Reducing carbon transaction costs in community based forest management

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Abstract

The paper considers the potential for community based forest management (of existing forests) in developing countries, as a future CDM strategy, to sequester carbon and claim credits in future commitment periods. This kind of forestry is cost effective, and should bring many more benefits to local populations than do afforestation and reforestation, contributing more strongly to sustainable development. However community forest management projects are small scale, and the transaction costs associated with justifying them as climate projects are likely to be high. A research project being carried out in six developing countries is testing carbon measurement and monitoring methods which can be carried out by community members with very little formal education, which should greatly reduce these transaction costs. Using hand-held computers with GIS capability and attached GPS, villagers with four years of primary education are able to accurately map their forest resource and input data from sample plots into a programme which calculates carbon values.

Key words: avoided deforestation, transaction costs, participatory carbon measuring and monitoring, carbon entitlements,

Transaction costs, community based forest management

1. Introduction

Under the Kyoto Protocol, forestry will be permitted as a sink measure under the Clean Development Mechanism (CDM), but only in the forms of ‘afforestation’ and ‘reforestation’. These tend to involve large-scale plantation systems, which although cost effective in terms of carbon sequestered, in most cases have very limited benefits to local populations, if any. However, many communities in developing countries have started to manage existing natural forest in a sustainable way, under a variety of programmes such as Joint Forest Management (JFM) and Community Forest Management. These schemes were set up for conservation and social development purposes, not with a climate related motive. Although this does not qualify for CDM under present LULUCF rules, generally all these types of Community Based Forest Management (CBFM) do result in additional carbon sequestration. If the decision regarding eligibility of forest management under CDM were to be reversed in the future, the financial incentives provided by sale of carbon offsets could potentially swing the balance and encourage many more communities to engage in this sort of forest management, and thus promote the protection of tropical forests and the avoidance of deforestation, which in itself a major environmental problem worldwide. In particular it would encourage communities in remote locations, who because of their unfavourable location are unable to market regular forest products, to participate in forest management and reduce the pressure of deforestation.

The paper first considers the potential of CBFM as an instrument for carbon sequestration, for example during a second commitment period under a future CDM-type set-up. It considers some of the broader implications of this as regards equity and carbon entitlements. It then turns to the specific question of the transaction costs related to CBFM as a carbon strategy, and how to reduce these. CBFM projects are by nature small scale and represent a low intensity means of sequestering carbon. Compared to afforestation, the amount of carbon saved per hectare per year is low, although the forest management costs are also much lower. This means that transaction costs per ton and per hectare are likely to be rather high, even if simplified procedures for small scale forestry CDMs are applicable[1].

An important element of the transaction costs will be the measuring and monitoring of increases in biomass in the forest, the methods to do which will have to adhere to the strict LULUCF rules as regards carbon measurement and accounting. The costs of employing professional intermediaries to use scientific methods to gather, process and submit such data are likely to be high, meaning that any financial gains to the community are likely to be wiped out. The paper considers the possibility of developing techniques which can largely be carried out by the communities themselves, at a much lower cost, and whether the results could be as reliable as 'expert' measurement and monitoring.

The paper describes a research project being carried out by the University of Twente and ITC (the International Institute for Earth Observation and Geo-Information), both in the Netherlands, and three regional research institutes (in Nepal, Tanzania and Senegal), which is testing carbon assessment methods involving the use of handheld GPS/GIS devices by local communities who are already engaged in community forest management activities for other reasons (conservation, timber production, non-timber forest products, ecotourism, firewood supply etc). The purpose of the research is to demonstrate that such communities can make reliable assessments of the increased sink values of their forest and monitor this over an extended time period. If this objective can be realised, it may help to open the way for reconsideration of the types of sinks allowed under CDM in the future, and for communities of this kind to supplement their forest based livelihoods through the sale of their carbon as a non-timber forest product in the future commitment periods, and possibly to the 'non-compliance' market in the shorter term.

[1] A decision was taken at CoP9 to introduce simplified procedures for small scale forestry projects (those sequestering less than 8kT carbon per year) during the first commitment period, in parallel to those for small scale energy projects.

2. Sinks in the CDM

As confirmed at CoP9 (Milan, December 2003), when the Kyoto Protocol comes into force, the Clean Development Mechanism (CDM) will provide an instrument by which finance from the North may be used, among other things, to support certain kinds of tropical forestry (afforestation and reforestation). The decision to include the sink function in CDM has been welcomed by many, since about 25% of atmospheric carbon is believed to derive from deforestation and other land use changes. However, there are considerable doubts about the wisdom as regards the selected form of these sinks, both from an ecological and from a social point of view. Afforestation and reforestation projects will have a tendency to be large, low labour input schemes owned by companies or formal organisations, and will often involve monocultures of fast growing species since this is a cheap and effective way of sequestering carbon. Moreover there is a risk that if they prove to be competitive in carbon terms, considerable areas of non-forest land may be converted to carbon-dedicated tree plantation and alienated from use by local populations for other purposes for 60 years and more. Some writers believe that afforestation and reforestation are the most socially inequitable of all sink possibilities (Saunders etc al 2003). All in all it is clear that this approach is unlikely to yield positive benefits for the mass of the rural population in the developing world, and thus may not live up to strong criteria of sustainable development.

