REDD Monitoring, Reporting and Verification Systems in Nepal: Gaps, Issues and Challenges

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Abstract: Reducing Emission from Deforestation and Forest Degradation (REDD) is an incentive based approach for climate change mitigation that has gained global attention. Following the global discourse and trend, Nepal is preparing herself to participate in the REDD implementation process with the financing from the World Bank's Forest Carbon Partnership Facility (FCPF). Developing a measurement, reporting and verification (MRV) system of monitoring carbon emissions is one of the most important aspects of the REDD mechanism. In this article, we analyse the existing forest resource monitoring system in Nepal with reference to requirements for the REDD MRV design as suggested in the Intergovernmental Panel on Climate Change (IPCC) good practice guide. Our analytical focus revolves around understanding the current policy provisions and institutional infrastructure, as well as identifying existing gaps Similarly, we also analyse the national capacity gaps for designing and adopting the REDD MRV. Finally we have outlined possible issues and challenges for designing and implementing REDD MRV in Nepal. Based on all these aspects, we have suggested a MRV system design that would acknowledge the role of existing institutions and consider the state restructuring.

Key words: forest monitoring, co-benefits, carbon, greenhouse gases, forest inventories

INTRODUCTION

Parties of the United Nation Framework Convention on Climate Change(UNFCCC) are required to measure and report their national sources and sinks of greenhouse gases (GHGs). Participating countries (both developed and developing countries) need to measure the quantitative information on their anthropogenic emissions and removals of GHGs by adopting the guidelines developed by the Intergovernmental Panel on Climate Change(IPCC), and then report these activities through national communication to UNFCCC. Therefore, the evolving REDD mechanisms- a performance-based payment mechanism, need to incorporate reliable and credible measuring, reporting and verification (MRV)[***] systems to demonstrate the level of performance, and this determine the volume of payments. This has also been agreed in the 13th Conference of Parties (COP13) that the developing countries are expected to design a measurable, reportable, and verifiable process for

[***] Measuring refers to the actual accounting techniques and methods that state and non-state actors may employ when estimating GHG emissions and removals,reporting reflects the idea of uniformity in format, units and timing for the inter organizational communication both at national and international levels, and verification denotes the standardized re-assurance of the quality of these estimates through an independent body (Ellis and Moarif 2009).

anthropogenic emissions reductions, which can be enabled by technology, finance and capacity building (Breidenich and Bodansky 2009).

Nepal is member country of UNFCCC since 2005. Nepal is preparing for participation in the REDD mechanisms; it has developed a Readiness Preparation Proposal (RPP) with financial assistance from the World Bank's Forest Carbon Partnership Facility (FCPF). In this context, preparation of a reliable and credible MRV system has been one of the vital elements of the REDD readiness process. The RPP aims at designing a monitoring system for GHGs emissions and other benefits and impacts over time. However, the country's preparedness in this aspect is slow because of limited understanding about the MRV requirements and the existing available information on forest cover and land-use change.

Therefore, it is imperative to understand the existing institutional infrastructure, availability of information, and capacity to meet the standards specified in the RPP. This MRV paper assesses the existing and potential issues and challenges for designing the REDD MRV system in Nepal. Information for this paper was collected from REDD documents, the IPCC good practice guidelines[****], and other relevant literature. This paper outlines the existing forest monitoring practices, analyses the gap in existing forest monitoring systems, and identifies issues and challenges to develop an effective REDD MRV system in Nepal. It also elucidates several methods adopted for monitoring deforestation and forest degradation in Nepal in the past, and also sheds light on the several policy provisions and institutional arrangements for supporting past monitoring provisions. Finally, it analyses gaps in the existing forest monitoring practices that need to be addressed in order to design an effective REDD+ MRV mechanism in Nepal.

ASSESSMENT OF FOREST MONITORING SYSTEM IN NEPAL

Realizing the importance of monitoring in forest management, a monitoring system was adopted in Nepal in the 1960s. Since then, forest resource assessments have been carried out on a periodic basis using different methodological tools, and have also been given space in forest sector policy and legal frameworks. Understanding of the policy provisions, institutional architecture and methodological approach for forest monitoring provides insights to designing an effective MRV system for REDD in Nepal.

POLICY PROVISIONS AND INSTITUTIONAL ARCHITECTURE

The Master Plan for the Forestry Sector (MPFS 1989) identified the need for forest resource statistics in scientific forest management in Nepal. This plan identified the need a Forest Resource Information-Decision System (FRIDS) with adequate human resources (MPFS 1989) and the establishment of a National Land Resource Centre (NLRC) for generation and management of nationwide forest-related spatial data. The NLRC was envisaged as a facilitator unit in the policy and plan formulation process and in management and decision-making in the forestry sector of Nepal.

