Community monitoring in REDD


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Some of the authors of this publication are also working on these related projects:

REDD+ project View project

Linking local action to international climate agreements in the tropical dry forests of Mexico View project

Community monitoring in REDD+

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- Communities in forest areas can be trained to map and inventory forests although they may need technical support for some tasks.
- The cost of community carbon monitoring is likely to be much less than for professional surveys and accuracy is relatively good. The degree of precision depends on the size of the sample. There is a tradeoff between the cost of increasing the sample size and the amount of carbon that communities could claim.
- Entrusting forest inventory work to communities could have other advantages for national REDD+ programmes, such as transparency and recognition of the value of community forest management in providing carbon services.

Introduction

The scope of REDD+ now includes, in addition to reducing emissions from deforestation and degradation, conservation, sustainable management of forests and enhancement of forest carbon stocks ('negative degradation'). This means that countries participating in REDD+ will need to carry out forest inventories regularly and systematically to measure changes in forest carbon stocks. Forest inventories could be expensive if professional surveyors are employed and there could be a serious shortage of survey services. A cheaper option would be for communities in forest areas to do the forest inventories, particularly communities that are involved in payments for environmental services (PES) or other community forest management (CFM) schemes.

This chapter looks at ways in which communities could carry out forest inventories to monitor changes in carbon stocks. First, we explain the detailed data that communities and countries would need to collect if they are to be rewarded for reduced degradation and for forest enhancement. We then briefly present the steps involved in collecting data and describe some experiences with community carbon monitoring. Finally, we discuss reliability and costs, and how community carbon monitoring might be integrated into national REDD+ systems, and draw some conclusions. The chapter is mainly based on the authors' experience of the Kyoto: Think Global, Act Local (K:TGAL) programme.[1]

Stock change related to degradation and forest enhancement

Most community forest management (CFM, see Chapter 16) programmes are not primarily directed at reducing large-scale deforestation (land use change). Their focus is on sustainable fuelwood and charcoal production, decreasing slash and burn farming, and controlling the collection of fodder and grazing in the forest. Successful CFM not only halts degradation of forests, but also enhances forest carbon (which can be seen as 'negative degradation'). Reduced degradation and forest carbon enhancement are both now included in REDD+, and CFM could, therefore, be rewarded. However, the implications for monitoring, reporting and verification (MRV) have not been fully appreciated in current debates.

The kind of degradation that CFM attempts to reverse tends to be slow. Typically, emissions are in the range of 1–2 tonnes of carbon (3–7 tonnes CO_2) per hectare per year. Forest enhancement from CFM also happens fairly slowly. Remote-sensing methods cannot pick up such small changes, let alone measure them over the short time frames of carbon accounting periods (yet to be defined, but perhaps 1–2 years, and in any case not more than 5 years). Although some types of degradation can be measured using a combination of high-technology remote-sensing procedures (e.g., Souza *et al.* 2003),

1 The Kyoto: Think Global, Act Local programme (www.communitycarbonforestry.org) was financed by the Netherlands Development Cooperation. All views expressed in the chapter are, however, those of the authors. Parts are taken from Skutsch *et al.* (2009b). The GOFC-GOLD Sourcebook, (2009: Chapter 3.4, Van Laake and Skutsch) gives a more technical account of procedures and options for community-based monitoring.

these methods are not meant to deal with the type of degradation that CFM addresses. Rather, they detect activities such as logging, which are sporadic, localised and thus easier to observe in satellite images. Nevertheless, the small but positive gains that are associated with CFM are important from a climate change perspective, not least because they span very large areas.

In order to make credible international claims for reduced degradation and forest carbon enhancement resulting from CFM, countries will need to monitor carbon using Tier 3 standards (see Box 8.1 and Chapter 7) through regular ground inventories over CFM forests. If generalised data (Tiers 1 or 2) are used, the margin of error will be wider than that of the small per-hectare carbon savings that result from CFM. Since the costs of forest inventories are essentially the same per hectare regardless of the biomass level, it may not be cost effective for governments to regularly survey forests which are changing only slowly. This means that CFM efforts to reduce forest degradation could go unrewarded under REDD+ because of the cost of MRV under a compliance regime.