As Landell-Mills and Porras (2002), Brown et al (2003) and others point out, there are several ways in which forest can play a role in carbon sequestration, in addition to afforestation and reforestation. The decision to allow only afforestation and reforestation projects under CDM (essentially, the plantation of trees in areas where there are none now) cuts out many other important aspects of forest management, in particular the management of existing tropical forests. Improved forest management (eg by reduced impact forest logging) can both increase sequestration and reduce emissions. Conservation and protection against deforestation cuts emissions. Moreover, substitution of sustainably produced biomass for fossil fuels may also be a forest based climate strategy to cut emissions. Avoided deforestation and secondary forest regeneration is thought to be a much more cost effective means of reducing atmospheric carbon than afforestation and reforestation (Pearce, 2000; Watson et al. 2000; Klooster and Masera 2000; Malhi et al 2003). Slowing deforestation and promotion of forest regeneration could reduce 12-15% of expected emissions in 2050, a not inconsiderable contribution to the overall problem (Klooster and Masera, 2000).

A very important aspect of this is the co-benefits that can be obtained from forest management and particularly from community based forest management for carbon (Swingland, 2003; Katoomba 2002). These range from ecological gains (conservation of wilderness values, biodiversity protection, watershed management, erosion control) to social gains (provision of livelihoods). There is no doubt that both nature and society will in the long run be better served by management and protection of existing forests, than by industrial size plantation projects designed to sop up as much carbon as possible in the shortest possible time. The UNFCCC is after all only one of several international agreements and forest management offers an opportunity for it to join up with efforts under the Convention for Biodiversity (CBD), the World Summit on Sustainable Development (WSSD) and the Millennium Goals.

3. Why CBFM was not included in the CDM

There are a number of reasons why forest management in general and CBFM projects in particular were not accepted under Clean Development Mechanism. The first is related to the idea that sinks in general should only be allowed to account for a small proportion of the carbon reduction (if any), since the global warming problem is seen to be caused fundamentally by unsustainable use of fossil fuel and the need to change energy consumption patterns (Greenpeace, 2003). This view is held by a number of environmental groups despite the fact that about a quarter of atmospheric carbon in fact derives from forest clearance and other land use changes. Forest management was rejected by such groups on the grounds that if it were allowed, it will offer a cheaper alternative, open the flood gates to land use related projects, reduce the pressure to invest in energy conservation and renewable energy, and particularly reduce the transfer of improved technology from North to South (Mwandosya, 2000). On the other hand sinks were strongly lobbied for by a number of Northern countries including the USA and Australia. The Marrakech compromise, reached under considerable time pressure at the meeting, was to accept a limited form of sinks, i.e. only afforestation and reforestation. But a better way to control the proportion of investment in sinks is to cap it – as has also been done[2]. This cap could rise in the future as commitments are increased. At present reduction quotas are relatively small – averaging 5% of the 1990 emissions of the industrialised countries – but in later commitment periods these will have to increase up to 50 or 60% if atmospheric carbon is to be kept at what are considered 'safe' levels. At that point, there will be more room for sinks, and particularly for forest management, without compromising the drive for energy efficiency and renewable alternatives.

Another major reason for not including management of existing forests was the fear among many that this might lead to the destruction of such forest and its replacement with (faster growing, easier to manage, more carbon-profitable) plantation forest. As the rule now stands, afforestation can only take place on land which has never been forested, and reforestation on land that has not had forest on it since 1990, so there is no possibility of destroying forest to plant more under CDM finance. This does remain a problem if management of existing forest is allowed in the future – after all, enrichment planting and replanting are valid forest management practices which may conducted in the best and most sustainable situations, where forests are being managed for a variety of objectives. The problem is to ensure that such practices are not used to reduce the current multi-functional role of the forest to a single one – carbon saving - or at least, that a balance among functions is attained. There would certainly have to be some controls and enforceable codes of conduct regarding forest management practices under CDM. Indeed there is active work going on at the moment to try to find acceptable forest management and sustainable development criteria to protect these broader values under CDM conditions, as in the ENCOFOR project for example (Katoomba, 2003; FACE 2004). The difficulties of bringing such standards in to the process are going to be political, not technical.

[2] Annex 1 countries are allowed to use sinks up to 1% of their base year emissions, times 5 (ie about one fifth of their total emission reductions, per year, over the 5 years of the commitment period).

Much of the stalling up to now in the discussions on sinks in general, for for forest management in particular, was due to the permanence issue: carbon in woody biomass is held for only the lifetime of the plant, and thereafter re-released into the atmosphere; and a forestry project may be subject to risk of unplanned carbon release (fires, accidents etc). This is as true for afforestion/reforestation projects as for forest management and cannot be used any more as an argument for excluding forest management, since the concept of temporary CERS (tCERS asnd ICERS) was accepted at CoP9 to deal with this problem.

At the same time there are a number of other technical problems related to inclusion of sinks under CDM, and of forest management and avoided deforestation in particular. To demonstrate real carbon savings and additionality, the procedures for verifying the carbon offsets must be very rigorous, using technically approved measurement methods. While the carbon held, for example by 30,000 ha of newly planted eucalyptus forest can be fairly easily assessed at any point in time, the changes in carbon held before and after patches of existing (mixed species, mixed age) forest are brought under CBFM are much more difficult to measure and to verify. It was at least in part these practical problems that barred the way to forest management in the last round of climate negotiations, and it is in this area that work needs to be done if forest management is to be accepted in the future. Procedures have now been developed by the IPCC for the case of afforestation and deforestation (IPCC 2003) and these will need to be further developed if forest management and CBFM in particular, is to be admitted in the future.