The Department of Forest Research and Survey (DFRS) has become the only department in the

**** Good Practice Guideline refers to the response to the invitation by the (UNFCCC) to the Intergovernmental Panel on Climate Change (IPCC) to develop good practice guidance for land use, land-use change and forestry. It provides supplementary methods and good practice guidance for estimating, measuring, monitoring and reporting on carbon stock changes and greenhouse gas emissions under Article 3, paragraphs 3 and 4, and Articles 6 and 12 of the Kyoto Protocol.

Ministry of Forest and Soil Conservation (MOFSC) to deal with the issue of forestry research in the country. A total of 104 staff are working in the DFRS, among which two-thirds are technical forestry staff (DFRS 2004). However the department lacks the legal tools to deal with the forest research and survey related issues. The DFRS is responsible for conducting the periodic national forest inventories, updating the forest cover maps and other forestry information at national level. Although, there are some field research stations at different localities throughout Nepal, the DFRS does not have local offices at either the district or regional levels. Instead of recognizing the role of DFRS, Forest Act 1993 and Regulations 1995 have authorized the District Forest Office (DFO) to prepare district-level Forest Management Plan with periodic resource inventories. Nonetheless, such plans have been prepared based on secondary information, mostly from the Land Resource Mapping Project (LRMP) statistics, which were prepared in 1978-1979.

Additionally, the Department of Survey under the Ministry of Land Reform and Management (MLRM) has also been involved in land-use related spatial data acquisition, storage, analysis and dissemination since 1961-1962 in Nepal.

Methods Adopted for the Forest Resource Assessment in Nepal

Originally, the forest monitoring system in Nepal was designed with the purpose of generating revenue from the forestry sector. The forest-cover maps were used for the preparation of working plans. Later the objectives of forest inventories were reoriented to generate different variables like forest biomass, forest density required at national and district levels. Therefore, in each successive national forest inventory (NFI) assessment, more forest variables were included. A brief outline of the different methodologies adopted in the national forest inventories and land use assessments in Nepal over the past few decades is presented in table 2.

Table 2: Summary of National Forest Inventories (NFIs) and methodologies used

Forest Monitoring Efforts:	Leading Organization	Methodology Adopted	Major Output Variables
First NFI (1960s)	Forest Resources Survey Office, USAID	▪ Aerial Photographs ▪ Field measurement with Grid ▪ Systematic Sampling Design	Forest resource information and forest cover maps
District Forest Inventories (1968-1989)	Forest Survey Division (Now DFRS)	Aerial Photographs and Ground Measurement	District forest cover maps and forest statistics
LRMP (1986)	GoN and Kenting Earth Sciences Limited, Canada	▪ Aerial photographs (1:12000 resolution) ▪ Landsat imagery and field verification	▪ Wall to wall hardcopy ▪ Land utilization map at 1: 50000 scale

Forest Monitoring Efforts:	Leading Organization	Methodology Adopted	Major Output Variables
Second NFI (1990s)	DFRS and FRISP, Finland	Satellite Images (Landsat TM of 30 m resolution), aerial photographs, Photo point sampling method	National level and Region wise forest area and stocking estimates
JAFTA, Forest Classification (2000)	JAFTA, Japan	Satellite images (Landsat TM and IRS 1D satellite data), ground checking and Field Sampling	Forest area classification at the national scale, and Forest resource maps
Forest Cover Change Analysis (1990 to 2000)	DoF	Satellite imageries (Landsat TM), topographic Maps (1:25000), tield verification and rectification, no ground sampling.	Terai districts only, 1:25000 map
Sources: (Acharya and Dangi 2009; Shearman 2009; DoF 2005; FAO 2005; JAFTA 2000; Shrestha *et al.* 2001; NFI 1994)			

ANALYSIS OF GAPS OF EXISTING FOREST MONITORING WITH RESPECT TO REDD MRV

The IPCC has its own sets of requirements for REDD MRV. Nepal has a long way to go to meet the standards of the IPCC Good Practice Guidance (GPG) for MRV mechanisms. This section thus highlights the prominent gaps of the existing forest monitoring system in Nepal with respect to the REDD MRV requirements.

Methodological Gaps

IPCC GPG has recommended a number of optional measures (tiers[*****]) for measuring and recording deforestation and forest degradation. Countries can choose the suitable tiers based on the availability of baseline information, financial resources and technical capacities. Nepal has chosen to adopt tier 2 for now and is preparing to develop its national capacity to shift to tier 3(for details on tiers see table 5). Based on different literature on the NFIs of Nepal, Table 3 identifies gaps in the existing monitoring and recording system in Nepal.

