

Phase 2: Implementation and monitoring of (and learning from) demonstration activities, and further capacity building on technical elements.

Phase 3: SLMS is upgraded to monitor national performance of REDD+ policies and measures; full MRV is in place for assessing GHG emissions and removals in the forestry sector and for reporting mitigation performance to the UNFCCC Secretariat.

COP.19 also acknowledged that NFMS may provide appropriate information on how the safeguards are addressed and respected.

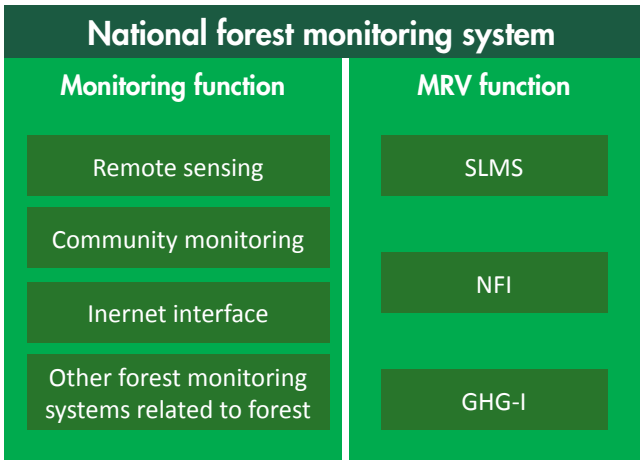
UN-REDD has proposed a "three pillars" approach for building NFMS strategy (Figure 3), based on the methodological equation proposed by the IPCC (see section 1.5.3).

Pillar 1: An SLMS

Pillar 2: An NFI

Pillar 3: A national GHG-I as a tool for reporting to the UNFCCC Secretariat on anthropogenic forest-related GHG emissions by sources and removals by sinks.

Figure 3: **Approach to fulfill the function of the national forest monitoring system**



1.5.1 SLMS

SLMS need to focus on collection of data on land use and forest area change due to human activities. The UN-REDD NFMS strategy envisioned that SLMS would use satellite remote sensing as a central tool for monitoring REDD+ activities in combination with an online GIS dissemination portal. Remote sensing techniques should be applied to fulfil the required consistency, completeness, comparativeness, accuracy, and transparency, as recommended by the IPCC (IPCC, 2003). Assessment of historical rates of deforestation and degradation is feasible through remote sensing (Vidal et al., 2013; Wang and Myint, 2016), but a consistent methodological approach over time is critical to fulfil the needs of UNFCCC.

1.5.2 NFI

An NFI is considered to be a key monitoring system which produces information on forest resources (volume, growth, and quality of growing stock); forest carbon stocks and their changes; land use structure; forest ownership; forest health; and biodiversity. Anthropogenic GHG emissions and removals by sinks associated with forests are estimated from the NFI. Ultimately, the NFI allows countries to calculate country-specific emission factors for each relevant land use category, as well as subcategories based on stratification of forest land.

1.5.3 National GHG-I

The GHG-I is the third "pillar" of the NFMS strategy. The GHG-I is a highly useful tool, providing a good framework for the forest sector for estimating and reporting GHG emissions and removals.

An inventory of GHG emissions by sources and removal by sinks can be made by using the IPCC equation.

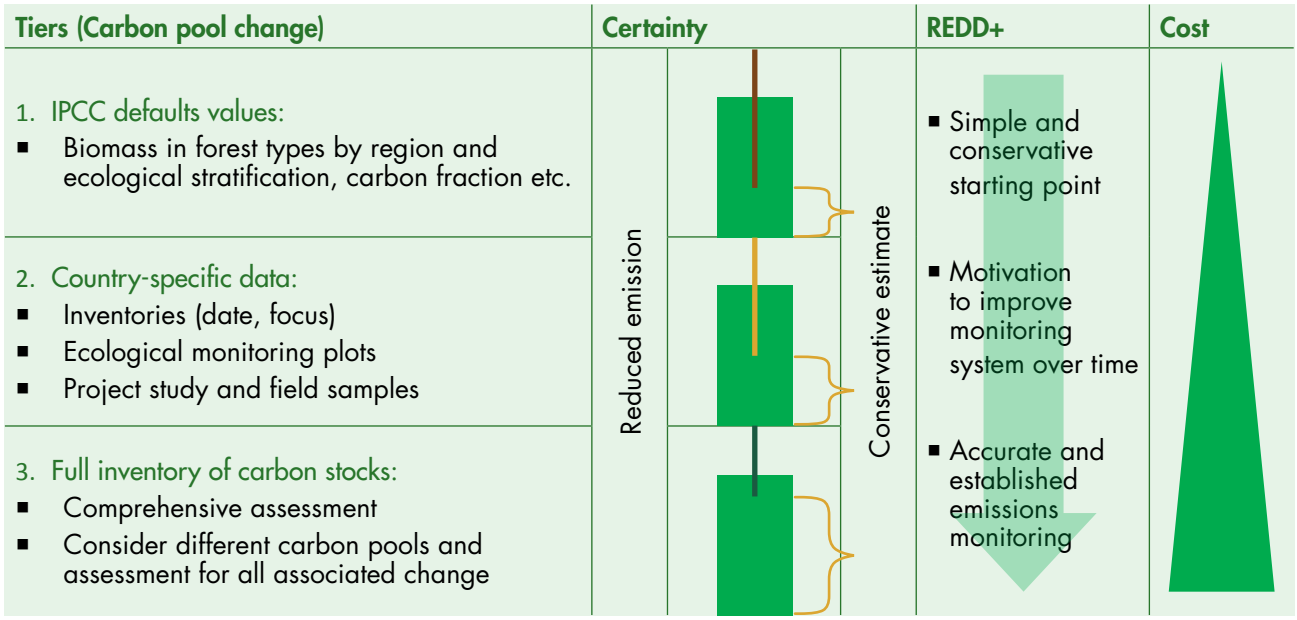
Emissions (E) = activity data (AD) × emission factors (EF)

where activity data are changes in the area of land use assessed through SLMS, expressed in ha/yr for deforestation and degradation, and m^3/yr for wood extraction for timber or fuel. Emission factors are the average amounts of emissions per unit area of each type of activity given by NFI, expressed in t CO_2/ha or t CO_2/m^3.

The IPCC Guidelines 2006 allow for inventories with different levels of complexity, known as "tiers" (IPCC, 2006). Tier 1 methods are designed for simple procedures that use the IPCC equation and default values for the estimation of emission and stock change factors. Tier 2 uses a similar approach, but the emission and stock change factors are based on country- or region-specific data; and Tier 3 uses higher-order methods. The methods and procedures used in Tier 3 include models and inventory measurement systems prepared to address unique national circumstances. Accordingly, inventories using Tiers 2 and 3, although costly, will be more accurate and uncertainty will be reduced (Figure 4).

National GHG-I provide essential country information and allow assessment of whether the implementation of REDD+ activities, policies, and measures are resulting in measurable climate change mitigation.

Figure 4: **Tiers for forest greenhouse gas inventories**



Source: Hewson et al., 2014, adapted from GOFC-GOLD 2011.

1.6 REDD+ Readiness in ICIMOD's REDD+ Himalayan Countries

Bhutan

The process of formulation of Bhutan's readiness preparation proposal (R-PP) began in 2010. The Watershed Management Division of the Department of Forests & Park Services, Ministry of Agriculture and Forests, is the focal point for REDD+ and Bhutan joined the UN-REDD Programme in 2011. The government then prepared its R-PP and submitted it to the Forest Carbon Partnership Facility (FCPF) in November 2013 (Royal Government of Bhutan, 2013).

Bhutan is working on several REDD+ readiness activities, including

- assessing land use and land use change drivers, forest law, policy, and governance;
- analysing historical land cover and forest type change;
- developing a REDD+ strategy document;
- completing an NFI;
- developing allometric equations and software for biomass data analysis;
- evaluating environmental services;
- preparing a REDD+ safeguards framework;
- finalizing the Land Policy that was drafted in 2010;
- formulating reference emission levels; and
- developing an internet GIS interface for the NFMS.

India

India has not yet submitted its R-PP, although it has been at the forefront of shaping a comprehensive concept of REDD+ at the international level (MoEFCC, 2014). The key issues and challenges are constructing the national FRL, building independent MRV systems, and establishing safeguards information systems.

Myanmar

Myanmar became a partner country of the UN-REDD Programme in December 2011 and has quickly taken steps to start implementing REDD+ readiness activities through the preparation of the Myanmar REDD+ Readiness Roadmap in 2013, which was submitted to FCPF in the same year. This roadmap has identified six major components to be implemented in its REDD+ readiness activities (Government of Myanmar, 2013):

- Management of REDD+ readiness.
- Stakeholder consultation and participation.
- Development and selection of REDD+ strategies.
- Implementation framework and safeguards.
- National forest reference emission level.
- NFMS.

Nepal

Nepal initiated the REDD+ readiness process from 2008 through submission of a REDD readiness plan idea note to the FCPF of the World Bank. Soon after, a REDD Forestry and Climate Change Cell, currently called the REDD Implementation Center, was established under the Ministry of Forests and Soil Conservation. The government then prepared and submitted the R-PP to FCPF in 2010. Since then, several studies have been conducted as envisioned in the R-PP, and a first draft of the Nepal REDD+ strategy was produced in 2014. This was upgraded through a series of consultations with relevant stakeholders, resulting the second draft of the Nepal REDD+ strategy in 2016. To demonstrate its readiness, Nepal has developed an ERPD at a subnational scale in 12 districts of the Tarai Arc Landscape (Government of Nepal, 2016). In January 2017 Nepal also submitted its FRL to UNFCCC. Furthermore, the Forest Investment Plan submitted by Nepal is also endorsed by the World Bank.