4. Integrating carbon management in CBFM

The nature of CBFM

Community forest management, as an intervention, i.e. on a project basis, long predates the carbon issue[3]. It was started as a means of reversing degradation of natural forests

[3] It goes without saying that communities have managed forests since time began. What is meant here are schemes in which there is some intervention from outside to stimulate this or re-enforce it. There are many types of CBFM ranging from essentially autonomous management which is recognised and accepted as such by the forest administration, through collaborative efforts of local communities with state or private organisations, to relatively top down management systems in which the local people are

and trends of deforestation in developing countries, which occurs because many forests, though legally the property of the state, are *de facto* unregulated common property resources. Because local communities generally do not have legal rights over these forests, and the state does not have the means to manage them adequately, they have been subject to mismanagement, both by third parties (clandestine logging companies or corrupt state forest officers) and by members of the local communities themselves (illegal clearance for agriculture, over-exploitation of forest resources etc). By clarifying the ownership and rights situation and putting the local community at the helm by means of a recognized, locally legitimate management committee or co-operative, much of this plundering of the forests can be halted.

The incentive for the local community is usually greater returns on forest products (Poffenberger 1990; Hobley, 1996, Agarwal and Ribot 1999). Under CBFM, state owned natural forest is essentially contracted out to local communities, which then have exclusive rights to harvest certain products under an agreed management plan, which ensures that the rate of harvesting does not exceed the rate of natural regeneration. In West Africa this is mainly being applied in the context of fuelwood supply around major cities (Kerkhof, 2000; Kerkhof, Madougou and Foley, 2001; Foley et al 1997; Dianka 1999) while in India various forms of Joint Forest Management now provide forest dependent people legal and sustained access to a variety of non-timber forest products (NTFPs) such as bamboo, gum, rubber, beedi leaves, wild fruits, medicinal herbs, as well as timber in some cases, for income generation (Poffenberger and McGean, 1996; Sarin, 2001, Skutsch 1999). In Mexico, large numbers of communities are managing the forest under CBFM for timber production and have set up local cooperative enterprises to further this, displacing illegal forestry concerns which had earlier had unhindered access to the forests (Klooster and Masera 2000). Unlike the illegal companies, who just move on when they have taken whatever timber is valuable, it is not in the interest of the local community to run the forest into the ground; they use a management plan which ensures sustainability of the resource. In a few places, communities have been encouraged to take up forest management for conservation reasons and biodiversity protection, but the lack of economic incentive is a serious

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essentially just labourers. For the purposes of this paper I am not distinguishing between these types but use CBFM as a general term to cover them all.

problem. In the E. Usambaras of Tanzania, in the surroundings of the Amani Nature Reserve, villagers are starting to draw up forest management plans for their own forest lands partly with a view to ecotourism, recognizing that money can be earned by guiding tourists around, and that biodiversity and a healthy forest is essential for this. Clearly, the further the forest is from national infrastructure (roads, facilities), the higher the transport costs, and the less the opportunity for earning cash from sustainable forest management. And this is perhaps where carbon, as a 'non-timber forest product' (Skutsch, 2003) becomes most interesting; for carbon is a virtual product, with no real transport costs.

Valorising carbon in CBFM

During the AIJ phase, a number of forest based projects were included (19 out of the total of 125 AIJ projects), some of which involved forest management in developing countries. Most of these were primarily directed to carbon saving, and set up expressly for this purpose (eg FACE projects), although of course they could not claim official credits for this. In some cases finance was raised on the basis of the market value of the carbon saved, and in a few, the local communities were actually paid on a per ton basis (eg the Scolel Te project in Mexico (Tipper 2002; Brown and Corbera 2003). In others this link was never made, for example, in the project in Burkina Faso, which was based on an earlier CBFM project designed to produce sustainable fuelwood supplies, the finance for the AIJ project went to cover the overhead costs of the implementing agencies and the local community was not in any way paid for the carbon sequestered. Thus from the AIJ experience one can unfortunately not learn a great deal about how the grafting on of carbon to existing forest management activities could stimulate these and create the necessary financial incentive to local communities.

For if CBFM were to be accepted under a future CDM type mechanism, carbon would in all likelihood be only one of many products marketed by the community, and probably not the most important or even the most valuable. Most non-timber forest products have relatively low commercial value individually. Carbon could be seen simply as an additional non-timber forest product, which increases the overall economic gain, possibly tipping the balance so that in the eyes of the community the total financial picture becomes positive and makes overall management worthwhile (this would be necessary if the CDM carbon additionality criterion is to be met).