***** 3 tiers of IPCC guidelines

Table 3: Analysis of gaps in the existing forest monitoring system in Nepal with respect to REDD MRV

Area of Monitoring	Existing Practices	Identified Gaps
Deforestation	Remote Sensing (RS) application:Satellite Imageries and Aerial Photographs (APs) of different scales or resolutions	▪ RS data was mostly based on medium resolution images or APs ▪ Need to depend on RS data from external sources ▪ Methodology used for each periodic inventory differs, making them incompatible with other inventories ▪ Trees outside of forest areas were not considered ▪ Lack of stratification
	Field Inventory: Grid-based systematic sampling design in most of the inventory case ▪ Lack of regular interval sampling	▪ Lack of a permanent sample plot ▪ Variation in sampling design in each inventory ▪ Different output variables considered in each inventory ▪ Drivers of deforestation ignored
Forest Degradation	Selective Felling Monitoring: Measured in gross methods of growing stock inventory	▪ Need for more specific monitoring ▪ Lack of periodic data from PSP
	Forest Fire Monitoring: On a case-by-case basis and measured in gross terms	▪ Need specific monitoring mechanism ▪ Lack of mechanism to detect fire ▪ Lack of forest-fire zoning
	Grazing Impact Monitoring: Existing practices ignore it	▪ Not considered in previous forest inventories ▪ Hard to determine methodology for monitoring grazing impact
	Insect Pest and Diseases Damages Monitoring:	▪ Need for more specific monitoring ▪ Lack of periodic data from PSPs
	Other Natural Hazard Impacts Monitoring: Hazard monitoring does not form part of NFIs in Nepal.	▪ Lack of data on forest loss by natural hazards ▪ Difficulty to delineate natural hazards in forest cover maps ▪ Carbon stock loss not considered

Area of Monitoring	Existing Practices	Identified Gaps
Carbon Stock	Although NFIs have not included carbon stock calculation, some other studies have attempted to through more general methods (using NFI growing stocks plus allometric equations)	▪ Specific measures required to monitor the carbon stock change among the 3 tiers suggested by IPCC GPG ▪ Lack of time-series data on biomass growth for most of the species
Co-Benefits	NFIs does not cover it at all, although, some of the forest-based projects have measured the other benefits and impacts.	▪ Biodiversity, socio-economic, and watershed services are not covered in the existing structure of forest monitoring and reporting in Nepal.

Capacity Gaps

Herold (2009), in his study to assess the capacity of tropical countries to monitor emissions, found that only 3 out of 99 non-annex-I countries currently have the capacity to monitor deforestation and forest degradation. In this line, Nepal does not have a national level land-use-change detection program. Though the DFRS has been active in generating and maintaining forest statistics in Nepal, there is lack of reliable and consistent periodic data. We have analyzed Nepal's capacity for MRV using Herold's (2009) capacity analysis indicators. This analysis is presented in Table 4.

Table 4: Key Gaps of Nepal's forest monitoring system with respect to REDD MRV

Indicators	Nepal's existing forest monitoring status
Consistency	There is lack of a consistent and systematic approach for monitoring and recording forest information (esp. deforestation and forest degradation) in Nepal. Methods adopted for periodic forest monitoring are not consistent.
Transparency	The forest resources inventory database is not publicly available.
Comparability	Since the methods used for past NFIs were inconsistent, the data is not comparable.
Completeness	Considering the requirement of REDD MRV (monitoring of deforestation, forest degradation and carbon stock) Nepal lacks sufficient data.
Accuracy	Except the second NFI (1994-1998), all NFIs have excluded error and uncertainty. Even the second NFI data does provide the necessary information about the probable sources of error and uncertainty. Therefore, the accuracy of the existing NFI results are questionable.

Indicators	Nepal's existing forest monitoring status
Human Resources	Though donor agencies have contributed to developing Nepal's capacity for NFIs, Nepal still lack sufficient human resources for REDD MRV.
Material/Source of Data	Nepal has to depend on external sources for remote sensing data.

ISSUES AND CHALLENGES OF DESIGNING REDD+ MRV MECHANISMS IN NEPAL

The preceding section discussed the gaps of existing forest monitoring mechanisms in Nepal with respect to REDD MRV. In addition to such gaps, there are a number of other issues and challenges for designing a REDD MRV mechanism in Nepal, which are outlined in this section.