Pakistan

Pakistan submitted its R-PP to the FCPF of the World Bank on 31 July 2013 (Government of Pakistan, 2013) and started implementing it in June 2015. Pakistan has also submitted a concept paper for the financing of REDD+ to the Global Environment Facility of the UNDP for its consideration under the category of Sustainable Forest Management (Government of Pakistan, 2013). Currently, Pakistan's REDD+ Readiness process intends to achieve the following outputs by June 2018:

- Development of a national REDD+ strategy and implementation framework.
- Development of NFMS and an MRV system.
- Designing of Pakistan's FRL for reporting to the UNFCCC and result-based payments.
- Development of grievance redressal mechanisms, a strategic environmental and social safeguards assessment, an environmental and social management framework, and a safeguards information system.
- Awareness raising and outreach at the national level.
- Designing of REDD+ payments for environmental services for two sites in Pakistan.

2. Establishing REDD+ MRV

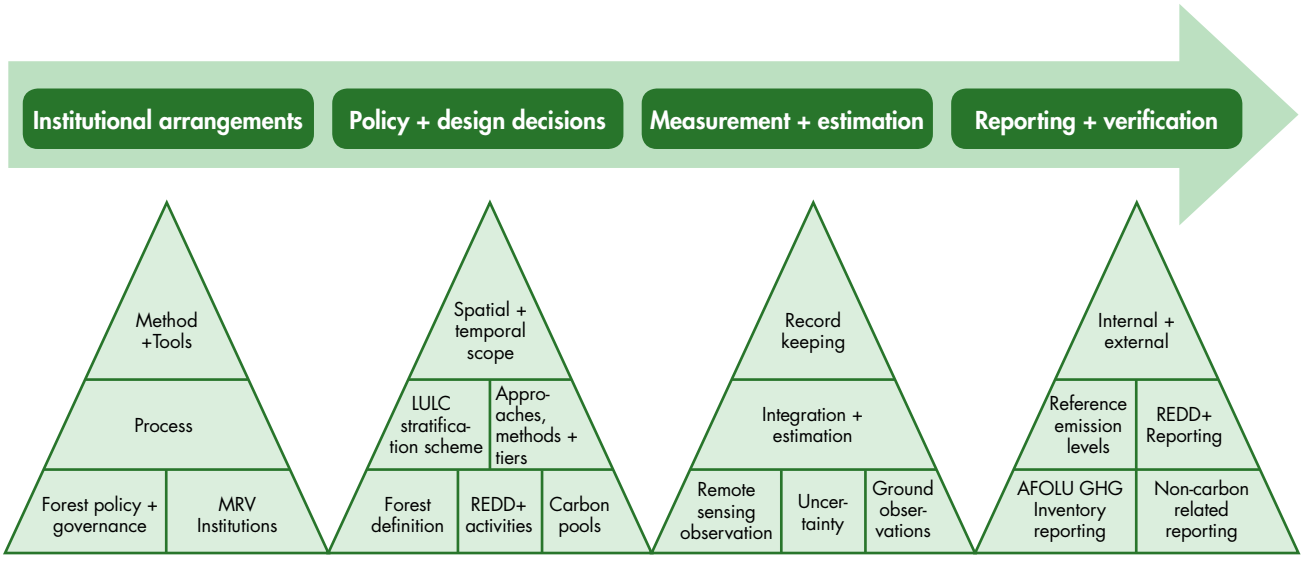
Various actions have to be completed to establish a REDD+ MRV system (Annex 1). These can be categorized broadly into the following themes (Figure 5) (GFOI, 2016):

- Institutional arrangement.
- Policy and design decisions.
- Measurement and estimation.
- Reporting and verification.

Establishing a clear and well-recognized institutional framework is mandatory to ensure sustainable and effective REDD+ MRV. Forest policy and governance; an MRV institution; a process; and methods and tools are key components of the institutional arrangement. Similarly, policy and design decisions are vital components when establishing REDD+ MRV, and function as the backbone to measurement, estimation, reporting, and verification. Measurement and estimation require technical solutions relating to collection or generation of activities data; estimates and uncertainty assessment then follow. Finally, QA and QC processes, comprehensive documentation, and archiving may follow.

Concepts and actions within reporting and verification mostly rely on institutional arrangements, policy and design decisions, and measurement and estimation. On one hand, participating in the REDD+ MRV process is voluntary in the context of results-based payments. On the other hand, reporting and verification comprise a sequential process: (i) submission and technical assessment of the FREL and FRL; and (ii) reporting and technical analysis of emissions and removal associated with REDD+ activities consistent with the FRL and FREL.

Figure 5: **Left to right and bottom to top hierarchical progression pyramid of MRV themes and sub-themes.**



LULC, Land use land cover; AFOLU, Agriculture, forestry and other land use; GHG, Greenhouse inventory

3 Status of REDD+ MRV in ICIMOD's REDD+ Himalayan Countries

Forest cover change analyses provide information on historical changing dynamics of forests at given temporal and spatial extents. Historical forest cover monitoring; forest inventories; and GHG estimation through remote sensing, GIS work, and field data are building blocks for establishing modern, comprehensive NFMS in REDD+ implementing countries.

Box 4: **Definition of forest**

FAO

The FAO definition of a forest as an area that includes a minimum threshold for the height of trees (5 m), at least 10% crown cover (canopy density determined by estimating the area of ground shaded by the crown of the trees), and having a minimum size (0.5 ha), is widely accepted worldwide.

UNFCCC

According to the UN Climate Change Convention, a "forest is a minimum area of land of 0.05–1.0 hectares with tree crown cover (or equivalent stocking level) of more than 10–30% with trees with the potential to reach a minimum height of 2–5 meters at maturity in situ. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground, or open forest. Young natural stands and all plantations which have yet to reach a crown density of 10–30% or tree height of 2–5 meters are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest."

CBD

According to the Convention on Biodiversity (CBD), "Forest is a land area of more than 0.5 ha, with a tree canopy cover of more than 10%, which is not primarily under agricultural or other specific non-forest land use. In the case of young forests or regions where tree growth is climatically suppressed, the trees should be capable of reaching a height of 5 m in situ, and of meeting the canopy cover requirement."

All ICIMOD's REDD+ Himalayan countries have their own history of forest cover monitoring. India has a long and well-managed history of NFMS, using its own satellite images and producing results every 2 years since 1987. Other countries also monitor their forests, using different approaches. These differences begin with definitions of "forest" (Table 3).

Probably the critical factor is crown cover threshold, which is used to distinguish the forest into "closed forest" and "open forest". The 10% threshold of crown cover encompasses both open and closed forests. The term "closed forest" refers to areas where tree cover exceeds 40%, while "open forest" refers to areas where tree cover is between 10% and 40%. In the case of India, however, closed forest is further divided into dense and very dense according to crown coverage on 30%–70% and on more than 70%, respectively.

Table 3: **Definition of forest cover in REDD+ Himalayan countries**

Countries	Forest definition adopted in recent forest cover monitoring	Commonalities
Bhutan	Land with trees that spans more than 0.5 ha, with trees higher than 5 m and a canopy cover of more than 10%. It does not include land predominantly under agricultural or urban land use (Royal Government of Bhutan, 2011).	The threshold for crown cover is the same for all REDD+ Himalayan countries. The threshold for height and minimum area are the same for India, Myanmar, and Nepal. However, in Pakistan, minimum tree height has been set at 2 m upon maturity.
India	Land with a tree canopy cover of more than 10% and area of more than 0.5 ha. Forests are determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 m. Forests may be evergreen or semi-evergreen; deciduous; forest plantations; scrub forests; and littoral, swamp, or mangrove.	
Myanmar	A minimum threshold for the height of trees (5 m), at least 10% crown cover (canopy density determined by estimating the area of ground shaded by the crown of the trees), and a minimum forest area size (0.5 ha).	
Nepal	An area of land at least 0.5 ha, a minimum width or length of 20 m with a tree crown cover of more than 10%, and tree heights of 5 m at maturity.	
Pakistan	An area of land at least 0.5 ha with a tree crown cover of more than 10%, comprising of trees with the potential to reach a minimum height of 2 m. This will include existing irrigated plantations as well as areas that have already been defined as forests in respective legal documents and are hence expected to meet the requisite defined national thresholds for Pakistan.	

3.1 Status of REDD+ MRV in Bhutan

3.1.1 History of national forest cover monitoring in Bhutan

The first systematic land cover and land use assessment in Bhutan was carried out by a land use planning project under the Ministry of Agriculture in 1995. The Land Cover Mapping Project at the National Soil Services Centre updated the land cover maps in 2010. The land cover assessment was carried out using ALOS images (AVNIR-2) in 2006–09 winter seasons at resolutions of 10 m (Table 4). Land cover maps produced by the land use planning project in 1995, topographical maps (DSLR), Landsat (2004–05), and Google Earth were used as references (NSSC, 2011). The data and methodology used on both occasions are summarized in Tables 4 and 5.