It is evident that for maintenance of ecological forest values (biodiversity conservation, watershed protection), communities are at present not rewarded at all in money terms, although the benefits mainly flow to others downstream (both in the physical sense and inter-generationally) (Pagiola et al, 2002). Lack of payment or incentive for these services to the public can be seen as a major reason why many communities have allowed their forests to degrade, or have actively participated in deforestation by encroaching on the forest area and converting it to other, more immediately profitable uses. Carbon is the first of these forest environmental services that, through the Kyoto Protocol, has been given financial value and a market system, and this opens up interesting possibilities for future arrangements for other forest services (Pagiola et al 2002). At the same time, of course, the introduction of a market system may bring with it many negative effects, for example increasing gaps between those with access to the market and those without, so any experiments in this type of arrangement need to be very carefully monitored and critically investigated (Corbera, 2002).

Equity issues under CBFM

Indeed, equity issues under CBFM as a whole have not yet been thoroughly researched, and the level of success of this approach in terms of distribution of benefits undoubtedly needs further study. At present this approach is thought by many forestry professionals to be a cost effective and 'fairer' model for forest management, than systems which rely only on overstretched and inefficient state forest management. Many countries are moving towards greater empowerment of local communities over forests in this belief. But in welcoming this major shift towards 'participatory forestry', it is as naïve to conclude that it will solve all deforestation problems as it is to think that it will necessarily be just and democratic at the local level. The reality is that any financially attractive activity at local level is potentially subject to appropriation by those with power and influence, and the fact that such an activity bears the label 'community' is not in itself any guarantee that the benefits are widely distributed. Undoubtedly there are many unresolved conflicts and inequities in many cases of community based forest management, not least in the area of gender (Locke, 1999; Sarin 2001).

If CBFM is directed towards carbon harvesting in the future because this offers an attractive financial return, then equity issues certainly need to be addressed, both at the local community level, and in the question of who get what in the whole chain of the carbon market. Valorizing carbon means that the issue of carbon entitlements has to be settled. As Saunders et al (2003) point out, if carbon is considered a mineral, the precedent would be for the state to claim full ownership, while if it were considered a crop, then under normal property law it would be owned by the cultivators. There are likely to be legal struggles over this issue in the future, particularly in cases where the forest is still state property. This is not to say that management by local communities would then be out of the question, since they might equally well be paid for their services in 'nurturing' the carbon, rather than for the product itself, but the various modalities, and the economic shares, need to be considered.

This also means that rights to other aspects of forest property may be held up to the light, examined, and possibly clarified. This could lead to long overdue, real empowerment of local communities over forest resources, but at the same time, formalisation of local ownership may bring with it problems, and not necessarily be in the interests of the rural poor. What is 'the local community' and who speaks for it, are questions of enormous importance. In parts of West Africa, where there is a general movement towards decentralization, ownership of forest is being devolved to the local communes, but these are elected bodies which span several villages, while the groups that actually manage the forest under CBFM are at sub-village level. The question of who gets what of the profits harvested from the forest has not been resolved. With profitable carbon added to the equation the stakes are simply set to become higher, and the share going to the actual forest managers may get less rather than more. Moreover certain groups among the managers themselves may become marginalized or pushed out all together. The market is a powerful mechanism, but also a dangerous one as far as equity is concerned (Brown and Corbera, 2003). Smith and Scherr (2002) in recognising this suggest that conditions need to be made under which more equity can be achieved, but clearly the underlying rights to land, forest and to the products of land and forest have to be equitable, and the local organisation too, before any such arrangements could be made to work in an equitable way.

5. Transaction costs of CMFB carbon projects

The main reason for pursuing the valorisation of carbon in CBFM, apart from the fact that it might be an efficient and effective way to reduce atmospheric carbon, is that the market opportunity offered by carbon offset sales could, in principle, be used as a push towards better management of forests for a wide variety of other benefits, social and ecological. New CBFM initiatives would then be additional, in CDM terms, because it is precisely the carbon reward that makes them worthwhile from the community's point of view.

For carbon to be profitable to the community as a non-timber forest product however, the transaction costs associated with its 'harvesting' it would have to be considerably lower than the market price of the carbon[4]. These transaction costs relate to formulation of the activity as a climate project with a baseline, getting it approved as such, measuring and monitoring carbon sequestered, establishing the validity of these measurements through formal procedures of verification, marketing the carbon offsets, etc. These costs may be high, for carbon is a heavily controlled product. The bureaucratic steps involved – all of which have, in the end, to be paid for by the producer – will be many, complicated and expensive. As Brown and Corbera (2003) point out, the greater the number of stakeholders and actors in the process, the greater the danger of the control, and the profits, falling into the hands of powerful groups. For this reason it is important to consider to what extent the necessary activities can be carried out by the producers themselves.

Several studies have already considered the potential of CBFM as a carbon sequestration instrument and done some costing on this. For example, a team working

[4] The market price of carbon from forest will in any case be lower than from energy projects, reflecting its semi-permanence.

in Harda (Madhya Pradesh) established that teak and dry deciduous forest under community protection in Joint Forest Management (JFM) schemes sequestered 1 to 3 metric tons of carbon per hectare per year as a result of annual growth (Poffenberger et al 2001). Forest experts established this contemporaneously by comparing unprotected areas with those which were protected under a variety of different mechanisms including community based forest management The forest management costs vary according to management activity but range from $1 per ha to $100, so at the lower end of the scale the management activities could in fact be financed entirely out of the carbon income, assuming a market price of $5 per ton. But this does not take into account the carbon transaction costs. If the activities connected with these are carried out by experts, there is likely to be little margin of gain to the communities themselves. As Landell-Mills and Porras (1999) have pointed out, it is precisely the transaction costs that are likely to be the key factor in determining whether or not such forest management for carbon is financially feasible.