Adopting a Suitable Definition of Forest

Adopting an acceptable definition of forest is an important step in designing REDD+ MRV mechanism in Nepal. The Forest Act 1993 provides an official definition of forest as "any area that is fully or partially covered with trees". However, this definition neither mentions the percentage of crown cover or the stand density necessary for an area to be considered as forest; nor it considers trees outside of designated forest areas eg; Trees Outside Forests(TOFs). The Marrakech Accords under the Kyoto Protocol have made a provision that parties should define 'forest' based on geographical boundaries and other parameters by selecting a single value for: crown area (10-30%); tree height (2-5m); and land area (0.05-1 ha) (Angelsen 2008; UNFCCC 2001). Nepal also needs to follow a consistent definition of forest using the criteria mentioned by the Marrakech Accords.

Scale of Accounting

While designing the REDD MRV mechanism, an important consideration is the spatial (geographical) scale of accounting. The MRV mechanism needs to be based on the spatial scale on which carbon accounting and financial transactions occur. The REDD literatures (see Chomitz 2006; Ebeling *et al.* 2007 and Pedroni *et al.* 2007), have discussed different scale-based approaches: national, sub-national, and a combination of both (i.e. hybrid or nested). Nepal needs to define an appropriate scale while designing the MRV mechanism. The project/ sub-national level has the advantage of promoting ownership at the local level, but it might have a problem with leakage.A national approach can handle the leakage measurement at inter-regional levels, hence the chances of adjusting additionality and leakage on different regions becomes higher with a national approach. Although the national approach can address the issue of leakage, there might be a lack of motivation and ownership by local actors. It implies that additionality in one part of the country or one kind of land use may be counter affected through leakage in another part of the country or land use. The net benefit of carbon accumulation thus might be negative. Therefore, the choice of scale needs to be made considering the effectiveness, efficiency and equity outcomes of the REDD project at all levels .

Approach and Method for Designing MRV Mechanism

Equally important consideration for designing a REDD MRV system is the methodological choice from the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG LULUCF). The IPCC Guidelines

suggest three different (see table 5) methodological approaches for two MRV variables: activity data and emission factors. For the activity data (the change in forest area), the IPCC recommends three different approaches. Similarly for the assessment of emission factors it suggests three different tiers. This guidance suggests the method of estimating GHG emissions and the removal under 3 levels of confidence i.e. Tier 1, Tier 2 and Tier 3 (see table 5). These tiers represent gradual improvements in accuracy, with tier 3 being the most accurate, with corresponding increase in cost. The IPCC recommends Approach 3 and Tier 2 as the minimum requirements for REDD+ participation (IPCC 2003; GOFC-GOLD 2009).

Table 5: IPCC GPG Tiers for Monitoring for Deforestation and Forest Degradation

Tier of IPCC-GPG	Requirement	Example of Data Needs (e.g. Biomass)
Tier 1 (basic)	IPCC methods and IPCC default values (no data collection needed)	Default Mean Annual Increament (MAI) (for degradation) and/or forest biomass stock (for deforestation) values for broad continental forest types—includes six classes for each continental area to encompass differences in elevation and general climatic zone; default values given for all vegetation-based pools
Tier 2(intermediate)	IPCC methods and country specific data for key factors (including more detailed country specific strata)	MAI and/or forest biomass values from existing forest inventories and/or ecological studies. Default values provided for all non-tree pools Newly-collected forest biomass data.
Tier 3 (mostdemanding)	Country specific methods or models, national inventory of key carbon stocks, repeated measurements of permanent plots to directly measure changes in forest biomass	Repeated measurements of trees from permanent plots and/or calibrated process models. Can use default data for other pools. Stratified by in-country regions and forest type, or estimates from process models.

Therefore, selection of the approaches and the Tiers is required while designing the REDD+ MRV system. Selection needs to be based on at least three factors: organization, infrastructure and human resource for the MRV (IPCC 2003; GOFC-GOLD 2009). The review of these factors above suggests that Nepal should select Tier2 as the best alternative for now.

Co-Benefits in the REDD MRV System

REDD+ not only contributes to reducing forest-based emissions of GHGs, but also creates co-benefits. The co-benefits include enhanced watershed functions, maintenance of local climate regimes, restoration of soils and biogeochemical systems, and conservation of aquatic and terrestrial biodiversity (Parker *et al.* 2009; CCBA 2008). Similarly, the socio-economic benefits and impacts may include impacts on livelihoods or improvements in community health. Therefore, the MRV system should address the monitoring, reporting and verification of the co-benefits generated from REDD implementation.