Box 8.1. IPCC monitoring standards: Tiers 1, 2 and 3

Tier 1 data are default data on average carbon stocks and growth rates for six typical vegetation classes for each continent. Tier 1 data are highly generalised and may be very different from the actual situation in any given location on the ground. Tier 2 data are based on national-level inventories and studies, and are typical values for forest types present in that country. Tier 2 data are likely to be a little closer to the actual situation, but could still be very inaccurate for specific locations. It is likely that safety margins will be needed and deductions will be made to ensure estimates are conservative and to avoid 'hot air' if Tier 1 and 2 data are used. Tier 3 data are site specific, usually measured in permanent *in situ* plots. As the error factors are low, a much larger part of the estimated carbon saving can be claimed.

Community monitoring of carbon stocks

One option to address these issues is to have communities that manage forests do the forest inventories. Payments for carbon could be based on these inventories. Although several studies have examined the capacity of local people to assess forest biodiversity or disturbance (Topp-Jørgensen *et al.* 2005; Holck 2008; Danielsen *et al.* 2009), only a few projects have trained local people to make detailed measurements of carbon stocks. Two examples are the Scolel Te project in Mexico, from which carbon credits are sold in the voluntary market (Box 8.2) and the K:TGAL project. K:TGAL is a research project designed specifically to assess the feasibility, reliability and cost effectiveness of community forest carbon inventories (Skutsch 2005; Zahabu *et al*. 2005; Tewari and Phartiyal 2006; Karky 2008). It examined CFM projects in 30 sites in eight countries in Africa, Asia and Latin America, over periods of 3–5 years.

K:TGAL found that local people with as little as 4–7 years of primary education who are already involved in CFM can easily be trained to carry out forest inventories using standard methods such as those recommended by the Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance (IPCC 2003). Box 8.3 summarises the K:TGAL methodology, which involves sampling all aboveground biomass (trees, shrub and herb layers, and litter), but not soil carbon. Soil carbon is excluded because of the technical difficulties of estimating changes in soil carbon over time, and because it is not yet clear whether soil carbon will qualify for carbon credits under REDD+. Belowground biomass is calculated using standard factors (secondary data on the typical ratio of belowground to aboveground tree biomass).

Box 8.2. Community monitoring in the Scolel Te project

The Scolel Te project in Chiapas involves tree planting in a coffee agroforestry system and other agricultural systems, as well as sustainable management of surrounding natural woodlands. An NGO, AMBIO, manages the project using a system called Plan Vivo. The project is financed from the voluntary carbon market. Farmers develop plans for carbon sequestration on their land and draw up contracts with AMBIO through a highly participatory process. Following 1–2 days of training, each farmer measures yearly increases in woody biomass stock using standard forest inventory methodology. Farmers from one village cross-check carbon measurements of farmers from another participating village, and AMBIO technical staff recheck 10–15%. Each participant has a passbook to record carbon increments and payments for the carbon (through Plan Vivo certificates). The anticipated increment in carbon is calculated up front. Farmers receive around 20% of the anticipated payments when they begin to cover start-up costs. The rest of the payment is made in two stages (after 5 and 10 years). This system encourages farmers both to take part initially and to look after the trees. Only 90% of the total carbon recorded can be sold, leaving 10% to cover uncertainties. Farmers receive approximately 60% of the value of the credits in the voluntary market, the rest is used to cover the overhead costs of AMBIO (http://www.planvivo.org).

