Monitoring, Reporting and Verification of greenhouse gas emissions

Key message

For REDD+ to be a credible mitigation strategy, considerable investment is needed to strengthen national monitoring, reporting, and verification systems for greenhouse gas (GHG) emission reductions and removals.

1 **The information requirements for effective monitoring, reporting, and verification (MRV) systems of GHG-emission reductions/removals from forests include[1]:**

- Estimation of the areal extent of significant land use classes and monitoring of land use change within and between various classes (activity data).
- Carbon density measurements and monitoring of changes to carbon density within major land use classes.

2 **The monitoring of GHG-emissions reductions/removals related to REDD+ can be carried out using field measurements, remote sensing, or modelling.** Each of these approaches has pros and cons relating to effectiveness, efficiency and the ability of different countries to implement systems (see TCG 2009 for an overview). There are also outstanding issues that need to be decided upon in order to establish REDD+ systems[2]:

- What should be monitored? Definitions of 'forest' exist (although they are diverse) but have not been decided for REDD+. For degradation, forest conservation, sustainable forest management, and enhancement of carbon stocks, there is an option to create new definitions under REDD+ or to use the definitions that are already agreed in the IPCC Good Practice Guidance.
- The level of accuracy required. This is defined by 'tiers'[3]. Tier 2 accuracy is the minimum required for reliable estimates, and is achievable for monitoring deforestation at low cost. It is much more difficult and costly for other activities, such as degradation.
- Monitoring of gross deforestation. There are two options, depending on whether net emissions are considered (i.e. measuring emissions from deforestation and degradation and removals from replacement vegetation) or not.
- Monitoring of forests remaining as forests. This includes activities such as degradation, sustainable forest management, and enhancement of carbon stocks. In general, monitoring these activities is more complex and for some the climate benefits are relatively small. However, the overall area affected may be much larger than for deforestation.
- Monitoring of other land cover conversion to forests. Internationally accepted methodologies and standards already exist under the Clean Development Mechanism, which could be reviewed for their applicability to national REDD+ programmes.

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3 **The reporting of GHG-emission reductions/removals should be carried out in accordance with the principles of transparency, consistency, comparability, completeness, and accuracy as defined by the IPCC.** The principles of completeness and accuracy are particularly challenging, given that datasets are of low quality in many countries. Meridian (2009) suggests two options for dealing with a lack of completeness and high uncertainty:

- Use of the conservativeness principle, employing discount factors in a pragmatic way to address the uncertainty of REDD+ estimates.
- Disallow the uncertainty principle[4] and follow the IPCC Good Practice Guidance (GPG) that promotes accuracy and uncertainty analysis.

The first option could simplify requirements for obtaining defendable REDD+ estimates, which would promote participation. Nevertheless, effort should be made to reduce uncertainties using appropriate higher tiers and uncertainty analysis. Where uncertainties are high, concerns over underestimating sources or overestimating sinks can be addressed by using conservative approaches.

The use of conservative 'verifiable proxies' for estimating emissions from deforestation has been proposed[5] such as:

- the systematic collation of satellite data across the whole forest estate;
- forest area change observations from satellite data; or
- measurements of policy efforts (i.e. measuring inputs rather than outputs).

Proxies are already being used in the Amazon Fund. In this case, the proxy for emissions reductions is created by only focussing on the area change in deforestation to estimate deforestation rates, averaging deforestation rates over a 10 year period to establish a reference level, and using a conservative and standardised value of carbon stocks of 100 tonnes per hectare (Table 1).

For an international REDD+ system where performance is linked to accurate GHG estimates (rather than proxies), countries are likely to require an operational forest GHG inventory with a track record of successfully reviewed inventory reports (i.e. implementation of the MRV plan) and an agreed reference level endorsed by the UNFCCC. As countries progress to Phase 2 and 3 of REDD+ (i.e. from more proxy based approaches towards GHG based approaches), Approach 3 for activity data[6], providing explicit gross rates of change in forest cover, and tier levels 2 or 3 should be used in the monitoring system for the key categories[7]. These are likely to be minimum requirements for market involvement in national REDD+ schemes.

