A review of experience of community monitoring for REDD+

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Introduction

At the 15th Conference of Parties of the United Nations Framework Convention on Climate Change (UNFCCC) in Copenhagen, December 2009, an Accord was drafted proposing to stabilize global greenhouse gas concentrations in the atmosphere at a level that keeps global temperature increase below 2◦C in the coming century (UNFCCC 2010a). The goal of the Copenhagen Accord can only be achieved if rates of deforestation and forest degradation in tropical developing countries are reduced as emissions from tropical forest destruction contribute approximately 17% of global greenhouse gas emissions annually (Barker et al. 2007). The use of economic instruments to provide positive incentives for reducing emissions forms the basis of the agreed UNFCCC policy "Reduced Emissions from Deforestation and Forest Degradation in Developing Countries (REDD+)" (Clements 2010; UNFCCC 2010b). Payments would be linked to reducing emissions relative to a "reference emissions level". The five elements that are included in the agreement are: reducing deforestation, reducing degradation, enhancing forest carbon stocks, sustainable management of forests and conservation (Danielsen et al. 2011; UNFCCC 2010b).

The fact that rewards will be proportional to achievements in reducing carbon emissions or increasing sequestration rates relative to a reference level means that quantitative monitoring of changes in forest area and carbon stocks – both at the national level and at the project level – is central to REDD+. Monitoring has been defined as "the systematic measurement of variables and processes over time" and "assumes that there is a specific reason for that collection of data, such as ensuring that standards are being met" (Spellerberg 2005), and it is required for a large number of international agreements such as the Millennium Development Goals and the national legislative frameworks of many countries, as well as for REDD+. Despite legal frameworks and an obvious need, however, monitoring often receives low priority because it can be difficult and expensive to coordinate. Thus, monitoring of the impacts of conservation policy intervention falls well behind that of most other policy fields (Ferraro & Pattanayak 2006; Donald et al. 2007; Danielsen et al. 2009).

In the case of REDD+, changes in forest area can usually be determined through analysis of satellite imagery, but ground level monitoring will in many cases be essential to determine changes in forest (and thus carbon) stock, the primary purpose of which would be to justify claims for carbon credits or other rewards. Procedures for making such measurements are outlined in the IPCC Good Practice Guidance (IPCC 2003) and follow strict scientific principles of sampling. However, monitoring at ground level may be important for other reasons too. For the success of REDD+ projects, monitoring of impacts on other environmental variables such as biodiversity could be important, as well as monitoring the underlying processes and causes of loss of forest biomass.

The rationale for community forest monitoring

Most of the literature on methods of natural resource monitoring covers an externally driven approach in which professional researchers from outside the study area set up, run, and analyze the results from a monitoring programme that has been funded by a remote agency (e.g. Goldsmith, 1991; Spellerberg, 2005; Sutherland, 1996). But this approach has been criticized for being expensive to sustain over time and reliant on skills that are not endemic (Sheil 2001) and it has been suggested that linking monitoring to the decisions of local people may help make monitoring more relevant locally and hence sustainable (Danielsen et al. 2009)

Moreover, many countries have already selected community forest management as a central part of their REDD+ plans. For who can manage forests better than those living within or beside them? It has been argued that greater recognition of community rights and empowerment of communities over forests can help achieve improved forest outcomes (Charnley & Poe 2007), and highly successful community forest management programmes can be found in many countries (Nepal, Mexico and Tanzania to mention just a few). In addition, community forestry reserves have been set up in a number of Amazon countries and in Indonesia, mostly in connection with the land use rights of indigenous groups, with a view to promoting environmental conservation and supporting livelihoods. These experiences can be used in the context of REDD+, redefining the forest management and conservation practice, such that community forest management (CFM) is likely to contribute in a significant way to reducing forest emissions and increasing forest carbon stocks. At the same time, REDD+ can improve the chances of CFM success and make forest conservation on the ground more profitable (Agrawal & Angelsen 2009)

Given that monitoring of stock changes will be essential at the local level, and given the high costs associated with expert measurement, a very practical solution is to engage those communities who are already involved in forest management for REDD+ to carry out the requisite monitoring themselves. There is some experience available as regards the practicability of this (see Box 1). But the rationale for community monitoring goes beyond this, and relates to community rights.