A parallel study in Adilabad (Andhra Pradesh) found that protection of coppiced shoots and seedlings resulted in storage of 5-7 tons of carbon per ha per year for degraded teak sites and 6 for mixed forest (Poffenberger et al 2002). The $60-$120 earned per ha would easily be sufficient to cover the overhead costs of forest management, although again the transaction costs were not calculated or included. In both the cited cases, the carbon measurements were made by experts, rather than local community people, and the costs of this were not recorded.

Other well-known projects related to carbon sequestration and community based CBFM in developing countries include the Noel Kampff project in Bolivia, where management costs were estimated at $1.25 per ton (WRI, 2002). In this project the transaction costs were partially estimated. For a 634,000ha area of mixed forest containing 118m tons of carbon, estimation of mean stock to +/- 10%, at 95% level of confidence, would require 81 sample plots and cost US$19,000; 5% accuracy would require 452 sample plots and cost US$108,000. Fixed costs (independent of sample size) would cost an additional US$140,000 (Chomitz, 2002). These costs are based on the assumption that professionals are involved in the sampling, with local assistants.

Unfortunately transaction costs for small projects which involve community groups are thought to be relatively higher than for industrial plantations which are more uniform in nature and under one owner, as well as having the advantage of economies of scale (Smith and Scherr, 2002). Chomitz concludes that the cost per ton of measuring carbon stored in biomass will be approximately inversely proportional to the size of the carbon sink (this follows from standard statistical theory). The cost for small, heterogeneous forest management projects could be exorbitant if done by fieldwork, especially if high levels of accuracy (e.g. 5% rather than 10% as in the case described above) are demanded. He suggests therefore that such projects might have to rely on standardized, benchmarked (default) values (Chomitz, 2002), but these are likely to be set at very conservative (unfavourable) levels. Of course it is also reasonable to expect that aerial and satellite imagery may in the future be able to offer considerable, and relatively cheap, data – which with ground-truthing (for example by local communities) might turn out to be a good solution for monitoring changes in forest biomass. But it is unlikely that remote sensing on its own will ever be sufficiently precise for setting up the initial baseline measurements, which is perhaps the most costly activity that has to be undertaken. Moreover ground truthing at least for spot sampling will always have to complement the use of remote data.

One possibility is that for this kind of project, which has many benefits beyond the carbon value, government should subsidise some of the transaction costs (Michaelowa et al, 2003). The Dutch programme for CDMs at present reimburses small energy projects for the costs of preparing the baseline, after an initial screening process, and other purchasers of carbon offsets might be willing to do the same for forestry projects with social benefits. The problem would be better solved however if the scale of the projects could be increased for example by bundling or by bringing many small CBFM instances under one umbrella project with one baseline and one certification process. Not only would this greatly reduce the overall transaction costs, it would simplify the process of marketing the offsets. Larger purchasers are generally only interested in larger projects, for example, the PDF looks only at projects producing carbon work €3m, or 50kT tons of CO_2 per year (Michaelowa et al, 2003), and in the future, as emission reduction quotas rise, one could expect that most investors will want to purchase in larger quantities. At present there is a specially ruling with simplified procedures for small LULUCF projects producing under 8 kT CO_2 per year, and this is very welcome in the first instance. In the long run, however, if carbon becomes a serious commodity on the world market, it is clear that such 'special cases' will be relegated to the margins.

The general conclusion from the small number of available studies of carbon in forest managements projects is that reducing the transaction costs is a necessary if not sufficient step for including CBFM under CDM in the future. Different methodologies with lower costs need to be tested and presented to the policy makers for eventual approval. One interesting possibility is to let the local population do their own measurement and monitoring. There is at least one example of a project in which communities have been involved themselves in measuring carbon savings (Tipper, 2002). This mainly involved agro-forestry and small farm systems in Mexico (the Scolel Te Project). Here a trust fund was set up with donor finance to buy carbon credits from farmers. The trust fund is managed by representatives of farmer cooperatives, a local research institute and the Edinburgh Centre for Carbon Management (foreign expertise). A local company does much of the day to day administration and technical work. Farmers produce their own plans for forestry and agroforestry, which are reviewed by the technical team, and sign a contract for the sale of the estimated carbon that is going to be sequestered. Most of the monitoring is done by the farmers themselves (reviewing farms in neighbouring villages), with only occasional and sample checking being necessary by the technical team (that is to say, the local company contracted for this). Although this situation is rather different from measuring carbon savings in an existing forest, it does indicate that village people may be motivated by the financial rewards of selling carbon, and competent in making carbon measurements themselves, following a quite elaborate field manual of procedures.

