

# **Community Based Forest Management as a Climate Strategy (with carbon as a non-timber forest product)**

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## **Abstract**

Under the Kyoto Protocol, forestry is permitted as a sink measure under the Clean Development Mechanism (CDM), but only in the form 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 only limited benefits to local populations. Many communities in developing countries however transform unsustainable management of existing natural forest, to sustainable management, under a variety of programmes such as JFM and CBFM, which are unrelated to climate change. This type of management does result in additional carbon sequestration, but credit for this cannot be claimed under CDM.

One of the reasons for not recognising the sink capacity of community based management initiatives is undoubtedly the difficulty of measuring the carbon saved, and various uncertainties such as leakage and permanence. There are strict rules about how carbon can be measured and rigorous data will be a prerequisite if such projects are to be accepted under the climate convention. However the cost of employing professional scientific methods to gather and process such data (the so called 'transaction costs') are likely to be prohibitive, meaning that any financial gains by the community as a result of 'selling' their carbon, will be wiped out. The trick is then to find techniques which can at least partially be carried out by the communities themselves, at a much lower cost, and to demonstrate that these are as reliable as 'expert' methods.

A research project carried out by the University of Twente, ITC and three regional research institutes (in Nepal, Tanzania and Senegal) 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. 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 begin to open the way for these communities to supplement their forest based livelihoods through the 'sale' of their carbon as a non-timber forest product in the future

## **1.Introduction**

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. In particular afforestation and reforestation projects may be supported, which will yield carbon credits to the investing party. Such projects, even if they do not promote monoculture, which is an obvious danger, will have a tendency to be large, low labour input schemes owned by companies or formal organisations. Moreover there is a risk that if they prove to be competitive in carbon terms, considerable areas of land (whether 'waste' or agricultural land of low value or productivity may be converted to carbon-dedicated tree plantation and alienated from use by local populations for other purposes for 60 years and more. Existing forest areas will not be included<sup>1</sup>.

This paper describes a research project, which is concerned with increasing the prospects of other sorts of forestry under a CDM-type mechanism. In particular the research is exploring the potential for projects involving community based management of natural forest (CBFM) to market the additional carbon which is sequestered as a direct result of their other management activities. This means international marketing, either in the form of CERs under the Kyoto agreements, or through the so called 'non-compliance market' that is to say, to companies or organisations which are striving to promote sustainable development or to improve their green image and are willing to

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<sup>1</sup> Here the definition of 'forest', which has still to be agreed, is important. If for example the definition is 'land use with more than 30% crown cover of trees' then heavily degraded forests which by 1990 had already fallen below this threshold, are probably included.

invest in carbon reducing projects even if these are not officially approved by the UNFCCC<sup>2</sup>.

In such a CBFM system, carbon would be only one of many products marketed by the community, and probably not the most important or the most valuable. Most forest products have low commercial value, and some forest values are at present not rewarded in money terms at all. For this reason 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. CBFM initiatives are an attempt to encourage communities instead to protect the forest. The community might consider managing forest for a variety of purposes – for marketable products such as sustainably produced firewood, for mushrooms, flowers, butterflies or honey etc; for values which are not at present directly rewarded in money terms, such as biodiversity (e.g. to encourage eco-tourism), or for water catchment. If carbon sequestration were to be rewarded in money terms, then this incentive might be just enough to tip the balance and encourage communities to engage in such management.

For carbon to be profitable to the community as a non-timber forest product however, the total costs associated with its ‘harvesting’ it would have to be lower than the market price of the carbon. These costs are the transaction costs related to formulation of the project as a climate project, getting it approved as such, measuring and monitoring carbon sequestered, and establishing the validity of these measurements, marketing, etc. These costs may be high, for carbon is a heavily controlled product in the sense that it

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<sup>2</sup> UNFCCC is the United Nations Framework Convention on Climate Change, set up in 1992. The Kyoto Protocol was adopted by the international community in 1997 and commits the developed countries (‘Annex 1 countries’) to reducing their greenhouse gas emissions by fixed amounts and dates.

has to be certified, following strict rules established internationally by the UNFCCC.