4 **Verification of GHG-emission reductions/removals** is used to assess whether information is well documented, based on IPCC methodologies, transparent, and consistent with the reporting requirements outlined in the UNFCCC guidelines. If existing systems for verifying GHG inventories are used, support will be needed to expand the number of expert reviewers[8].

5 **The costs of MRV systems are poorly known**, and depend on the country circumstances and the accuracy levels sought. The main sources of information are still those in the Eliasch Review[9], although there have been more recent assessments that include information from country planning processes. These find that the combined

Table 1: Example calculation for CO_2 emissions reductions in 2006 using the proxies for emissions reductions specified by the Brazil Amazon Fund

Average deforestation rate (10 yr average revised every five yrs)	1.95 million ha/yr
Rate in year 2006	1.40 million ha
Reduction in deforestation rate	**1.95 -1.40 = 0.55 million ha**
Conservative estimate of carbon stocks per hectare	100 tC/ha
Overall carbon reduction for 2006	0.55 million X 100 = 55 million tC
Overall CO_2 reduction for 2006	**55 million X 3.6 = 200 million tCO_2**

Source: http://www.rightsandresources.org/documents/files/doc_1311.pdf

costs of monitoring and capacity-building activities range from USD 2 to 25 per km^2, depending on the land area to be monitored, and existing capacities in the country[10]. Expert support has been estimated in the order of USD 10,000 to 30,000 per month[11], and training costs would be in the range of USD 100,000 to 140,000 per year[12]. The UNFCCC (2009) suggests that cost estimates in Hardcastle and Baird (2008) could be reduced by 30%, based on the experience of two existing REDD+ projects.

6 **The capacity to implement MRV systems is low in many countries**: Less than 20% of countries have submitted a complete GHG inventory and only 3 out of 99 countries (China, India and Mexico) currently have capacities considered to be very good[13] for both, monitoring forest area change, and for forest inventories[14].

Key publications on this issue

Hardcastle P.D. and Baird D. 2008. Capability and cost assessment of the major forest nations to measure and monitor their forest carbon, report prepared for Office of Climate Change. Penicuick: LTS International.

Herold, M. (2009) 'An assessment of national forest monitoring capabilities in tropical non-Annex I countries: recommendations for capacity building', report prepared for the Prince's Rainforest Project.

Hoare, A. (2008) 'Estimating the cost of building capacity in rainforest nations to allow them to participate in a global REDD mechanism', report produced for the Eliasch Review.

Meridian (2009) 'REDD Options Assessment Report (REDD-OAR)', Meridian Institute, Washington, U.S.

TCG (2009) 'Measuring and Monitoring Terrestrial Carbon as Par t of "REDD+" MRV Systems: The State of the Science and Implications for Policy Makers', The Terrestrial Carbon Group.

UNFCCC (2009) 'Cost of implementing methodologies and monitoring systems relating to estimates of emissions from deforestation and forest degradation, the assessment of carbon stocks and greenhouse gas emissions from changes in forest cover, and the enhancement of forest carbon stocks', UNFCCC, Bonn, Germany.

1 TCG, 2009

2 Meridian, 2009

3 Tier 1 is the lowest and Tier 3 the highest tier of accuracy. For an explanation of tiers see page 9 of: Wertz-Kanounikoff, S. and Verchot, L. (2008) 'How can we monitor, report and verify carbon emissions from forests?', available at: http://www.forestsclimatechange.org/fileadmin/downloads/movingahead9.pdf

4 In the REDD context this means where completeness, accuracy, and precision cannot be achieved emissions reductions or enhancements in C stocks should be minimised, to avoid overestimating the impacts of REDD.

5 e.g. Herold, 2009; Meridian, 2009

6 The IPCC Guidelines describe three different approaches for representing the activity data, or the change in area of different land categories, with Approach 3 being most rigorous.

7 Meridian, 2009

8 Ibid.

9 Hardcastle and Baird, 2008

10 UNFCCC, 2009

11 Mollicone et al., 2003; Hardcastle and Baird, 2008

12 Hardcastle and Baird, 2008

13 Forest area change time series & remote sensing capabilities were assessed as 'very good' where there is regular forest area mapping with most recent after 2000; Forest inventory capacities (growing stock and/or biomass) were assessed as 'very good' where there are multiple inventories (in-country), with the most recent after 2000.

14 Herold, 2009