6. Research on reducing carbon transaction costs of CBFM

At this point the transaction costs for carbon in CBFM are not clear, and need to be investigated. A research project working towards this end has recently been funded by the Directorate General for Development Cooperation of the Ministry of Foreign Affairs of the Netherlands, under its programme for capacity building for climate change. The project is entitled "Kyoto: Think Global, Act Local – Action Research to Bring Community Based Forest Management Projects under the UNFCCC and the Kyoto Protocol". The lead institute is the Technology and Sustainable Development Section of the University of Twente (Enschede, the Netherlands), in partnership with ITC (International Institute for Geo-Information Science and Earth Observation, Enschede, Netherlands), ENDA Energy (Senegal), the Dept. of Geography, University of Dar es Salaam, Tanzania (UDSM) and International Centre for Integrated Mountain Development (ICIMOD) in Nepal. All of these institutes have been involved for years in research and training in community based forest management, and all recognize the opportunities that the international climate treaties potentially offer to this kind of approach. They are also interested in new technological developments, which could facilitate participatory monitoring by local people of different aspects of forest sustainability, including carbon uptake.

The aim of the research is to explore the potential for CBFM as an instrument both for carbon saving and to work towards justification of CBFM as an allowable strategy under the climate agreements when these are revised in the next set of international negotiations ("Kyoto 2", for the second commitment period). This would also involve building capacity in the countries concerned to justify and present such projects under the treaties, and contributing to the scientific and technical debate as regards the rules and regulations as regards eligibility.

6.1 Methodology

Logic implies that if CBFM is to be included as a climate mechanism, a body of evidence needs to be built up to demonstrate its value and show that it can operate within the climate conventions. In particular:

- First, it needs to be seen whether community based forest management does in fact result in higher levels of carbon held in the forest ecosystem in the form of above ground biomass, leaf litter and soil, and root stock compared to unmanaged forest, what quantities are sequestered per annum, and what aspects of management are most responsible for this
- It needs to be shown under what circumstances this means of sequestering carbon is cheaper than other means or than the market price for carbon (otherwise CBFM will not be able to compete in the market for carbon)
- It needs to be shown that the CBFM has considerable development benefits in addition to the carbon saved (ie meets criteria for sustainable development)
- Reliable methods need to be developed to estimate and to verify such carbon savings and other benefits, and these methods should be as cheap as possible to use, otherwise the transaction costs may put CBFM carbon out of the market.
- The relative cost of communities themselves gathering the valid and reliable data and preparing inputs to the project proposal, need to be assessed, compared with the same work being done by professionals. These costs will vary depending on the ecological and physical conditions (variability of the forest, topography etc). The costs of this kind of data collection represent part, but not the full transaction costs, which would also include a number of tasks which are unlikely to be carried out by the communities themselves, such as preparation and submission of proposal, verification etc.
- The impact of carbon management on other aspects of forest management and the effects of this on the community, in other words the opportunity costs of the carbon management, needs to be monitored.
- The institutional arrangements and implications as regards rights to carbon ownership need to be investigated. Under what conditions might communities themselves be the 'owners' of the carbon, with what implications; alternatively, communities might be seen as providers of an environmental service (saving carbon), and compensated financially for this, with the carbon rights remaining with other actors (private organizations or governments). Questions also arise as to what kinds of intermediary organizations would be needed to set the project up, and to support the process technically (performing roles which the

community may not yet be in a state to do itself, such as preparation of baselines etc and to arrange for independent validation). Questions also arise with regard to how to bundle independent, small scale CBFM projects together so as to achieve economies of scale in transaction costs, and the implications of this for autonomy, ownership, distribution of benefits, and overhead costs.

The first conceptual step that the research has taken is to recognize that CBFM is not one activity but a combination of many and each may have a different effect (positive or negative) on the carbon balance. Apart from different silvicultural operations, there are other activities which need to be examined. For example, fencing to keep out cattle may protect saplings from trampling even though fodder is removed from the forest by hand. Many CBFM programmes are accompanied by improved stove campaigns, which may also reduce forest offtake. Efforts to introduce improved charcoaling technology, as in Senegal, may also have their carbon impacts. Such activities have been grouped into three categories: those that reduce the ongoing rate of degradation of forest and of deforestation itself (ie which slow or stop the loss of biomass); those that increase the stock of biomass (ie above its current level) and those that have the effect that sustainably produced woodfuel is used as a substitute for fossil fuels.

The research is now testing whether community participation in data gathering, based on local knowledge and local perceptions of sustainability, standardized forest mensuration methods, and an electronic database which uses other sources eg basemaps and remote sensing data, would provide a cost effective and reliable data system. Earlier research in related fields has demonstrated that local communities are able to use hi-tech methods such as lap-top based GIS, sequential photo series (wide-angled, hand-held), and a variety of electronic visualisation techniques to measure, record and display various environmental indicators (McCall, 2002). There are both ideological (Thrupp, 1989) and practical (Warren, 1991) reasons underlying the promotion of this kind of approach. Use of such technology by local communities is developing rapidly and there are increasing numbers of examples of participatory applications using hand held computers in watershed management (Gonzales, 2000), land management (Foster Brown et al, 1995), customary land mapping (Sirait et al 1994), studies on trees outside the forest (Rocheleau and Ross 1995) as well as in forest management (Jordan and Shrestra, 1998).

On the basis of these kinds of findings, the Kyoto, Think Global, Act Local project research team is working with hand-held computers, which operate by touch. They are equipped with GIS and GPS facilities which are intended to enable mapping of the forest areas by people with no basic training in mapping or surveying. The computer is also equipped with a tailor-made database programme for the input of data from forest sample plots. This data concerns standard forestry measurements such as *tree diameter at breast height*, which can be used with allometric tables to derive the above ground biomass of the trees, and thus ultimately the carbon stock of the forest. The database also allows inputs on weights of shrub and herb vegetation taken from sampling quadrats, which can also be translated into carbon values. The results of field experiments in which local community members with 4 to 7 years of primary education use this system, are described in Box 1.