The bureaucratic steps involved – all of which have to be paid for by the producer - are many, complicated and expensive.

Many of the procedures that would have to be followed for carbon certification are at the moment beyond the scope of community skills and would require outside agents or brokers (eg preparing project proposal and submission of this to UNFCCC), and some require independent bodies to be involved (validation of the estimates of the carbon saved). Such activities in any case would have to operate on a scale much bigger than that of a typical community forest management scheme, and would probably 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, the researchers believe, could easily be carried out by the community themselves at a much lower cost than if done ‘professionally’, since the carbon sequestered is a direct function of the increased biomass in the forest area as a result of forest management activity. The constraint is only that the measurements of the increased biomass must be valid, reliable and replicable, and transmitted in such a form that confidence in such measurements is assured.

The paper describes the aims and conceptual basis of a research project recently funded by the Directorate General for Development Cooperation of the Ministry of Foreign Affairs, under its programme for capacity building for climate change. The project started in January 2003, and is planned as a five year study, although finance has for the time being been secured only for the first year.

## **1.1 Nature of the research project**

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, in partnership with ITC (Enschede), ENDA Energy (Senegal), the Dept. of Geography (U.DSM) and ICIMOD (Nepal). All of these institutes have been involved for years in research and training in community based forest management<sup>3</sup> 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 starting point is that under the climate change treaties, forestry is recognized as a means of combating global warming. As Landell-Mills and Porras (2002) point out, there are several ways in which forest can play a role in this: through afforestation and reforestation to increase carbon sequestration; through improved forest management (eg reduced impact forest logging) both to increase sequestration and to reduce emissions; through conservation and protection against deforestation, to cut emissions, and through substitution of sustainably produced biomass for fossil fuels to cut emissions. However the eligibility of most of these forms of forestry under the Clean Development Mechanism (CDM), the instrument which applies to investment in carbon saving in

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<sup>3</sup> There are many types of community based forest management varying from autonomous, traditionally based systems to collaborative efforts in partnership with state or private organisations, to top-down management systems in which local people are essentially just labourers. At this stage we are not distinguishing between these various forms but use CBFM as a general term to cover all.

developing countries, is very limited<sup>4</sup>. Only *afforestation* and *reforestation* projects are currently admitted (thus not management of existing forests, whether by communities or any other agency). Forest management in developing countries might also qualify for funds as an *adaptation*<sup>5</sup> mechanism, but the conditions under which it will be admitted to this are not yet clear.

The aim of the research is to explore the potential for community based forest management of existing forests (CBFM) as an instrument both for carbon saving and for adaptation, and try to justify CBFM as an allowable strategy under the climate agreements when these are revised in the next set of international negotiations (“Kyoto 2”, which may take place around 2008). This would also involve building capacity 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.

The research has considerable ramifications as regards the whole prospect of ‘ownership’ of climate projects and of forest resources. If local communities, either individually or in the form of federations, are able to submit their forest management plans for climate finance, all be it with the assistance of intermediary organisations, this implies considerable changes in the status quo or power balance in forest management. Greater empowerment of local communities in managing their local resources, and greater returns to them, is without doubt one of the underlying aims of the research. A

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<sup>4</sup> Various forest management activities are permitted in developed countries to reduce carbon, but not in the developing countries under CDM, as they do not have carbon reduction quotas or national baselines as regards their total sink capacity.

<sup>5</sup> Adaptation projects are those which help a county adapt to the inevitable effects of global warming and having nothing to do with carbon saving as such. They will be funded largely by a 2% tax on all CDM projects, and are primarily intended to provide finance for projects such as malaria prevention, building dykes as flood protection, waters conservation etc.

lot of interesting questions arise as regards in what forms and within what framework this could develop, and what sort of collaborative arrangements are possible/advisable. Would the communities be the ‘owners’ of the carbon saved, or would they simply be hired in for their environmental services/labour in producing, measuring and monitoring it? Most importantly, the question of who gets what share of the profits needs to be seriously considered, and whether the ‘crumbs’ left for the community after all the other agencies have taken their fees, make the endeavour worthwhile (Bosello and Roson 1999).