There has been considerable concern regarding community rights over forest under REDD+ and fear in some quarters that communities may lose access to forests which they need for their livelihoods, if credits are claimed at a higher level. One way in which community rights in REDD+ can be strongly supported is through their involvement in monitoring carbon stocks. It is noted that there is a clause in the preparatory SBSTA text on REDD + methodology which is intended to give indigenous peoples and local communities a definite stake in process, which states: “ The Conference of Parties recognize(s) the need for full and effective engagement of indigenous peoples and local communities in, and the potential contribution of their knowledge to, monitoring and reporting of activities.” … and “encourages, as appropriate, the development of guidance for effective engagement of indigenous peoples and local communities in monitoring and reporting" (Skutsch & Trines 2011; SBSTA 2009)

If monitoring of carbon stock changes associated with community forest management activities for REDD+ is devolved mainly to the communities themselves, this may help to strengthen their position within the whole REDD+ system. Firstly, it may be important for themselves in understanding the impacts of their forest management activities on carbon stocks – seeing which management activities lead to more carbon savings and which to less. But also, if the all-important data on stock change rates is in the hands of the community, they will be in a better position to negotiate for the rewards that should be forthcoming under REDD+. Ownership of this data could be a key to protection of their rights to such rewards.

Strengths and weaknesses of community monitoring

There are in addition multiple practical benefits to involving local people in monitoring of carbon stocks under REDD+.

- Firstly, a large workforce can be recruited to facilitate collection of large amounts of data across scales not otherwise feasible.
- Secondly, local people can complement scientific endeavors with skills and knowledge that scientists may lack (Berkes et al. 2000)and they can provide important ecological data in areas where academic studies have not been conducted (Doswald et al. 2007; Aswani & Hamilton 2004); they are much more knowledgeable about the local area.
- Lastly, local labor may be partly voluntary and cost will be low (Moller et al. 2004)

Some risks and conditions that will need to be dealt with include;

- Training will be needed to ensure that the strict procedures approved by the IPCC are followed.
- Supervision may be required in early stages
- Reliability of community measured data would have to be assured
- Local people might be tempted to exaggerate the carbon stock increases if they are rewarded on the basis of these
- As with all REDD+ carbon measurements, third party independent verification will be required.

Accuracy and reliability

Accuracy and reliability is paramount and it will be important to establish that communities are indeed capable of generating data which is up to the standards of the IPCC methodology. Most studies about community monitoring relate to other conservation variables such as biodiversity. These vary in their findings, and further scientific tests of the accuracy of participatory monitoring methods would be very helpful (Danielsen et al. 2007). An important part of accuracy as regards biodiversity measurement is the correct use and 'translation' of locally derived traditional measures into more 'scientific' data sets.

For the case of carbon stock measurement, the procedures used are not traditional but follow standard scientific formats. Skutsch et al. (2011) report on community measurement of carbon stock in 39 sites across 7 countries, over periods from 3 to 6 years. In three cases, experts (professional foresters and scientists) were contracted to carry out stock measurement in forests which the communities had already measured. In all three cases, there were no significant differences in the estimate of mean stock, or in the confidence level between the experts´ measurements and the communities´. Variability of locally produced data is usually a consequence of different communities employing slightly different techniques, rather than any lack of skill within the community. Hence variability of locally based data can be reduced by standardising the techniques used. Reliability can be increased by increasing the sampling frequency – something that is easily done by local communities living close to the forest resources (Danielsen et al. 2011)

Costs and sustainability

Skutsch et al (2011) estimate the cost of community carbon stock monitoring at between $2.5 and $5.5 per hectare per year, with expert monitoring costing from twice to three times this. Danielsen et al (2011) analyzing the cost of a variety of different community monitoring activities in 17 sites found annual costs of $0.04–2.4 per hectare (median $0.58 per hectare)..