Table 4: **Data and method used for land cover mapping in Bhutan**

Year	Sensor	Spatial resolution	Scale	Minimum mappable area (ha)	Mode of interpretation	Sources
1992	Landsat-TM	30 m	1:250,000	NA	Visual & digital	LUPP, 1997
2010	ALOS images (AVNIR-2)	10 m	1:50,000	0.5	Unsupervised & supervised	NSSC, 2011

Table 5: **Status of forest cover in Bhutan**

Year	Forest area (sq. km)			% of geographical area	Sources
	Open	Closed	Total		
1992	NA	NA	27,835.7	72.5	LUPP, 1997
2010	NA	NA	27,052.41	70.46	NSSC, 2011

NA, not available

3.1.2 Status of forest carbon inventory in Bhutan

Fieldwork has been completed and data analysis is in progress. The soon to be published NFI report will have two volumes. Volume I will focus on conventional tree parameters — number of stems, volume, and basal and other information. Volume II will focus on biomass, forest carbon, biodiversity, and forest information, among other things. The ICIMOD REDD+ Himalayan project is supporting the development of allometric equations for 20 tree species. National communications have previously reported carbon stock based on IPCC default values.

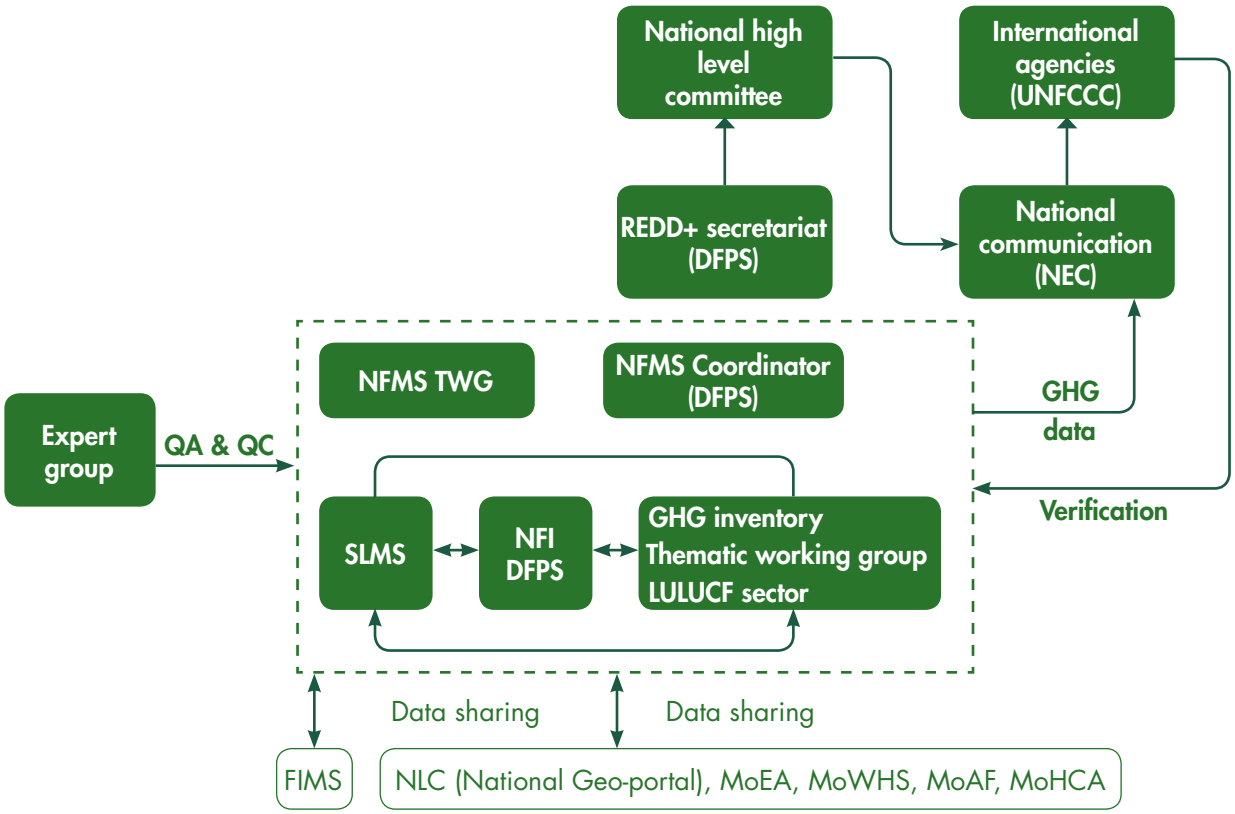
3.1.3 Proposed NFMS institutional framework in Bhutan

The Royal Government of Bhutan has prepared an action plan for Bhutan's NFMS for REDD+ under UNFCCC (Royal Government of Bhutan, 2015). This proposes that the institutions indicated in Figure 6 act as the lead government agencies or institutions for each of the respective components of the NFMS, namely:

- the Department of Forest and Park Services for the SLMS and NFI; and
- the National Environment Commission for the national GHG-I for the LULUCF sector, and for compiling and reporting the national communication to UNFCCC.

Specific QC processes will be integrated into the processes, as set out by the IPCC, and an overall QA assessment will be carried out by an independent third party. Under these arrangements activity data, emission factors, and GHG emissions data should be shared between the involved institutions to maximize transparency and openness.

Figure 6: **Proposed institutional arrangements for Bhutan's national forest monitoring system**



Source DFPS, 2015.

DFPS = Department of Forests and Park Services; GHG = Greenhouse gas; LULUCF = Land use, Land use change and Forestry; MoAF = Ministry of Agriculture and Forests; MoEA = Ministry of Economic Affairs; MoHCA = Ministry of Home and Cultural Affairs; MoWHS = Ministry of Works and Human Settlement; NEC = National Environment Commission; NFI = National Forest Inventory; SLMS = Satellite Land Monitoring System; TWG = Technical working group.

3.2 Status of REDD+ MRV in India

3.2.1 History of national forest cover monitoring in India

Forest cover data of India gathered at 2-yearly intervals from 1987 are available from the FSI. Data quality and image classification procedures are continuously advancing with time, and this has increased accuracy and reliability. In the first assessment, LANDSAT-MSS (80 m) images were manually or visually interpreted with a mappable area of 400 ha. During 1989–93, Landsat-TM (30 m) images were used, with a minimum mappable area of 25 ha. Interpretation procedures for both visual and digital images were advanced during 1995–99, and the data have been fully digital since 2001 (Table 6). Interpretation is now at a scale of 1:50,000 and is more objective, based on a minimum mapping unit of 1 ha. Forest cover data, based on two recent inventories, are represented in Table 7.

Table 6: **Data and method used for land cover mapping in India**

Year	Sensor	Spatial resolution	Scale	Minimum mappable area (ha)	Mode of interpretation	Sources
1987	LANDSAT-MSS	80 m	1:1 million	400	Visual	FSI website
1989	LANDSAT-TM	30 m	1:250,000	25	Visual	
1991	LANDSAT-TM	30 m	1:250,000	25	Visual	
1993	LANDSAT-TM	30 m	1:250,000	25	Visual	
1995	IRS-1B LISSII	36.25 m	1:250,000	25	Visual & digital	
1997	IRS-1B LISSII	36.25 m	1:250,000	25	Visual & digital	
1999	IRS-1C/1D LISS III	23.5 m	1:250,000	25	Visual & digital	
2001	IRS-1C/1D LISS III	23.5 m	1:50,000	1	Digital	
2003	IRS-1D LISS III	23.5 m	1:50,000	1	Digital	
2005	IRS-1D LISS III	23.5 m	1:50,000	1	Digital	
2009	IRS-P6-LISS III	23.5 m	1:50,000	1	Digital	
2011	IRS-P6-LISS III & IRS-P6 AWiFS	23.5 m 56 m	1:50,000	1	Digital	
2013	IRS P6-LISS-III IRS-Resourcesat2-LISS III	23.5 m	1:50,000	1	Digital	
2015	IRS P6-LISS-III IRS-Resourcesat2-LISS III	23.5 m	1:50,000	1	Digital	

Table 7: **Status of forest cover in India**

Forest cover	2013 (source: FSI 2013)		2015 (source: FSI 2015)	
	Area (sq km)	% of geographical area	Area (sq km)	% of geographical area
Very dense	83,502	2.54	85,904	2.61
Moderate dense	31,8745	9.7	315,374	9.59
Open forest	295,651	8.99	300,395	9.14
Total forest cover	697,898	21.23	701,673	21.34
Tree cover	91,266	2.78	92,572	2.82
Total forest and tree cover	789,164	24.01	794,245	24.16
Includes mangroves*	4,628		4,740	

3.2.2 Status of forest carbon inventory in India

FSI has been estimating the carbon stock of Indian forests at 2-year intervals, using the IPCC Good Practices Guidelines methodology. Two variables — forest types and canopy density — are used to stratify the data. Above-ground biomass of trees, and biomass of shrubs, herbs, climbers, and dead wood are derived from the biomass equations or factors developed through a special study conducted by FSI. A 2015 assessment calculated the total carbon stock in Indian forests as being 7,044 million t (Table 8).

Table 8: **Carbon inventory of India, 2015**

Carbon pools	Carbon stock in forest 2015 (million tonnes)	Source
Above-ground	2,220	FSI, 2015
Below-ground	695	
Dead wood	29	
Litter	131	
Soils	3,969	
Total	**7,044**	

FSI, Forest survey of India

3.2.3 Proposed NFMS institutional framework in India

FSI will be the focal point responsible for NFMS, together with the National Remote Sensing Centre, the Indian Council of Forestry Research and Education, and the Indian Institute of Science (MoEFCC, 2014).