## **2. The theoretical potential of CBFM as a climate strategy**

By ‘climate strategy’ is meant a form of intervention that in some way relates to dealing with the problems of global warming and which could on these grounds claim funding from international financial sources for this. The main opportunities at the moment are the Clean Development Mechanism (CDM) and Adaptation Funds, although there are some other smaller ‘experimental’ funds, such as the BioCarbon Fund, and the Community Development Carbon Fund, which might be applicable for CBFM projects. In addition there is some potential for ‘non-compliance’ financing, that is to say, direct finance through private organisations looking for ‘green’ projects but not necessarily for carbon reductions certified by the UNFCCC.

Despite the fact that the Kyoto Protocol yet to be ratified by a quorum of the UNFCCC members<sup>6</sup>, quite a number of CDM projects are being started, funded particularly by the

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<sup>6</sup> To be internationally valid, it has to be ratified not only by 55% of all UNFCCC members (this has been achieved already) but also by enough Annex 1 countries so that 55% of all carbon emissions are covered. This was not yet achieved at the time of writing; at present the Annex 1 signatories account for only 44%

Netherlands (the CERUPT programme) and the Prototype Carbon Fund (funded by a number of Annex 1 countries including the Netherlands and managed by the World Bank). Neither has funded any sink projects as yet<sup>7</sup>. Two small funds (the BioCarbon Fund and Community Development Carbon Fund, also managed by the Bank) have just opened with a view to encouraging and offering an opportunity for experimentation small scale projects. The requirements for these smaller funds are much less stringent, particularly in terms of what is required of the project proposal. However, in the long run CDMs will be financed by commercial concerns as governments pass on their 'carbon debt' to their own industries and as these in turn look for cheap ways of saving carbon. Thus if CBFM is, in the long run, to have any chance to benefit on a large scale from such finance, it will have to meet the full demands placed on sink projects.

## **2.1 The Nature of Community Forest Management**

Community forest management, as an 'intervention', i.e. on a project basis, of course long predates the carbon issue<sup>8</sup>. It was started as a means of reversing degradation of natural forests in developing countries while at the same time providing local communities with greater returns (Poffenberger 1990; Hobley, 1996, Agarwal and Ribot 1999). State owned natural forest is contracted out to local communities, which then have exclusive rights to harvest products under a management plan, which ensures that the rate of harvesting does not exceed the rate of natural regeneration. In Africa this is mainly being applied in the context of fuelwood supply around major cities (Kerkhof,

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of the carbon. The USA, which emits about 20% of the global total has refused to ratify, but it is hoped that Russia will do so later this year, which will just tip the balance over 55%.

<sup>7</sup> The PCF has one project involving plantations, but this is to substitute charcoal for coal in iron production (in Brazil).

<sup>8</sup> 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-inforce it.

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 minor forest products (MFP) 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). The long term impacts of these programmes and their level of success in terms both of forest health and of distribution of benefits undoubtedly need further study, for there may certainly be some questions about whether the management is in fact actually resulting in 'sustainability' in both ecological and social terms<sup>9</sup>. However, at present this approach is thought by many professionals to be a cost effective and 'fairer' model for forest management, than systems which rely only on overstretched and inefficient state forest management.

Although it should result in considerably increased tree cover, and thus in increased sequestration of carbon, this type of forest management (in contrast to the creation of carbon sinks by new plantation of forest) has, as noted above, not been accepted under the Clean Development Mechanism rules of the Kyoto Protocol, which is the largest source of funding available to projects in developing countries under the climate treaties, by far. Should this decision be reversed, large amounts of funding could become available to support more community based forest management projects and benefit many more poor rural people, since in addition to the benefits they already gain from CBFM through the harvesting and sale of fuelwood, bamboo, forest fruits etc they

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<sup>9</sup> Undoubtedly there are many unresolved conflicts and inequities in many cases of community based forest management, not least in the area of gender. Studies are slowly beginning to emerge which throw more light on such issues (e.g. Locke, 1999; Sarin 2001)

would also be able to ‘harvest’ carbon. It is a further incentive, moreover, for protection of forest.