The assumption behind the research is that much of the data gathering work can be carried out by the communities themselves, after brief training, although technical back-up support will be necessary (e.g. programming the computers and inputting the base map, possibly recharging the computer batteries, and certainly dealing with them when they fail for one reason or another) . Other procedures that are beyond the scope of the community (e.g. preparation and submission of project proposal, validation and certification) would in any case require outside agents or brokers or independent bodies. Because of economies of scale, such activities would require bundling of many community forest management areas into one umbrella project for carbon purposes. However, the monitoring of and reporting on carbon sequestered are tasks which, according to the results of field testing, could easily be carried out by the community themselves a much lower cost than if done ‘professionally’, since the carbon sequestered is a direct function of the increased biomass in the forest area. Steps would have to be taken to show that this increase in biomass is the direct result of the management activities and not an independent on-going process (additionality), by use of a control area, but in all probability this could be done in one or two areas for the verification of carbon gains of many community forest management areas under one umbrella project.

6.2 Field results so far

At the local level, research is taking place in communities which are already undertaking CBFM under a variety of schemes. Two sites are included in Tanzania, one in Uganda, two in Nepal, two in Himalayan India, one in Senegal and two in Mali, with the possibility a further one in Burkina Faso.

The aim has been to measure the sustainability of on-going CBFM projects (in ecological, economic and social terms), and to make an assessment of the carbon that is saved (sequestered) by these activities. It is necessary not only to establish the carbon baseline but also the *change* in carbon level over time. Working with the groups (usually NGOs) that are backstopping CBFM activity at the grassroots level, the first step is to determine what indicators local people (or particular groups within the community) use in assessment of forest sustainability and health. Studies carried out for example in the Usambaras of Tanzania (Mapande, 2003) indicate that such indicators do exist and can be formalized, even possibly quantified. The main advantage of local indicators is that these often give very clear indications of differences of forest types/forest conditions within a given geographical area, and if such indicators can be shown to be consistent, this would very much simplify any forest sampling procedures. Such classification can also be correlated with remote sensing and aerial data. The idea is to combine such local knowledge with accepted forest science method when it comes to estimating the biomass stock.

Once an overview of the different types of forest present has been established, the total area of forest and the sub areas within it are mapped by boundary walking using the GPS function on the hand held computer. Despite some problems as regards getting GPS signals in heavy forest areas, this exercise generally creates no problems for local people. The trajectory walked is immediately visible to the user on the computer screen, superimposed on any basemap or aerial photo which has been installed. When the circuit around a particular forest area is complete, the computer is able to calculate the area immediately.

Biomass stock assessment is done using standard forestry methods (dbh measurement and allometric tables).   Following IPCC Guidelines (IPCC 2003), based on earlier work by MacDicken (1997), a sampling framework involving a random start point for a systematic grid is being used to located permanent sample plots within the community forest areas, stratified where necessary. The number of permanent plots required is calculated on the basis of the standard error of a limited number of pilot plots (which are also the plots used during the initial training session). The locations of the permanent sample plots, are measured out by local people, using measuring tape.   The handheld computer, with its geo-referenced GIS data in combination with its GPS, enables careful plotting of the locations of the permanent plots and immediate entry of the data on tree parameters and other vegetation weights (see Box 1). These tasks are not in principle difficult and do not require computer literacy (or even, necessarily, much conventional literacy).

The cost of such an exercise depends on the sampling intensity in space and time (and thus also on the variability of forest conditions). The reliability of the data produced (and the cost of the alternative) will be tested by independently contracting such work out to established professionals as a 'control test'. Assessment of the development impacts of the local forest management can likewise be made on the basis both of local (internal) indicators measured by local people and 'scientific' indicators measured by independent, outside researchers.

In the first phase of the project, work with the villagers was done on an experimental basis, and the individuals involved were paid the going daily wage rate for participation in what was regarded as a research exercise. However, in the next phase, participating villagers will be paid by the research project on the basis of the quantity of carbon actually saved, using project funds. Under these circumstances there will naturally be a temptation to exaggerate gains, but the villagers will be aware that controls are in place, with professional teams doing unannounced spot checks from time to time.

Box 1: Using hand-held computers for carbon assessment in the E. Usambaras, Tanzania

A number of village forest reserves have recently be established in the area around the Amani Nature Reserve in the E. Usambara mountains of Tanzania. In the Handei Village Forest Reserve, villagers, with technical help from forest officers, have drawn up management codes and practices to preserve these forest areas and have full rights over the products, which are now being harvested on a sustainable basis. In fact, the primary motivation of villagers is the preservation of biodiversity because of the potential of earnings from eco-tourism in this area. Tourists wishing to walk in the forest are accompanied by local guides pay a fee, most of which goes into a community fund.