Locally based monitoring tends to have higher startup costs associated with training and supervision (Rist et al. 2010; Topp-Jørgensen et al. 2005; Danielsen et al. 2011), but professional monitoring is more costly in the long run because of much higher expenditures associated with travel, field allowances, and salaries of experts (Balmford et al. 2003). Clearly, the lower the monitoring costs, the more financially sustainable the monitoring will be. Moreover, the locally based approach can also involve the community in planning, data collection, analysis, and decision making, which in turn may generate local support and ownership for the monitoring programme, enhancing its longevity. Chhatre and Agrawal(2009) suggest that this ownership is the primary advantage of locally based monitoring, as it leads to the local community regulating their own resource use (thus becoming a practice of internalizing the costs of resource exploitation, in so combating the 'tragedy of the commons' which continues to create environmental problems worldwide; Palmer Fry 2011)

The relative advantages of a community based approach compared to a professional approach are summarized in Box 2.

Tasks involved in community monitoring for REDD+

The primary tasks which communities would need to carry out in monitoring REDD+ comprise the following:

1. mapping and geo-referencing the boundaries of the forest, if this data is not already available
2. establishing a system of permanent sample plots and regular measurement of the standing biomass stock in each of the sample plots
3. calculation of carbon stocks from the measured forest parameters (e.g. diameter at breast height and tree height)
4. assessment of leakage
5. monitoring of other environmental variables such as biodiversity changes (though this need not necessarily be quantitative)

Mapping

The first step in forest carbon measurements is delineation of the forest boundaries and, if necessary, strata within the forest which represent different ecological or management conditions.

Mapping by community members may be facilitated by the used of Participatory Geographical Information Systems (PGIS). Various methods have been used in this context. The KTGAL project made use of handheld computers (PDAs) with GPS attachments, together with ArcPad software (Verplanke & Zahabu 2009). Smartphones have been used with freeware such as Cybertracker.

(Peters-Guarin & M. McCall 2011). Helveta has developed the so-called CI Earth technology as an interactive cartography application (Bey 2009) and Google have a package of tools in their Online Data Kit (ODK) which offer possibilities for community monitoring. Bhishma et al (2010) trained communities to use GPS for mapping. (Rana et al. 2010) suggest that GPS is less time consuming than use of chains and compasses for boundary mapping. However, use of ICT applications usually requires some technical backup or expertise, particularly when electronic equipment goes wrong. Moreover their programming needs expertise which is rarely present in communities.

Establishing permanent plots and measurement of biomass within them

The calculation of sample size is a technical exercise which is in most cases beyond the capacities of communities. A pilot survey is needed to establish the standard error of the mean, and on the basis of this statistic, the sample size may be established. Plots may be quadrats or circles and their size will vary according to the density of the forest. Setting out the plots in the forest also needs technical assistance.

Within the plots, measurements need to be taken to estimate total biomass, for which the most common method is to measure diameter at breast height (dbh) and tree height. A number of field guides describing procedures for this have been written especially with communities in mind (Theron 2009; Bhishma et al. 2010; Verplanke & Zahabu 2009). The usual method to measure dbh is a measuring tape or calipers, while hypsometers are used for height estimates. This data may be entered directly into a database on a handheld computer, or collected on paper. In general, the fewer times the data has to be reproduced, the fewer the opportunities for error. The KTGAL project used a computerised database in the field, with data being entered directly. However, small errors in measurement of diameters can result in large errors in biomass estimates. Alternative methods which could be used by communities are the Bitterlich method, and small hand held lasers such as LacerAce. New laser technology has recently been released which will make a complete 3 dimensional scan of a whole sampling plot in a matter of minutes, although quite complex software is needed to translate this into biomass estimates.

Methods used in mapping the forest boundaries can also be used to establish the position of the permanent plots and to re-find them for re-measurement in subsequent years.