Box 8.3. Methodology for community forest inventories

The K:TGAL field manual sets out a methodology for community carbon monitoring (www.communitycarbonforestry.org). The manual is designed to be used by an intermediary (e.g., local forest department or NGO). Intermediaries have basic computer skills, and are able to train people from the community and maintain the equipment. The method is 'participatory', although like all participation, the question of who actually participates may be problematic. In brief, the method consists of the following steps:

Boundary mapping. Georeferencing forest boundaries using a hand held computer or personal digital assistant (PDA) linked to a global positioning system (GPS) with a standard geographic information system (GIS) programme and a geo-referenced base map or satellite image. Boundaries are walked, and immediately appear on the base map on the screen. The forest area is automatically calculated (Figure 8.1).

Identifying strata. Heterogeneous forests are stratified on the basis of dominant tree species, stocking density, age and aspect (slopes, orientation), as well as by different types of community management. Strata boundaries are added to the base map using the same technique (walking the boundaries of each stratum).

Pilot survey for estimating variance, to determine the number of (permanent) sample plots required. Circular pilot plots are set out in each stratum and these plots are used to train people to do the biomass inventory. A central point is marked, and a sampling circle is set out; data on dbh (diameter at breast height) and the heights of all trees over 5 cm dbh are recorded in the database on the PDA. Trees are identified using local terminology. A drop-down menu opens for each entry, with multiple choices for data, such as species and condition, while numeric data are entered using the keyboard. The database is set up so that every tree is recorded separately in a file for each plot, and all the plots in one stratum are held in one file. The protocol is based on MacDicken (1997) and IPCC Good Practice Guidance (IPCC 2003). Local allometric equations and expansion factors in the database convert dbh and height variables into biomass estimates. Variance in biomass in pilot survey plots is used to calculate the sample size needed to achieve a maximum of 10% error. Statistical manipulations (means, standard deviations, confidence interval) are pre-programmed.

Permanent plots are laid out. Central points are marked in the field and on the computer base map using parallel transects across the area from a random start point. This is done by the intermediary with the help of the village team (Figure 8.2).

Re-finding the permanent plots and measuring biomass in each of them. For the annual survey by the community team, the plots are located using the GPS. The inventory is carried out as described in step 3.

Sampling the herb and litter layers. Samples of the herb and litter layers from quadrants within the permanent plots are bagged, dried and weighed.

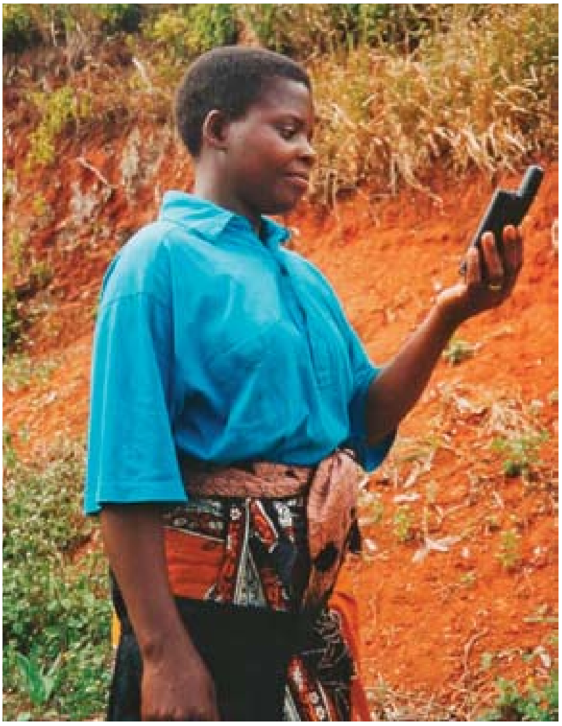

Figure 8.1. Using a personal digital assistant to map forest boundaries (Photo: Margaret M. Skutsch)

Figure 8.2. Setting out permanent plots (Photo: Cheikh Dieng)

Steady annual increases in carbon stock have been recorded in 24 of the 28 K:TGAL CFM sites for which data is available. In the other four, there were annual losses because of encroachments, but the overall trend was for increasing biomass, indicating that CFM was generally successful in building up carbon stocks. Moreover, the research showed that under CFM the carbon gain from forest enhancement was three times more than the estimated carbon gain from reduced degradation (Skutsch *et al.* 2009a, b).