3.3 Status of REDD+ MRV in Myanmar

3.3.1 History of national forest cover monitoring in Myanmar

The responsibility for processing forest cover data of Myanmar lies with the remote sensing and GIS section of the Planning and Statistics Division of the Forest Department, under the Ministry of Natural Resources and Environmental Conservation. The history of systematic forest cover assessment in Myanmar goes back to 1957 when 1:24,000 scale aerial photography and manual interpretation were used. The second survey was conducted in 1975 and used 1:1 million scale colour composites from 80 m × 80 m MSS data. The third survey in 1989 used 1:500,000 scale Landsat-TM data (30 m × 30 m resolution) and manual interpretation (FAO, 2010a). In 2000 a forest resource assessment was published, based on a survey conducted in 1997. This used a combination of various appraisals; however, the majority consisted of digital classifications of 30 m × 30 m Landsat-TM data. The Landsat 7 enhanced thematic mapper was used for the 2005 forest resource assessment, and that of 2010 was assessed through maximum likelihood classification from IRS Liss III images (Table 9). Forest cover assessment for 2015 was based on Landsat 8 images, acquired from October 2014 to March 2015, and the Forest Department is now planning to initiate real-time monitoring. Table 10 is representative of the status of forest cover in Myanmar.

Table 9: **Data and method used for land cover mapping in Myanmar**

Year	Sensor	Spatial resolution	Scale	Minimum mappable area (ha)	Mode of interpretation	Sources
2000	Landsat 5, 7	30 m	NA	NA	Visual and digital	FAO FRA (2000, 2005, 2010)
2005	Landsat 7	30 m	NA	NA	Maximum likelihood classification	
2010	IRS Liss III	23.5 m	NA	NA	Maximum likelihood classification	Forest Department 2015 FRA database
2015	Landsat 8	30 m	NA	NA	Maximum likelihood classification	

FRA, forest resource assessment; NA, not available

Table 10: **Status of forest cover in Myanmar**

Year	Forest area (sq km)			% of geographical area	Sources
	Open	Closed	Total		
2000	113,665.1	235,043.2	348,708.3	51.54	FRA assessments of FAO (2000, 2005, 2010) FAO (2010b)
2005	148,441.2	184,773.5	333,214.7	49.25	
2010	183,285.0	134,436.0	317,721.0	46.96	
2015	144,584.7	145,870.2	290,454.9	42.93	Forest Department 2015 FRA database FAO (2015a)

3.3.2 Status of forest carbon inventory in Myanmar

In Myanmar a systematic forest inventory was initiated in 1982, and since then various national and subnational (district forest management plan) inventories have been conducted (Government of Myanmar, 2015). However, the NFI methodology used previously was not suitable for REDD+ reporting, and so Myanmar is trying to conduct a multipurpose NFI with a redesigned methodology to measure carbon stocks (Government of Myanmar, 2013).

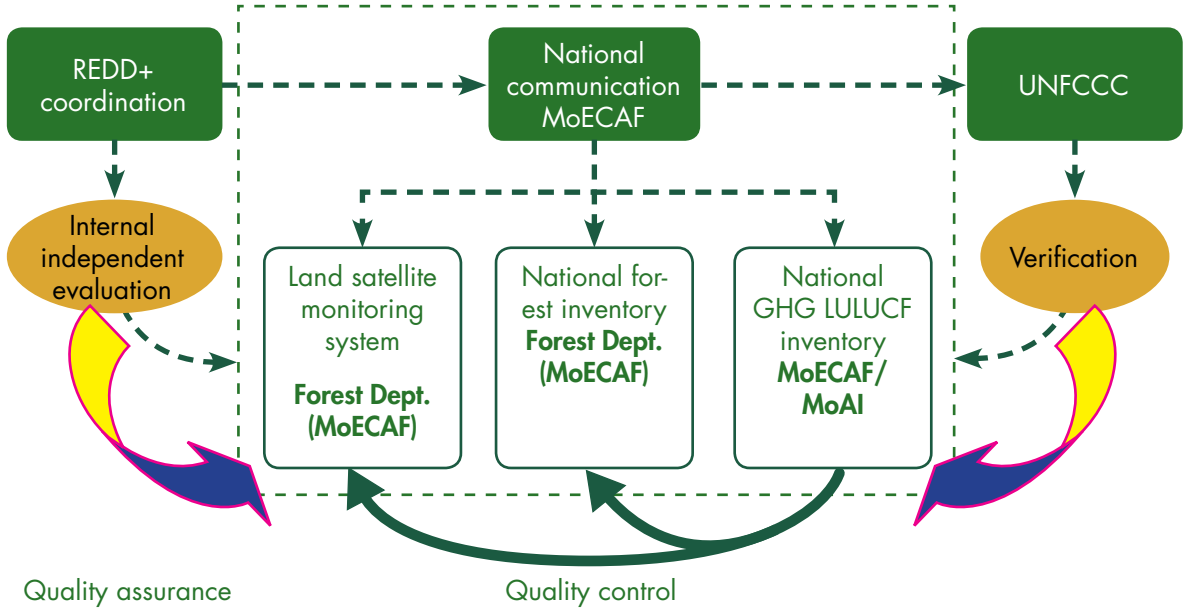
The Myanmar Initial Forest Reference Emission Level recently submitted to the UNFCCC applied carbon stock estimated using management plan inventory data collected between 2005 and 2015.

3.3.3 Proposed NFMS institutional framework in Myanmar

In September 2015 the Government of Myanmar drafted a document for the "Development of a National Forest Monitoring System" (Goverment of Myanmar, 2015). This proposed that the institutions indicated in Figure 7 should act as the lead government agencies or institutions for each of the respective components of the national

forest monitoring system. These bodies are: the Forest Department (and specifically the remote sensing and GIS section) for the land satellite monitoring system; the Forest Department for the NFI; the Ministry of Environmental Conservation and Forestry and the Ministry of Agriculture and Irrigation for the national GHG-I for the LULUCF sector; and the Ministry of Environmental Conservation and Forestry for compiling and reporting the national communication to UNFCCC.

Figure 7: **Proposed institutional arrangement for Myanmar's NFMS**



Source: Government of Myanmar, 2015. LULUCF, land use, land use change and forestry; MoECAF, Ministry of Environmental Conservation and Forestry; MoAI, Ministry of Agriculture and Irrigation.

3.4 Status of REDD+ MRV in Nepal

3.4.1 History of national forests cover monitoring in Nepal

The Department of Forest Research and Survey under the Ministry of Forest and Soil Conservation is responsible for forest cover assessment in Nepal. Nationwide forest resource assessments (NFI, 1994) conducted in the 1990s (DFRS, 1999) were based on mapping and interpretation of aerial photographs and satellite images (Landsat-TM). Aerial photographs covered 83.7% of Nepal and satellite images covered 16.3%. The minimum mappable unit varied, based on the methods used, and ranged from 1 ha to 25 ha. The latest forest cover assessment used RapidEye images with spatial resolutions of 5 m. The images were classified by wall-to-wall mapping through integration of an advanced object-based image classification and regression tree, supported by extensive visual interpretation using high-resolution Google Earth images (Table 11). The status of forest cover in Nepal is shown in Table 12.

Table 11: **Data and method used for land cover mapping in Nepal**

Year	Sensor	Spatial resolution	Scale	Minimum mappable area (ha)	Mode of interpretation	Sources
1987–98	Landsat & aerial photos	Landsat (30 m)	Aerial photo (1:50,000) Landsat-TM 30 m	1–25	Point sampling using aerial photos & visual interpretation of grid system for 51 districts	(DFRS, 1999)
2011–14	RapidEye images	5 m	5 m spatial resolution	0.5	Object-based image classification & extensive visual interpretation using Google Earth images	(DFRS, 2015)

DFRS, Department of Forest Research and Survey

Table 12: **Status of forest cover in Nepal**

Year	Forest area (sq km)				% of geographical area		Sources
	Open	Closed	Total	Other woodland	Forest	OWL	
1987–98	NA	NA	42,700	NA	NA	NA	(DFRS 1999)
2011–14	NA	NA	59,600	6,500	40.36	4.38	(DFRS 2015)

DFRS, Department of Forest Research and Survey; NA, not available

3.4.2 Status of forest carbon inventory in Nepal

The total carbon stock in Nepal's forests has been estimated as 1,054.97 million tonnes (176.95 t/ha). Of this total, tree components (live, dead standing, dead wood, and below-ground biomass); forest soils; and litter and debris constitute 61.53%, 37.80%, and 0.67%, respectively (DFRS, 2015). Above-ground biomass is estimated by summing the stem biomass, branch biomass, and foliage biomass, estimated from different allometric equations.

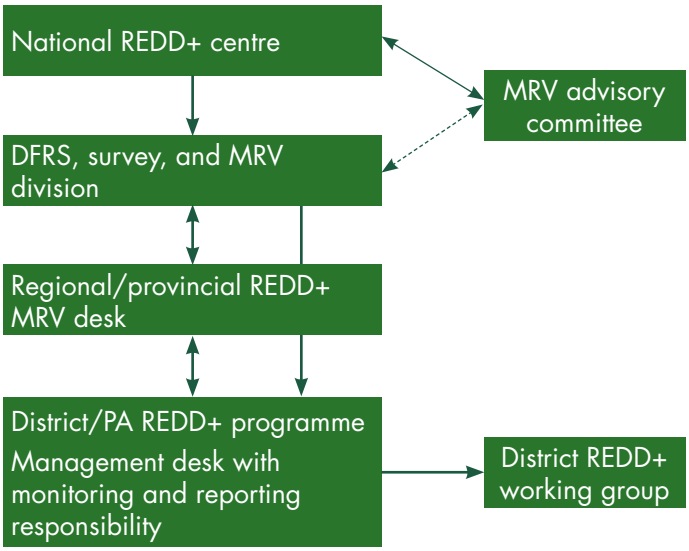
3.4.3 Proposed NFMS institutional framework in Nepal

The Department of Forest Research and Survey has been identified as the central authority for the design, operation, and updating of the NFMS. At a subnational level, district forest offices and protected areas authorities monitor, measure, update, and report land use change and forestry information to their central authorities (i.e., the Department of Forests and the Department of National Parks and Wildlife Conservation) annually. Consistently with the NFMS, resource inventories are compiled following community-based forest monitoring, at intervals of 5 years.