However, such conditions for MRV design are very difficult to achieve in practice in Nepal, for multiple reasons. First, the forest provides a number of associated benefits to the rural economy of Nepal, and specifying them for REDD MRV is challenging. Second, the choice of methods for assessing a wide range of co-benefits is another cumbersome task. Third, the existing lack of institutional capacity could also be a limiting factor for considering co-benefits in an MRV mechanism. Finally, the diversity of stakeholders and prospect gaining consensus among them is also a great challenge for Nepal (Kotru 2008). Amidst these challenges, any REDD+ MRV system cannot ignore incorporating the co-benefits as one of the most vital design elements.

Design of the MRV Governance Structure

The designing of a governance mechanism for MRV is one of the most challenging tasks for any developing country preparing for REDD. The task has become challenging due to the existence of weaker institutions and infrastructure than demanded by REDD requirements. Moreover, developing countries have their own specific methodological and capacity needs in addition to infrastructure and technological needs (Herold 2009) that make it urgent to establish an efficient, transparent and effective REDD governance structure. This overall (REDD) governance structure should hence also include an efficient MRV governance structure. In the case of Nepal, the points described below need more attention.

Institutional Accountability: At present, DFRS seems to be the most potential organization with the most potential for monitoring deforestation and forest degradation; however there are doubts about the efficiency, effectiveness and transparency of the DFRS. So, there is a need for a multi-stakeholder decision-making body to oversee the policy formulation and decision-making processes making it transparent, efficient and effective.

Multi-faceted equity: Nepal has diverse forms of forest management regimes including different community-based models and government-management. The design of REDD governance in Nepal must consider all of these management regimes and their associated institutions. The issue of equity is an important aspect to be considered for designing the governance mechanisms for REDD in general and MRV in particular.

Transparency: As envisioned in the REDD architecture, there will be financial transactions between the buyer and seller. However, there are still issues of poor governance and anomalies in government, which raises the issue of transparency.

Participation and Indigenous People's Rights: Considering the fact that about 80% of Nepal's population depend on the forest for earning their livelihoods—especially the forest dependent poor, women,indigenous communities and marginalized peoples—and also the great concern in the REDD process

for the rights of local communities, the establishment of a REDD governance mechanism needs to consider the rights of local and indigenous communities.

Consideration of the Future Political Scenario: The ongoing process of state restructuring toward a federalist model (GoN 2006) will have implications for institutional mechanisms like REDD MRV. Therefore, the forthcoming REDD+ MRV system should be flexible enough to recapture the potential restructuring in the national governance system in the future. In that case, the system should in general counsider at least three layers: national (centre/union), sub-national (state/district) and local (municipalities/VDCs) structures in its proposal with spaces to restructure if needed.

Design of Verification System: Since the REDD+ mechanism requires an MRV system to be in place after 2012, with explicit mention of a verification system for gauging deforestation and forest degradation, Nepal also needs to propose such mechanisms. Lack of mechanisms for verification in the part existing and ideological variations in the international level for a universally accepted verification system poses distinct challenges for Nepal's MRV design.

CONCLUSION

Designing appropriate institutional mechanisms is a critical aspect of REDD+ MRV system development for the UNFCCC member countries. Therefore, in addition to principles such as relevance, comprehensiveness, consistency, efficiency, robustness suggested in the sourcebook (GOFC-GOLD 2009), there might be some other principles like participation, equity, long-term stability and compatibility with existing institutional mechanisms to be considered emphatically for Nepal. In this context, the MRV system in Nepal should not only meet the international standards but also consider the voice of the local and indigenous communities of Nepal.

Considering the higher cost of establishing a new structure for REDD in general and for MRV in particular, and the lack of specialized human resources, the upgrading of the existing institutional infrastructure should be the first priority. To achieve this, the strengthening of the current policy and institutional architecture is the best alternative. For instance, the central forest-monitoring organization, DFRS, can be enlarged by adding an additional division to deal with REDD+ implementation. Alternatively, the current Forest Survey Division under the DFRS can be modified structurally to make it compatible with REDD implementation. Operational Guidelines specifying the role and responsibilities of such bodies can be designed to accommodate the performance, as per the expectations of international organizations under the UNFCCC. However, a policy-making and decision-making forum will be required to oversee the MRV mechanisms and to play a coordinating role among the multiple stakeholders.

Considering the financial implication and the technical capacity of the country, Nepal can adopt a Tier 2 MRV mechanism. Even within the Tier 2 methodology, cost effectiveness needs to be considered. For example, the country can acquire free-of-cost, medium-resolution satellite imageries for mapping deforestation at the national level. This can also be accompanied by ground-based forest inventories to generate some local engagement and employment and complement the government's monitoring capacity. The National Forest Resource Assessment 2010 (FRA 2010) should be taken as an opportunity to design a low-cost REDD+ MRV system.

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