While systematically monitoring carbon stocks over time gives good estimates of forest carbon enhancement, calculating emission reductions from reduced degradation is not so straightforward. The reference level for carbon enhancement is zero change, whereas the reference level for degradation is a hypothetical construct of the counterfactual, i.e., what would have happened without REDD+ in a business-as-usual scenario. Historical data on degradation are not available for most CFM areas. A conservative nominal rate (such as one tonne per hectare per year) could be set for the historical rate of degradation, but this would always be open to question.

To resolve this, a simple option is to reward *only* the measured forest carbon enhancement and to treat the avoided degradation as an additional, unpaid contribution. From a carbon buyer's perspective, this would be an advantage as carbon claims would be conservative. Because most CFM quickly reverses degradation and from then on enhances forest carbon, rewarding forest enhancement rather than avoided degradation makes sense (Figure 8.3).

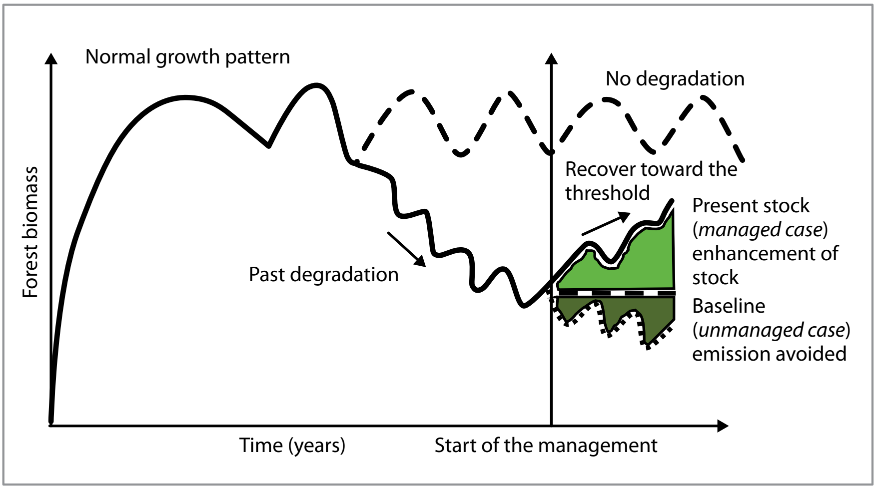

Figure 8.3. Avoided forest degradation and sequestration resulting from community forest management

Source: Zahabu (2008)

Reliability of community monitoring

How reliable is community monitoring? Are the results comparable to forest inventories carried out by professionals? Data from the K:TGAL project in community forests in Tanzania and the Himalayan region show that the difference in estimates of mean biomass made by the community in 2008 and those made by independent experts who carried out control surveys that year was never more than 7%, and was mostly less than 5% (Table 8.1). In all cases, the estimates of the community were lower than those of the experts. This seems to imply that the community estimate was more conservative, but probably reflects the fact that the expert survey was done several months after the community survey and that the trees had grown in the meantime. The real difference between community and expert estimates is almost certainly less than that shown in Table 8.1. However, in some cases, the variance of the estimates was higher for the community measurements, implying that, although the accuracy was good, the precision was weaker. The difference in

Table 8.1. Biomass estimates by villagers and professional surveyors in Tanzania and the Himalayan region

Site	Estimates by community	Estimates by professionals	Difference of means (%)
Dhaili village, Uttarkhand, India			
1. Even aged *banj* oak forest:			
Mean biomass (t/ha)	64.08	66.97	4
Standard deviation	25.42	25.46	
2. Dense mixed *banj* oak forest:			
Mean biomass (t/ha)	173.39	188.05	7
Standard deviation	59.09	62.37	
3. *Banj* oak *chir* pine degraded:			
Mean biomass (t/ha)	66.29	66.87	<1
Standard deviation	17.75	18.16	
Lamatar village, Nepal			
Oak forests:			
Mean biomass (t/ha)	125.28	125.99	<1
Standard deviation	72.56	50.47	
Kitulangalo SUA Forest Reserve, Tanzania			
Degraded *miombo* woodland:			
Mean biomass (t/ha)	42.19	43.15	2
Standard deviation	8.65	3.75	

Sources: Zahabu (2008), K:TGAL (2008)

precision, however, is because the consultants used a slightly different sampling method (e.g., larger plot sizes), not because of any lack of measurement skills on the part of the community.