Villagers fully appreciate the potential of marketing carbon as a by-product of their management activities. A group of 6 members of the Village Forest Committee, none with more than standard 7 education, were involved in a participatory technology evaluation regarding the hand-held computer technology for carbon assessment. First, standard forest inventory technique was explained, and an exercise carried out in which sampling plots of 10m radius were established, and all trees greater than 5 cm dbh were measured, and recorded, with species name (local terms), in an exercise book. Measurements of smaller trees were made on subplots and quadrats were used for undergrowth.

Then, hand-held iPAQ computers (about 15cm by20cm) equipped with the GIS system ArcPad and with Navman GPS were used by the villagers after a very short training, to mark the boundaries of the forest area, on a O.S. base map which had earlier been scanned into the computer. Boundary mapping requires simply walking around the margin of the forest and marking each turning point using a stylus on the touch screen. No understanding of mapping principles or computers is necessary for this task. Secondly, the villagers used the GPS function to navigate to the sample plots. This enables monitoring to be done at intervals on the same site, without having to mark the site visibly on the ground. The task involves simply lining up the ‘compass point’ on the screen with the direction arrow, while walking.

Finally, data on individual trees in the sample plot (species, dbh, height, condition) was entered onto a pre-installed pull down form, using a touch keyboard on the screen. Villagers had no difficulty entering this data using letters and numbers.

The main difficulties encountered had to do with hardware problems – the GPS system did not function well in some cases – and with the fact that the computer screen carries a large number of functions unnecessary for the tasks required for the exercise (the machines are essentially Pentiums with all the functions of a normal office computer), which was unnecessarily confusing. For example, the ‘zoom’ function, if hit by mistake, could make one’s position on the screen disappear! Clearly, technical backup is necessary to maintain these computers, and to install the necessary base maps etc. Nevertheless, the exercise showed clearly that villagers without any prior understanding of computers were easily able to use them for a number of tasks associated with carbon monitoring. Moreover, the potential of the device for other purposes – for example, in mapping village boundaries – was immediately perceived by themselves.

7. Discussion

The primary purpose of the field studies is to assess to what extent some of the transaction costs associated with CBFM as a CDM could be reduced if reliable data were to be gathered by local community people using high tech instruments, rather than by professionals. The hypothesis is that considerable cost savings can be made without undue loss of reliability, and various aspects of this will be studied in the research sites over the next four years.

There are however a number of other broader concerns that need to be taken up as spin-offs from the research.

(1) Carbon is only one of the many environmental services that local communities provide for the greater public in managing their forests. Other services include biodiversity protection and watershed conservation, and like carbon up to now, the work that these services involve, and the opportunity costs of alternative, foregone activities, are not rewarded in financial terms. There are no mechanisms available, no systematic funds, and no market for this. The case for the valorization of carbon may be seen as a test for the later valorization of other forest services in the future. The kinds of techniques used for the measurement of carbon could easily be adapted for data collection on other environmental indicators, and potentially make it possible for communities to take charge of the monitoring that would be required.
(2) The case of carbon raises interesting questions regarding ownership and empowerment. The forests concerned are in most cases considered property of the state, although in some cases the land has in fact been legally turned over to the local people. If carbon becomes a profitable commodity, it is likely that there will be juridical questions regarding its ownership and control of this product. There are two views on this: the one that predicts that control will be claimed and taken over by the state, and the one that predicts that it will be won by the local communities (the situation may vary from country to country). Either way it is bound to bring to the fore a major debate on carbon entitlements. This will inevitably bring with it a much needed debate also on the rights to and obligations as regards forests and their management in

the more general sense. Clarification of the rights of forest dependent people is long overdue, although bringing up this debate is not without its risks, and it is in no way a foregone conclusion that local peoples rights will be fortified everywhere.

(3) The question of who gets what at the local level needs to be carefully monitored, especially as the stakes increase. The market brings with it great power which may be used for preservation of forests, and for generation of income earning possibilities, but also the risk of increasing inequalities at the local level. This needs to be carefully monitored, and ways and means of ameliorating the situation by building in conditionalities need to be considered.

(4) At the same time the question of who gets what at different scales needs to be considered. The purpose in reducing transaction costs is to ensure that a reasonable chunk of the profit remains with the carbon producers, that is, the local people who manage the forest, but inevitably they will receive only a part share as there are many other actors involved in the whole carbon marketing chain. The bundling of different CBFM groups under umbrella organizations will be essential for economies of scale in this marketing but it will reduce the autonomy of the local group. The success of this may depend on the transparency of the umbrella arrangement and the trust that develops between these levels, but also on the share that each level takes of the profit. Then there are other levels to be considered: the national body that approves the project, the certification and verification service, the brokers cut, and the fees to the CDM Executive Board. The profit levels at all points in the chain needs to be analyzed and understood if the long term chance of CBFM as a CDM option is to be properly assessed.

(5)A further interesting aspect concerns whether the use of high tech means of gathering and transmitting data on carbon sequestered, increases its credibility. Electronic storage of data undoubtedly reduces paperwork and the risk of transmission errors, and much speeds up the process. In the past, rural communities have not been able to participate in international deals, not least because of the absence of any real line of communication; their knowledge and information have therefore been ignored. Will the use of electronic databases raise the status of the locally generated data such that it will be accepted as scientifically valid? Could this usher in a new era in which marginalised rural people are able to enter the world conversation? Or will doubt about the capacity of local people to perform essentially scientific measurements, and traditional information/power relationships prevail, despite the technological leapfrog?

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