Deriving carbon stock estimates from tree measurement data

Statistics such as dbh and height may be translated into biomass estimates through the use of allometric equations. These are derived in the first instance by destructive sampling, that is to say, cutting trees down and measuring and weighing them. In most countries, equations for the most common species have already been developed, and general equations are used for less common species. Communities cannot be expected to find these equations themselves however and are unlikely to be able to use them in their original form. However if the species is identified and dbh and height are entered into a simple database, such calculations can easily be automated, as was done in the KTGAL project. This also enables calculations of statistics such as plot totals, plot averages, strata averages, standard deviations etc. The carbon content is usually assumed to be 50% of the biomass.

Estimating leakage

Leakage refers to emissions that occur in other places due to the displacement of activities. For example, when a REDD project protects the project area from the cutting of timber, the activity might be shifted to a neighboring area in the vicinity, increasing emissions in this area; hence this effect has to be taken into account (Zhu et al. 2010).

Leakage can be quantified by monitoring deforestation, forest degradation rates, and resource consumption in leakage belts, i.e., the area adjacent to the project area. The size and location of the leakage belts can be identified beforehand by GIS analysis (B hishma et al. 2010). There are two approaches. The first one applies the same methods used in the community forest, to areas outside the managed area. The second uses proxy methods (such as gain-loss) involving estimates of quantity of the displaced activities.

Measurement of other environmental and social variables

While assessing carbon stocks and changes in carbon stocks is crucial to the MRV, it is only one of several components that will need to be measured in developing REDD+ activities. There are additional metrics to be monitored, many of which are already included in project methodology such as the VCS and the Climate, Community and Biodiversity Standard. These include:

• Socio-economic information: documentation of stakeholders, social governance structures, household income, biomass energy use, food and cash crops production, and benefit flows,

• Quantification and explanation of land use and land-use change: understanding the nature of deforestation drivers so as to model deforestation scenarios and develop appropriate responses. Monitoring changes in land-use types and accessibility (especially roads) is thus an additional requirement.

• Biodiversity: the majority of REDD verification standards currently require quantification of project effects on biodiversity, especially threatened species – hence the need for adequate assessment of biodiversity, including in the forest surrounding (Knowles et al. 2010)

Conclusions and reflections

Community monitoring has been shown to be feasible, reliable and cheaper than expert monitoring in a variety of natural resource monitoring situations. The few studies so far available on community carbon stock monitoring are positive in this regard. However, if locally based forest monitoring is to become a key element of the MRV of REDD+ schemes, further quantitative assessments of the relative strengths of different locally based forest monitoring methods would be advisable. It would be useful also to explore the extent to which community members can monitor other aspects of central importance to REDD+ implementation like governance, livelihoods, and biodiversity (Danielsen et al. 2011)

It is clear that in many circumstances locally based monitoring has advantages over conventional monitoring. It can build local capacity and relations between local people and the authorities, and can result in more rapid management interventions, although for many applications the approach needs further development and verification (Danielsen et al. 2009). For the case of REDD+, community monitoring may have additional advantages in empowering communities within the crediting system of REDD+.

It could be said that engaging local communities in monitoring for REDD+ involves transferring monitoring and reporting requirements, and their costs, onto poor local people. This indeed is a risk, particularly if the community is not the recipient of the carbon credits. However, a greater risk may be that the State will apply for credits using very rough estimates of carbon savings based on satellite imagery, bypassing the communities that actually manage the forests completely in terms of providing benefits (Danielsen et al. 2011)

However, a monitoring system based on local people carrying out the required tasks it is unlikely to be sustainable unless the benefits of the resources use are perceived locally. Monitoring is therefore most appropriate where local people have (a progtramme independent) significant interests in natural resource use, and for the case of REDD+, where there is some financial return to the community, whether in the form of carbon credits or other (Danielsen et al. 2009).