In addition, the monitoring and evaluation division of the Ministry of Forests and Soil Conservation coordinates all monitoring activities across the department and in other subsidiaries. There are established mechanisms for monitoring and evaluation, such as annual planning and monitoring workshops, quarterly review workshops, annual monitoring and reporting of community-based forest management groups, a monitoring system for harvesting of forest products, and publication of annual departmental reports.

Figure 8 shows the proposed institutional arrangements for managing the NFMS in Nepal.

Figure 8: **Proposed input to NFMS by the Department of Forest Research and Survey and MRV Division**



Source: Nepal REDD+ strategy, 2016.

3.5 Status of REDD+ MRV in Pakistan

3.5.1 History of national forest cover monitoring in Pakistan

Forests resources in Pakistan were studied by the Ministry of Environment in 1992, using Landsat (30 m) images of 1989-1990. Another survey was carried out in 2004 by the Pakistan Forest Institute (PFI) under the auspices of the Ministry of Environment (Table 13). Landsat images were again used for 1997 and 2001, and forest cover types were categorized into conifers, scrub, rangeland, mangrove, and riverine. Ground truthing was carried out in the field, using systematically selected sample plots along the grid every 5 km in the case of rangelands and every 1 km for forest areas.

Table 13: **Data and method used for land cover mapping in Pakistan**

Year	Sensor	Spatial resolution	Scale	Minimum mappable area (ha)	Mode of interpretation	Sources
1992	Landsat	30 m	1;250,000	NA	Manual	(FSMP, 1992)
2004	Landsat	30 m	1;250,000	NA	Maximum likelihood classifier (supervised classification)	(PFI, 2004)

NA, not available; FSMP, Forestry Sector Master Plan

In addition to the national level studies, PFI performed a district forest cover assessment in 2013. However, national forest cover data were available only for 1992 and 2004 (see Table 14). In order to map forest resources in accordance with harmonized and sustained procedures, the Government of Pakistan has recently modified the national definition of forests in Pakistan under the guidance of the IPCC and the UNFCCC.

Table 14: **Status of forest cover in Pakistan**

Year	Forest area (sq km)			% of geographical area	Sources
	Open	Closed	Total		
1992	NA	NA	42,240	4.8	(FSMP, 1992)
2004	NA	NA	43,920	5.01	(PFI, 2004)

NA, not available; FSMP, Forestry Sector Master Plan

3.5.2 Status of forest carbon inventory in Pakistan

The forest carbon inventory in Khyber Pakhtunkhwa (KP) and Gilgit-Baltistan began in 2014/15. Total carbon stock (above-ground and below-ground) in Gilgit Baltistan was assessed to be 16.95 million tons. PFI developed a sub-national Forest Reference Emission Level of Khyber Pakhtunkhwa in 2017 and has reported that the average annual emissions is 4.019 million-ton CO_2 eq. Uncertainty assessment is still being conducted for both the studies. However, there is no carbon inventory at a national level yet, although the Ministry of Climate Change has initiated this process in 2017 for development of NFMS and MRV System for Pakistan under REDD+ Readiness funds of FCPF. The results are expected in June 2018.

Some projects run by the provincial government are engaged in estimating carbon (Table 15).

Table 15: **Status of carbon inventory of Pakistan**

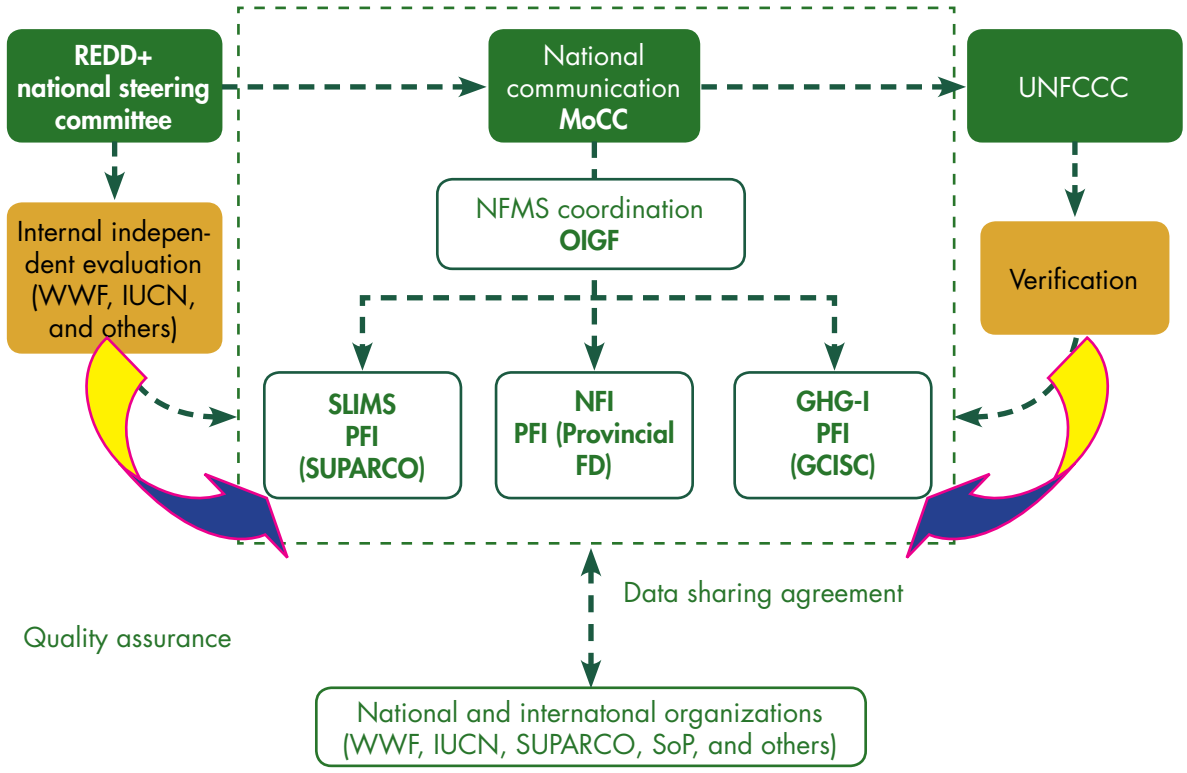
Province	Project	Duration	Implementing organization	Donor agencies
GB	REDD+ readiness preparation in GB	2013–15	GB FD	Government of GB
	Revised working plan for private forests of Diamer district	2015–16	GB FD	Government of GB
KPK	"Billion Tree Tsunami Afforestation Project in KPK"	2014–18	KPK FD	Government of KPK
	"Development of designated forest carbon assessment for REDD+ and promotion of carbon credit marketing in KPK"	2013–15	KPK FD	Government of KPK
	Carbon assessment of forests of KPK	2013–15	PFI	Government of KPK
AJK	Preparation of scientific forest management plans in AJK	2009–15	AJK FD	Government of AJK
Punjab	Satellite GIS-based mapping of major forest of Punjab for REDD+ readiness	2013–14 to 2015–16	Punjab FD	Government of Punjab

AJK, Azad Jammu and Kashmir; FD, forest degradation; GB, Gilgit-Baltistan; KPK, Khyber Pakhtunkhwa

3.5.3 Proposed NFMS institutional framework in Pakistan

While developing the NRMS Action Plan in 2015, the Government of Pakistan proposed an institutional framework to develop a sustainable monitoring mechanism for forest resources (see Figure 9). The government proposed that the PFI lead the implementation of the NFMS, with assistance from technical and administrative units — NFI, SLMS, GHG-I, and the monitoring department, which could work together to develop structures and arrangements to enhance the NFMS. The institutional arrangement, as part of Pakistan's National REDD+ Strategy, is in the process of being finalized, and should be complete by June 2018.

Figure 9: **Proposed institutional arrangement for a national forest monitoring system in Pakistan**



Source: Government of Pakistan 2015. FD, Forest department; GCISC, Global Change Impact Studies Centre; GHG-I, Greenhouse Gas Inventory; IUCN, International Union for Conservation of Nature; MoCC, Ministry of Climate Change; OIGF, Office of the Inspector General of Forests; PFI, Pakistan Forest Institute; SoP, Survey of Pakistan; SUPARCO, Space and Upper Atmosphere Research Commission; UNFCCC, United Nations Framework Convention on Climate Change; WWF, World Wide Fund for Nature.

Per the initial proposal, the Provincial Forest Department will support the PFI with the NFI, the Space and Upper Atmosphere Research Commission will provide support for the SLMS, and the Global Change Impact Studies Centre will provide support for GHG-I.

In the initial proposal, PFI was supposed to be supported by the provincial forest departments for the NFI, the Space and Upper Atmosphere Research Commission for SLMS, and the Global Change Impact Studies Centre for GHG-I.