Reliability improves with regular sampling over time. Ideally surveys should be done in the same season every year and, even though carbon gains may be calculated and rewarded over a full accounting period, annual surveys are recommended. Growth rates fluctuate because of variations in annual rainfall and temperature, and a data series may smooth and average out these effects. Further, if data are gathered annually, there is a greater chance of catching errors, as anomalies will show up. Annual surveys are also important for continuity, so that surveys become a habit. The teams trained to do the surveys will not forget what they have learned and have to be retrained.

Carbon estimates must normally be verified before any payments are made. Communities could also do some verification. The Scolel Te project (Box 8.2) verification method of combining measurements by 'neighbours' and technical staff is interesting and could be explored further.

Costs of community monitoring

A second important question is how the costs of community monitoring compare with the costs of professional monitoring. The K:TGAL experiment examined costs of community inventories for four sites in Tanzania (Table 8.2). The first year costs for the community surveys (high because of initial training and setting up permanent plots) were between 70% and 30% of the costs of professional surveys (Table 8.2). Costs fell rapidly over time since the surveys were done every year and little retraining was necessary. The average cost of community inventories over four years is about one-quarter the cost of

Table 8.2. Costs of carbon assessment by local communities compared to costs of carbon assessment by professionals

Study site	Forest area (ha)	Cost (US $/ha)				
		By local communities				By professionals
		Year 1	Year 2	Year 3	Year 4+	Yearly
Kitulangalo	1020	5	3	2	1	10
Handei	156	17	12	8	2	44
Mangala	29	53	37	24	6	176
Ayasanda	550	8	6	5	1	13

Source: Zahabu (2008)

professional surveys. The costs of community monitoring include the time of community members involved ($2 per day, the typical local day rate for unskilled labour), the time and expenses of the intermediary organisation that provides training and supervision, and a share of the costs of equipment and software. The costs of the professional survey were the actual payments made to the survey team based on normal local rates, including travel costs.

The main reason for the very high variation in costs between sites (Table 8.2) is that economies of scale are a factor, for both community and professional surveys. At a given degree of homogeneity, fewer sample plots are required for the same level of precision in large forests than in small forests. In addition, training is a fixed cost, and thus, per hectare, costs more for small forests than for large forests. This suggests that it might be cheaper for several communities to bundle their claims for emissions reductions together.

In the case of Dhaili, Uttarkhand, India, in three forest strata totalling 58 ha, the cost of community labour for the first year's work was estimated at $3 per hectare, while cost of the professional team was estimated at $5.50 per hectare. From the second year onwards, the costs would be about half this for both teams, since mapping boundaries and setting out sample plots would not have to be repeated.

There is a tradeoff between claiming more carbon payments by monitoring more precisely and the cost of this increased precision. More precision means increasing the size of the sample – in terms of both the size of each plot and the number of plots measured – which increases monitoring costs. The differences in cost between the professional and community approaches described above reflect this in some cases. It would certainly be possible for communities to make their estimates more precise by increasing the size of the plots, but this would involve more work. Until the value of a unit of carbon is known, it will be difficult to decide which way to go. There is also no ruling yet on what will determine the reward for carbon reductions – whether it will be the estimate of the mean, the lower end of the confidence interval, or some other discount factor that represents uncertainty. In the Scolel Te project, for example, only 90% of the measured carbon stocks are credited. Clearly, it will be difficult for the community itself to do complex calculations, but once the rules are agreed, the cost–benefit tradeoff will be much easier for the supporting intermediary to determine.