Box 1: Examples of locally based monitoring in REDD+

Community monitoring assessment has taken place in several locations around the world (Danielsen et al. 2010; Palmer Fry 2011; Danielsen et al. 2009), and from the observed cases was possible to extract those that made specific reference to REDD+ goals and requirements (see the following Table) . The experiences range from just carrying out the measurement of different biophysical parameters to comparing the outputs and cost with those of expert-based monitoring.

The studies cover the use of different tools under dissimilar management schemes and consider a diversity of forest types.

The experiences help us to recognize the benefits of this participatory and capacity building process but also to foresee the likely obstacles and risks.

The general conclusion from the review is that communities are skilled enough to fulfill many of the necessary tasks, but in all instances some training is required.

Monitoring activities carried out	Case study	Country	Forest Type
Biomass survey for assessing carbon stock following the IPCC (2003) Good Practice Guidelines.	B. S. Karky & Skutsch (2010)	Nepal	▪ Sub-tropical broad leaved ▪ Lower temperate broaded leaved ▪ Temperate conifer.
An overview of participatory biomass and carbon estimation. **Application of methodologies of national inventory, IPCC, McDicken and literature to execute inventory and calculate the biomass and carbon density**	R. Shrestha(2011)	Nepal	▪ Lower temperate broad-leaved forest ▪ Pine forest
Comparison of carbon stock changes in four villages	Zahabu & Malimbwi(2011)	Tanzania	▪ Woodland, ▪ Lowland ▪ Montane forest
Cutting-edge technology model for measuring and monitoring forest carbon emissions.	Bey(2009)	igeria	▪ Lowland ▪ Hill tropical forest
First approach to an experience on carbon stocks measurement using cyber tracker in Michoacán state.	Peters-Guarin& McCall (2010)	Mexico	▪ Temperate forest
Measuring carbon loss from forest degradation.	Danielsen et al. (2011)	India	▪ Temperate forest
		Madagascar	▪ Dry forest
		Tanzania	▪ Miombo woodland
Reforestation activities	Leimona et al. (2006)	Indonesia	▪ Grassland Dry farmland
To record the carbon outcomes of typical community forest management regimes **Assess local communities' capability of making carbon stock measurements themselves.**	M. Skutsch& L. Ba, (2010)	Guinea Bissau	▪ DryForest
		Mali	
		Senegal	

Box 2: Advantages and disadvantages of community based and expert based monitoring (From Knowles et al. 2010)

Monitoring component	External Consultants	Local Community Residents
Cost	High professional fees, travel and accommodation costs	High initial set-up and training costs followed by substantially lower salary, travel, accommodation costs over time
Local knowledge	Usually poor. Local guides and translators usually needed	Good. Residents typically know the area well in terms of access, logistics, local authorities, laws, and species names
Data quality	Good	Good, but dependent on appropriate training and data verification
Consistency	Potentially low if same consultants cannot continue with monitoring over lifespan of project	Potentially high if same team members or at least the same coordinators can be maintained
Intensity	Usually low. Too costly to spend long periods in field.	Good. Even if sampling is done part-time, substantial travel and set-up time is saved
Valueaddition	Low. Usually limited to technical input and PDD compilation	High. Project success depends on local resource users. Monitoring by locals creates ownership.
Spin-offs	Maybe for consultants' business, not for community.	Participation adds to the skills levels and capacity of local residents. Possible spin-offstoothercommunity PES activities
Management	Expectedto be good	Potential area of concern in many communities.
Logistics	Consultants' flights, vehicles and accommodation costs are high. In remoteareas, costsescalatewhenvehicles are needed.	If locally organised is cheaper and more appropriate, e.g. working by foot or animal can be effective because field surveys are spread over time.
Initial inputs, e.g. time	Low. Assumption is that professional teams need relatively little preparation time	High. Takes more time to identify, train and equip teams
Collection of other important data, e.g. socio-economic information	Generally poor. Very challenging to understand local socio-economy and culture, time-consuming to collect the data	Good. In-built knowledge of local economy and culture; easy to collect initial information and monitor changes

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