3.6 Capacities for NFMS in ICIMOD's REDD+ Himalayan Countries

NFMS capacities rely heavily on the existing inventory system; available data and their accessibility; technical and financial capacities for data collection; and on human capacities for data processing, reporting, and verifying. A qualitative evaluation of these capacities of ICIMOD's REDD+ Himalayan countries is presented in below Table 16.

The overall NFMS capacity of Bhutan and Myanmar is inadequate in all six areas with respect to SLMS, NFI, and national GHG-I, but the scenario is different in the case of India. India has an adequate SLMS, NFI, and national GHG-I, but these capacities need to be transferred at a subnational level. The SLMS capacity of Nepal is adequate as it has the required inventory, data availability, and human capacity for the preparation of reports. Its capacity to analyse information, and its technical and financial capabilities, however, are still inadequate. Similarly, its capacity to create an NFI and its national GHG-I are also inadequate.

In the case of Pakistan, the human capacity for report preparation is sufficient for SLMS and NFI but is inadequate for national GHG-I. The REDD capacity for national GHG-I, along with inventory; data availability; and the technical and financial capabilities of the SLMS, is inadequate. The situation for NFI is similar, except for the human and technical capacity for verification. Information on processing capacity and human and technical verification capacity for SLMS and NFI is adequate.

Table 16: **Capacities of REDD+ Himalayas countries in NFMS**

	Capacity and capability	SLMS			NFI			National GHG-I		
Bhutan	Inventory									
	Basic information (data available and accessible)									
	Technical and financial capabilities									
	Capacity for processing (analysing) information									
	Human capacity for the preparation of reports									
	Human and technical capacity for verification									
India	Inventory									
	Basic information (data available and accessible)									
	Technical and financial capabilities									
	Capacity for processing (analysing) information									
	Human capacity for the preparation of reports									
	Human and technical capacity for verification									
Myanmar	Inventory									
	Basic information (data available and accessible)									
	Technical and financial capabilities									
	Capacity for processing (analysing) information									
	Human capacity for the preparation of reports									
	Human and technical capacity for verification									
Nepal	Inventory									
	Basic information (data available and accessible)									
	Technical and financial capabilities									
	Capacity for processing (analysing) information									
	Human capacity for the preparation of reports									
	Human and technical capacity for verification									
Pakistan	Inventory									
	Basic information (data available and accessible)									
	Technical and financial capabilities									
	Capacity for processing (analysing) information									
	Human capacity for the preparation of reports									
	Human and technical capacity for verification									

GHG-I, greenhouse gas inventory; NFI, national forest inventory; SLMS, satellite land monitoring system.

	Not known yet
	Inadequate
	Adequate
	Sufficient

Source: regional workshop on "Measurement Reporting and Verification (MRV) in the context of REDD+ in the Hindu Kush Himalaya", Naypyitaw, Myanmar, October 2016

3.7 Development of FRL and FREL in ICIMOD's REDD Himalayan Countries

Bhutan has plans to establish FRL and FREL after finalizing the NFI work that is under way. Similarly, India is in the process of developing both FRL and FREL.

In case of Myanmar, the process is limited by activity data and emission factors concerning with standardization methodology for image classification, satellite datasets, sensors, acquisition time, forest definition, and the lack of qualified interpreters.

Nepal submitted national FREL and FRL for the historical period 2000–10 in January 2017 (MFSC, 2016). Land-cover data for 2000 and 2010, prepared under a NASA-SERVIR and ICIMOD collaborative programme, were used as activity data on deforestation and afforestation. A subnational FRL for the Tarai Arc Landscape area was also developed in 2013, based on historical averages of 1999 and 2011.

Pakistan is in the process of developing a FREL and FRL under the REDD+ R-PP. The reference period mentioned in Pakistan's R-PP is 1996–2016.

The direct drivers and underlying causes used to develop FRL processes by the countries in the REDD Himalayan project are summarized in Table 17 and Table 18.

The drivers of deforestation and forest degradation in the action plan for implementation of the Pakistan NFMS, 2015, are listed in Table 18.

Table 17: **Adopted definitions and major drivers of deforestation and forest degradation**

	Bhutan	India	Myanmar	Nepal
Deforestation	• A process of clearing and converting forest land to another land use, such as for agriculture, mining, or development	• The direct human-induced conversion of forested land to non-forested land	• Loss of forest cover by the conversion of forest to another land cover, i.e., below 10% of canopy cover (conversion of closed and open forest to non-forest)	• The long-term or permanent conversion of forest to other (non-forest) land
Direct drivers	• SRF land allotment for various purposes • Hydropower projects • Agriculture • Roads • Mines and quarries • Electricity transmission lines	• In the process of developing FREL	• Expansion of agriculture (subsistence and commercial) • Mining • Hydropower development • Infrastructure (roads, pipelines, special economic zones, power lines) • Urbanization and resettlement • Development of aquaculture	• Urbanization and resettlement • Encroachment • Mining or excavation (sand, boulders, stones)
Forest degradation	• Forest remaining predominantly forest, and not switched to a different land use, but the quality of the forest declines, and the carbon stocks of the forest are reduced	• Transition from higher to lower tree crown density or removal of lower canopy biomass (or both) or disturbance of soil, leading to reduction in carbon stocks	• Changes within the forest that negatively affect the structure or function of the stand, provided above 10% of canopy cover (conversion of closed to open forest)	• The long-term or permanent reduction of biomass in forest land remaining forest land
Direct drivers	• Timber harvesting • Firewood • Forest fires • Livestock		• Overexploitation of forest • Timber (legal/illegal) • Overharvesting of wood biomass as a source of energy • Unstable or pioneering shifting • Cultivation (not permanent conversion of forest into agricultural land) • Forest fires • Overgrazing • Storms • Pests	• Unsustainable harvesting and illegal harvesting • Forest fires • Infrastructure development (includes manmade disasters) • Overgrazing or uncontrolled grazing • Weak forest management practices (unmanaged or undermanaged) • Mining or excavation (sand, boulders, stones) • Expansion of invasive species
Source	Royal Government of Bhutan, 2017		Government of Myanmar, 2013	Government of Nepal, 2016

FREL, forest reference emission level

Table 18: **Drivers of deforestation and forest degradation in Pakistan**

Forest types	Direct drivers
Dry temperate	Demand for fuelwood, fodder, and timber; drought; grazing and browsing pressure
Moist temperate and Chir Pine forests	Demand for fodder, fuelwood, and timber; conversion of forest land to agricultural land and infrastructure (roads and buildings); flood; landslides; forest fires; diseases; timber smuggling; overgrazing
Scrub	Demand for fuelwood, fodder, and timber; conversion to agricultural land; forest fires, especially during summer; landslides and soil erosion; diseases; drought; leasing of mining sites within the forest area; overgrazing; overexploitation by timber contractors
Riverine	Demand for timber, fuelwood, and fodder; charcoal making; overgrazing; diseases; forest fires; drought; leases; Illegal use of forest land for agriculture; agricultural expansion
Mangroves	Demand for fuelwood, fodder, browsing; trampling, especially by camels; algal growth; conversion of forests to agricultural land

Source: WWF Pakistan and ICIMOD, 2013

4 Implementing an MRV System: Strength, Gaps, Obstacles, and Co-benefits for ICIMOD's REDD+ Himalayan Countries

The strengths and gaps listed in Table 19 reflect the current circumstances of the countries for which obstacles are anticipated during implementation of their REDD+ MRV. Their administrative and technical capacities for adopting MRV mechanisms, and good governance to ensure participation, transparency, accountability, and coordination, will determine the efficiency of REDD+ MRV implementation (Ochieng et al., 2016). Probably their greatest strength will be collaboration and coordination in raising their collective voice at international forums for the benefit of the people of the HKH region, particularly those living in mountain communities (Roy et al., 2015).

Table 19: **Strengths, gaps, obstacles, and opportunities resulting from REDD+ MRV in the HKH region**

	Bhutan	India	Myanmar	Nepal	Pakistan
Strengths	• NFI process is initiated • Coordination mechanism is easy (institutional arrangement) • Fewer forest types • Conducive policy & legislative environment (e.g., constitutional mandate for 60% forest cover)	• Strong institutional mechanism for forest resource assessment • Highly skilled technical manpower (FSI, ICFRE, NRSC, etc.) • Strong database (RS-based & ground inventory) • Own satellite images • Strong governance mechanism for implementation	• One maps/ geoportal/internet portal • Good inventory design • Long history of RS and GIS experience (FD)	• Building on existing governance system • Established linkage from local to national level monitoring system • Favourable policy arrangement	• Experience from past inventories • Information exists in sub-regional-level data • Implementation arrangement in place (MoCC, PFI) • Willingness to demonstrate at subnational level (Gilgit-Baltistan)
Gaps	• Lacking in technical capacity (e.g., no GIS or RS expert; no MRV) • Inconsistent data & methodology of land and forest cover mapping (e.g., LUPP 1995 & LCMP 2010)	• National strategy is not yet finalized • FREL and FRL not yet available • State- and district-level capacities lacking	• Image classification methodology • Acquisitions (seasonal variation in vegetation) • No systematic handover from predecessor to successor	• Insufficient capacity to meet technical & institutional requirement for implementation of designed MRV system • Financial gaps • Harmonization with new country federal restructure	• No standardized terminology or operating protocols (manual, guidelines) • Trained manpower and capacity building • Access to regional information • No demonstration sites yet • Lack of MRV demonstration or piloting activities
Obstacles	• Too many stakeholders (government, NGOs, communication)	• Dependency of people in fringe villages on forest resources • Limited or no availability of alternatives for addressing deforestation & forest degradation • Fewer initiatives by private sector	• No access to high-resolution images • Infrastructure • Human resources • Lack of clear definitions (deforestation & forest degradation) • Frequent change in focal persons	• Diverse & conflicting interest among stakeholders • Over-expectations • Verification a lengthy & expensive process • Frequent staff transfers	• Coordination mechanism

Table 19 cont.