Community monitoring and national REDD+ programmes

Under REDD+, countries will have to carry out far more forest inventories than they have in the past if they are to report under the United Nations

Framework Convention on Climate Change (UNFCCC) at the accuracy that the IPCC has proposed (i.e., a maximum 10% error at the 90% confidence level). Community monitoring seems to be a simple option for dramatically scaling up forest inventories. Within a national REDD+ programme, community monitoring could be a relatively cheap way to get accurate ground-level data (Tier 3). Countries could start community monitoring, especially where communities already actively manage forests, while still using gain–loss (Tier 2) or other methods in areas where this is not yet possible.

Communities could upload the results of their inventories directly into national electronic databases. Simple statistical analyses can detect suspicious reporting. As in all carbon-reduction schemes, some form of verification (such as random spot checks using very high resolution remote-sensing techniques) would also be necessary.

Data from community inventories could be used:

- To directly assess biomass and biomass change over time;
- To support stratification of forest resources into homogeneous units based on resource type, resource condition, management regime and temporal dynamics;
- To support independent validation of claims for reductions in carbon emissions by correlating individual inventories with satellite imagery *ex ante* and *ex post*. This may eliminate the need for extensive field visits and thus lower transaction costs;
- To make data estimates more accurate, and reduce uncertainty and error margins, thus allowing a country to claim more carbon credits, particularly for reducing degradation and enhancing forest; and
- To distribute financial benefits transparently under national carbon payment for environmental services (PES) or PES-like systems (Luttrell *et al*. 2007; Peskett and Harkin 2007; see also Chapter 17).

Further, community inventories will highlight the importance of community management in providing carbon services, and legitimise community claims to a share of the financial benefits. Communities will also have a stronger negotiating position in disputes about the relative value of forests versus other land uses.

There are several possible institutional models for linking community inventories to national REDD+ programmes. Clearly, all carbon PES programmes could require communities to be responsible for biomass inventories. Payments would be based on results, and the costs of making the inventories would be recouped by communities from the payments they receive for carbon. However, in the short term this could lead to high transaction costs. There might also be intercommunity conflict because some communities have more opportunities to earn carbon credits than others; not only do forests naturally differ from one another, but the way forests were managed previously may have increased or decreased opportunities to earn carbon credits. As a transitional step before national REDD+ systems become fully operational, communities could be paid a flat rate per hectare to measure and monitor changes in carbon stocks rather than being paid for carbon gains. Although it might seem that this would remove the incentive to restore carbon stocks, the payment could be tied to a management agreement, which would be a proxy for reduced degradation and forest carbon enhancement.[2] Countries would benefit because they would get detailed data on changes in carbon stocks, which would enable them to claim carbon credits for reduced degradation and forest enhancement. Communities would earn income for generating data, not for the carbon itself.

Conclusion

Community forestry is likely to be adopted by many countries as part of national REDD+ programmes. Although other monitoring methods (professional forest inventories, gain–loss methods based on secondary data) could be used to claim rewards for changes in carbon stocks, community monitoring has a number of advantages. It is cheap and relatively reliable, particularly if carried out annually, and it delivers Tier 3 data. Community monitoring is feasible in all forest areas within range of rural settlements, particularly in forests that are already under CFM or that REDD+ will bring under CFM. Community monitoring may, in itself, encourage communities to become involved in REDD+. From a national point of view, community monitoring could be a transparent way to make carbon payments related to output.

Current rules for REDD+ carbon accounting are not clear. We do not know, for example, how avoided degradation will be assessed at the local level, what proportion of the increase in carbon stock may be claimed by a community as 'forest enhancement', or how much communities can expect to be paid. Clarifying these rules and spelling out the benefits communities can expect are essential to move current experiments with community monitoring forward and to make community monitoring an integral part of national MRV systems.

2 Most PES systems currently work with flat-rate payments and are not output based, mainly because measuring outputs of, for example, biodiversity or water conservation, is very difficult. Carbon is much easier to measure, but, nevertheless, it may not always be necessary to base rewards on actual outputs.

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