	Bhutan	India	Myanmar	Nepal	Pakistan
Opportunities (co-benefits)	• Additional information on biodiversity & social safeguards	• Sustainable forest management & additional NCB • Capacity building of regional partners • Learning from regional partners	• Encourage landscape management • Encourage community-based forest management • Land use change & CO_2 estimation	• Mainstreaming PES for economic development • Social & environmental safeguard • Sustainable forest management • Livelihood support • Improvement in forestry governance	• Information on biodiversity can be made available • Information on soil, land, & other natural resources

FD, forest degradation; FREL, forest reference emission level; FRL, forest reference level; ICFRE, Indian Council of Forestry Research and Education; NCB, non-carbon benefits; NFI, national forest inventory; NGO, non-governmental organization; NRSC, National Remote Sensing Centre; PES, payment for ecosystem services; PFI, Pakistan Forest Institute; RS, remote sensing (source: Regional Workshop on "Measurement, Reporting, and Verification (MRV) in the context of REDD+ in the Hindu Kush Himalaya", Naypyitaw, Myanmar, October 2016)

5 REDD+ MRV: Conclusions and Regional Perspectives

Developing a REDD+ MRV system comprises setting up technological procedures (acquiring the RS data; data processing; implementing NFIs; and developing FRL and FREL, GHG-I and others); institutional arrangements (NFMS and MRV); and capacity development. Good governance must also be assured. Moreover, ensuring the participation of all stakeholders, increasing transparency in national and international forums, and coordinating multiple actors are crucial in establishing MRV in REDD+ activities.

All ICIMOD's REDD+ Himalayan countries are developing momentum towards establishing reliable and comprehensive MRV systems, but their progress and stages are different. For instance, India has a very strong and robust satellite land monitoring system and has its own satellite sensors. The NFI system and database are also well organized in India, compared with other regional countries. Although India has made an important contribution to REDD+ climate negotiations, its R-PP, FRL, and FREL are yet to be finalized. However, Bhutan, Myanmar, Nepal, and Pakistan have already prepared their R-PP and are in the process of fulfilling other requirements. Nepal submitted its FRL in January 2017, showing strong commitment to REDD+ readiness. It is also practising community-based forest management, and so the involvement of communities at every step of the REDD+ and MRV process (e.g., community monitoring, measurement, monitoring and reporting), means Nepal is also very good at conducting forest inventories. Myanmar, on the other hand, is developing the OneMap system and aims to establish effective coordination between ministries, to provide an example to other countries. In this context, regional collaboration such as a south–south learning platform can support the development of transparent, comprehensive, comparable, consistent, and accurate REDD+ MRV in the HKH region.

The ICIMOD regional REDD+ initiative, under its REDD+ Himalayan component, facilitates the REDD+ readiness processes of the member countries (Bhutan, India, Myanmar, Nepal, and Pakistan) at various scales through capacity building and knowledge sharing. Being an important aspect of REDD+ activities, MRV is being given priority in the knowledge-sharing platform. Such regional south–south learning platforms also serve to promote common understanding of MRV functions, and aim to assist collaboration in developing a common methodology in this region.

Members of a south–south learning platform would support their regional partners in developing transparent, comprehensive, comparable, consistent, and accurate REDD+ MRV. This could be achieved by fostering regular learning–sharing meetings, workshops, and training; publishing regional frameworks, good practice guidelines, and manuals; and coordinating, cooperating, and collaborating on emerging issues. The following would support maintenance of harmony and synergy in REDD+ MRV at a regional level:

- Systematic, consistent, and measurable REDD+ MRV.
- Methodology that ensures comparable results, data source, sampling design, analysis, and assumptions, to safeguard comprehensiveness.
- Activities that are participatory, local-community friendly, and acceptable to all involved stakeholders.
- An awareness-raising programme about MRV activities among all involved stakeholders.
- Regular sharing of updates and reports about the MRV mechanism and processes on public platforms and media (crucial to maintain transparency).
- Formulation of standardized protocol, framework, guidelines, or manual, which will be required for preparation of forest inventory at regional level. This should be verifiable by some international agency or agencies nominated by UNFCCC for this purpose.
- Adoption of IPCC Guidelines by countries at regional level, so consistency can be maintained (provided countries have mutually accepted and agreed frameworks).
- Ideally, use of the same methodological framework and data; however, this is limited by the technical, human, and financial capacity of individual countries.
- Application of guidelines, standards, and procedures developed from IPCC and UNFCCC.

Use of reliable and updated data, standardized methods, and experienced experts (all key to enhanced accuracy). Countries could share their expertize in performing MRV for more reliable and accurate results.

Similar to circumstances relating to REDD+ readiness, countries are at different stages of implementing REDD+ MRV. For instance, Nepal submitted its FRL in 2017, whereas other countries are still preparing theirs. Similarly, India is at an advanced stage in terms of NFMS compared with its regional partners. In this context, a regional platform could function for knowledge exchange between the partner countries, as shown in Table 20.

Table 20: **Country support matrix**

		Requesting support from:				
		Bhutan	India	Myanmar	Nepal	Pakistan
Providing support for:	Bhutan	Good NFI process, large variety of parameters	Mobilizing own (national) resources; capacitating nationals in REDD+ processes; exchanging NFI information	Mobilizing own (national) resources; capacitating nationals in REDD+ processes; allometric biomass equations	Mobilizing own (national) resources; capacitating nationals in REDD+ processes	Mobilizing own (national) resources; capacitating nationals in REDD+ processes; multifunctional NFI
	India	Technical workshops on NFI, or on remote sensing and GIS (or on both)	Strong institutional mechanisms for FRA; skilled, technical manpower; resilient databases; well-established JFM	Technical workshops on NFI or on remote sensing and GIS (or on both); obtaining satellite imagery (India has its own satellite data)	Technical workshops on NFI or on remote sensing and GIS (or on both); how to fine-tune NFI; acquisition of advanced technology and capacities to use it	Technical workshops on NFI or on remote sensing and GIS (or on both); information on centralized data management system
	Myanmar	OneMap database system; improved database methodology (to reduce inconsistencies)	OneMap database system	OneMap geo-portal; good inventory design; remote sensing and GIS experience	OneMap database system	OneMap database system
	Nepal	Community involvement in the MRV process at regional and local level; development of FRL and FREL	Community involvement in REDD+ processes and projects; development of FRL and FREL	Local-level REDD+ implementation and stakeholder participation; development of FRL and FREL	Good monitoring system with a strong link between local and national level; community monitoring	Information on centralized data management system; development of FRL and FREL
	Pakistan	A newcomer to REDD+ processes, but can offer information and experiences on previous forest inventories				Experience through past forest inventories

FRA, forest resource assessment; FREL, forest reference emission levels; FRL, forest reference levels; JFM, joint forest management; MRV, measurement, reporting, and verification; NFI, national forest inventory (source: Regional workshop on "Measurement Reporting and Verification (MRV) in the context of REDD+ in the Hindu Kush Himalaya", Naypyitaw, Myanmar, October 2016.)

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Annex 1

Annex 1: **Actions to establish REDD+ MRV (based on GFOI, 2017**

Themes	Components	Actions
Institutional arrangements	Forest policy and governance	1. Identify key REDD+ activities and their spatial locations (if possible) within defined scope of reporting 2. Perform an assessment of drivers of deforestation and forest degradation; assess and document any enhancement activities 3. Identify countermeasures or prevention of deforestation and forest degradation 4. Align with other forestry programmes and land use planning policies 5. Conduct a capacity needs assessment for implementing forest governance measures 6. Develop an institutional capacity-building plan
	MRV institution	1. Identify national REDD+ stakeholder 2. Agree on scope of NFMS and MRV process 3. Designate a single entity with overall responsibility for REDD+ reporting 4. Define roles and responsibilities of agency or group developing REDD+ estimates 5. Ensure all institutions have in-depth knowledge of UNFCCC requirements and fundamentals of IPCC Guidelines and other specific requirements of REDD+ programme or bilateral agreements
	Processes	1. Establish coordination mechanisms and agree on approval processes 2. Create MRV project development plan 3. Allocate adequate budgets to support initial development of the MRV system 4. Establish national processes for completing UNFCCC reporting and verification process including technical assessment of FREL, FRL, and REDD+ emissions and removal estimates 5. Establish mechanism for identifying lessons learned, strengths, weakness, and opportunities for improvement
	Methods and tools	1. Establish framework and document for regular archiving of RS data, ground observations, and safeguard information (major activities) 2. Establish and document framework for integration of data and generation of estimates for all identified reporting requirements 3. Establish quality assurance and quality control procedures for review and validation of data and information collected and generated, focused on maintaining the quality of estimates
Policy and design decisions	Forest definition	1. Identify key stakeholders to engage in national forest definition process for all identified reporting requirements 2. Consult key stakeholders and agree on a national definition of forest 3. Document the agreed national forest definition (i.e., tree height, canopy cover, area, thresholds)
	REDD+ activities	1. Formulate and prioritize REDD+ activities under national REDD+ strategy or action plan 2. Document and justify (using KCA) all REDD+ activities, explaining stepwise approach if necessary

Annex 1 cont..

Themes	Components	Actions
Policy and (cont...)	Carbon pools	1. Document all available data for forest carbon pools, within identified forest strata, drawing on existing national data sets, commercial data, research programmes, demonstration projects, and regional/international data as appropriate 2. Conduct a KCA using available data to determine significant forest carbon pools for each identified REDD+ activity and document results and rationale behind decisions 3. As two equally valid approaches to estimate the stock change (stock change and gain or loss) are in place, the next action is to select and apply the appropriate method under nationally available data and identified reporting requirements 4. Identify how to collect and generate additional data to meet accepted methodological approach (if required)
	LULC stratification scheme	1. As the Cancun Agreements indicated that REDD+ mitigation actions should not incentivize conservation of natural forest, design a scheme to distinguish managed and unmanaged land 2. Further stratify forest land based on type and extent of human activities or forest types, in accordance with request to improve quality of estimation of emissions and removals 3. Document this scheme, linking with MRV process and IPCC reporting principles of transparency
	Approaches, methods, and tiers	1. Document the appropriate approach, methods, and tier requirements for the scope of NFMS and MRV 2. Assess data requirements and integration options for identified approaches, methods, and tiers 3. Identify investment level needed for staffing, equipment, and capacity building; communicate back through established institutional arrangement to ensure support and secure adequate ongoing budget 4. Conduct gap analysis between available and required data needed to achieve selected approach, method, and tier 5. Draw on KCA to develop priority data acquisition plan for all data sources; assess capacity required to collect data, develop and manage integration tools, and produce LU monitoring system to meet the selected approach, method, and tier
	Spatial and temporal scope	1. Define temporal scope of FRL 2. Determine and document spatial extent of REL and REDD+ reporting (i.e., national and subnational)
Measurement and estimation	RS observation	1. Consult RS experts (domestic and international) to identify the most efficient approach for developing activity data 2. Identify the most appropriate RS data sources to support documented design decisions 3. Generate consistent and multi-date forest area change activity data with associated uncertainty estimates 4. Document process to ensure transparency and identify any areas for future development or research
	Uncertainty	1. Uncertainty related to activity data, emissions factors, change estimates, etc., should be estimated using robust and statistically rigorous methods and thereby reported to maintain transparency 2. Uncertainty assessment could comprise RS, statistical inference, and ground data
	Ground-based observations	1. NFI to provide detailed procedures of ground-based observations 2. NFI to produce information on forest resources (volume, growth, and quality of growing stock); forest carbon stocks and their changes; land use structure and forest ownership; forest health; and biodiversity

Annex 1 cont..

Themes	Components	Actions
Measurement and (cont...)	Integration and estimation	1. Develop systems for reporting GHG emissions and removals (requires combined data from different sources) 2. Integrate the framework based on data, assumptions, and models 3. Develop the tools; may range from simple Excel sheets to automatic analytical systems
	Record keeping	1. Systematically and transparently document all records, including approaches, methods, and data sources used in a consistent and comprehensive set of standard methods and operating procedures 2. Ensure all documentation is made available to key personnel
Reporting and verification	AFOLU GHG-I reporting	1. Coordinate between REDD+ and the AFOLU GHG-I to develop national communication reports of anthropogenic emissions from managed forests within the LULUCF sector, using consistent approaches, methods, and tiers
	Non-carbon-related reporting	1. Identify opportunities to harmonize national and international reporting requirements with the relevant sector 2. Build reporting on safeguards information, biodiversity, industry statistics, and community and cultural information within the one system
	Reference emission levels	1. Construct FRL
	REDD+ reporting	1. Ensure all elements required for REDD+ reporting are included in the BUR technical annex on results-based actions relating to REDD+. Data and information in the REDD+ technical annex to the BUR should include: • Summary information of assessed FREL and FRL expressed in t/CO_2 equivalent per year • REDD+ activity or activities included in the FREL and FRL • Territorial forest area covered • Date of the FREL and FRL submissions and date of the final technical assessment report • Period (1 year) of the assessed FREL and FRL
	Internal and external analysis	1. Perform verification: • Verification: the process of assessing the data and information submitted • Internal verification: the approach to quality assurance based on peer support and review that enables integration of quality into internal assessment from start to finish • External verification: the confirmation of estimates and supporting documents by an independent third party 2. Follow nationally established procedures for internal verification of estimates 3. Follow national process for participation in external verification (i.e., the international consultation and analysis processes of UNFCCC) 4. Link verification process to continual improvement process to feed back all recommendations

AFOLU, agriculture, forestry, and other land uses; BUR, biennial update report; FRL, forest reference level; GHG-I, greenhouse gas inventory; KCA, key category analysis; LULC, land use and land cover; LULUCF, land use, land use change, and forestry; MRV, measurement, reporting, and verification; NFMS, national forest monitoring system; RS, remote sensing

Annex 2

Questionnaire: MRV in the context of REDD+ in Himalayan countries

Purpose

The information will be compiled in a technical report which will provide a baseline for REDD+ MRV status in REDD+ Himalayan programme countries.

Respondent's name:

Profession/expertize:

Institution/affiliation:

Country:

		Monitoring years, from recent to previous			
Years		e.g. 2017	2016	2015	2014
		Area (sq km) or %			
Land use categories					
Forest					
(if applicable)	Open				
	Closed				
Agricultural land					
Grassland					
Wetland					
Settlement					
Others (specified if any)					

Information required at national, subnational, project, or pilot level based on official figures, statistics, or examples.

1. Land use and land cover change monitoring system

i) Please enter the monitoring status of land use and land-cover change in your country in the table below, based on official figures:

ii) What definitions were used for the following categories in the land use monitoring system?

Forest:

Agricultural land:

Grassland:

Wetland:

Settlement:

Agroforestry (if applicable):

Others:

iii) Which institutions were involved in land use and land cover monitoring?

Year	Level of monitoring (e.g., national, subnational, pilot study)	Institutions involved		
		Led by	Supported by	Others

iv) Which methods and data sources were used for monitoring?

Year	Field sample intensity (%)	If satellite images were used		
		Types	Land use classification method	Validation

2. Carbon monitoring system

i) Is there a carbon inventory in your country? If yes, please mention its status in your country.

Carbon pools	Level of inventory[a]	Carbon stock (t/C/ha)	Method used for monitoring	Field sample intensity (%)	Verification procedure[b]	Institution involvement (led/supported/ others)
Forest carbon						
AGB						
BGB						
Dead wood biomass						
Litter biomass						
Soil biomass						
Carbon from trees outside the forest						
• AGB						
• BGB						
Carbon in other land (specify)						

[a] N, national; PS, pilot study; SN, subnational.

[b] CM, compliance monitoring; ER, expert review; PR, peer review; TPM, third-party monitoring.

AGB, above-ground biomass; BGB, below-ground biomass

Verification procedures: Compliance monitoring (CM)/expert review(ER)/third-party monitoring (TPM)/peer review (PR) or specified if any

ii) If allometric equations were used, are they sufficient? If not, are there any plans to develop new and test existing equations?

3. GHG monitoring system

i) Does a GHG-I system exist in your country? If yes, please complete the table below.

Date (recent to previous)	Gross GHG emissions	tonnes of CO_2 equivalent	Focal institution for inventory	Supported agencies
	Total			
	Scope 1*			
	Scope 2*			
	Scope 3*			
	Scope 1*			
	Scope 2*			
	Scope 3*			
	Total			

*if applicable.

Scope 1*: direct emissions, including emissions from combustion in owned or controlled boilers, furnaces, vehicles; and from chemical production in owned or controlled process equipment

Scope 2*: indirect emissions, including emissions released into the atmosphere associated with consumption of purchased electricity, heat, steam, cooling, and others

Scope 3 *: indirect emission, including waste disposal; or purchased materials, fuels, and others

ii) Are there any guidelines for measuring, reporting, and verifying GHG emissions in your country?

4. Forest Reference Emission Level (FREL) & Forest Reference Level (FRL)

i) Do any FREL & FRL records exist in your country? If yes, please state the reference period: from ……. to ……., and complete the table below

SN	Definition		Major proxy drivers
1	Deforestation		
2	Forest degradation		

ii) What data do you have and what are the gaps?

5. Measurement Reporting and Verification (MRV) mechanism and function

i) Are there any institutional arrangements for MRV in your country? If yes, please explain it with the help of a chart, organogram, etc.

ii) Existing organizational framework and mandate for MRV in your country, in the form of a chart. Please provide national levels at the top and lower units (subnational and others) below.

iii) Institutional capacity (human resources) in the form of a chart. Please provide national levels at the top and lower units (subnational and others) below.

6. What are the current MRV activities in your country?

i)

ii)

iii)

iv)

v)

7. In your view, how can MRV activities be made more transparent and comprehensive?

8. In your view, how can MRV system of your country be made comparable at the regional level?

9. In your view, is it possible to adopt same methodological procedures and data (remote sensing image) used at national level for maintaining the consistency at regional level?

10. In your view, how can accuracy be assured at a regional level?

11. Institutional capacity (human resources and others). Please indicate the current capacity (inadequate, adequate, sufficient)

	LCMS	CMS	GMS	FREL/FRL
Inventory				
Basic information (data available and accessible)				
Technical and financial capacities capabilities				
Human capacity for processing (analysing) information				
Human capacity for the preparation of reports				
Human and technical capacity for data verification				
CMS, carbon stock monitoring system; FREL, forest reference emission level; FRL, forest reference level; GMS, greenhouse gas monitoring system; LCMS, land use and land-cover change monitoring system				


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n the Context of REDD+
the Hindu Kush Himalaya

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ISBN 978 92 9115 603 0