## **2.2 Why CBFM was not included in the CDM**

There are several reasons why CBFM was not included in the CDM rules as decided at international climate meetings in Bonn and Marrakech in the last few years. On the political side there was considerable controversy over whether sinks should be allowed at all, since this was rejected on grounds of principle by the environmentalist movements but strongly lobbied for by a number of Northern countries including the USA and Australia. One good reason for including sinks is that deforestation is itself responsible for 25% of all global carbon emissions. Sinks offer a much cheaper and easier, if temporary, solution to the build up of atmospheric carbon compared for example with the development of highly efficient automobile engines let alone restructuring of national economies so that they are less automobile dependent. The compromise – which was reached under great time pressure at the meetings – was that sinks would be allowed, but only in limited amounts<sup>10</sup>.

At the same time there are considerable technical problems related to inclusion of sinks under CDM, and of forest management in particular. It must be understood that financing for carbon projects is made on a per ton basis; Northern countries finance carbon projects in developing countries in order to reduce their own carbon debt, and generally a tendering system is in place. Projects wishing to obtain investment on the basis of the carbon they are going to save or sequester, have to demonstrate in very real

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<sup>10</sup> It is ironic that the US having achieved this victory in the international negotiations subsequently pulled out of the Kyoto agreement entirely.

terms exactly how much carbon will be saved, at what per ton cost. The procedures for estimating such (future) carbon savings and for verifying the ‘carbon offsets’ that they have in reality been achieved, are going to be very rigorous and based on scientific theory and technically approved measurement methods<sup>11</sup>. This is because the investing country needs ‘proof’ that it has reduced its carbon debt by a given amount. While the carbon held 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 an existing (mixed species, mixed age) forest is brought under community based forest management 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, and CBFM as a particular form of forest management, is to be accepted in the next round (2008).

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 forest management of existing forest is allowed in the future – after all, enrichment planting and replanting are valid practices which may be conducted in the best

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<sup>11</sup> The issues of *permanence* (the fact that carbon is not permanently removed from circulation by sequestration), *additionality* (the effects of the project must be additional to what would have happened anyway), *leakage* (the effects of the project must not be offset by its impacts elsewhere) all have to be dealt with. Projects also have to demonstrate that they contribute to *sustainable development* locally.

and most sustainable forest management 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. There would certainly have to be some controls and enforceable codes of conduct regarding forest management practices employed under CDM, but to develop a fair and workable system is clearly very difficult and will undoubtedly keep foresters and climate negotiators busy for years.

As regards the potential for finance of CBFM under the adaptation funds, the rules at present state only that projects have to demonstrate that they help a country to adapt to the conditions which climate change will inevitably bring (ie this has nothing directly to do with carbon or carbon saving). Better managed forests can clearly contribute to such adaptation for example by moderating local micro-climates, as watershed protection etc, and also by providing additional livelihoods for people when their primary means of support are threatened, for example where agriculture becomes more uncertain due to reduced reliability of rainfall, or where certain crops can no longer be cultivated because of changes in temperature. However, in order to claim such funds, CBFM projects will have to justify themselves on the basis of such arguments, in quantitative terms. As yet no forestry projects have been able to successfully make such claims. Here again there is a need for capacity building and methodology development, and no studies are known to have tackled this question.

### 2.3 Earlier research on CBFM for carbon sequestration

This is not the first piece of research to have addressed the potential of CBFM under the climate treaties. For example, a team working 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. On the world market, carbon is currently valued at between \$10 and \$20 per ton. The forest management costs (that is, overheads incurred by the Forest Department) 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. This does not however take into account the *transaction costs* (which include development of a CDM project proposal, creating the baseline<sup>12</sup>, making the necessary carbon measurements of changes in vegetation on a periodic basis, reporting on these, etc). If such activities 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 the transaction costs that are likely to be the key factor in determining whether or not such forest management 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

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<sup>12</sup> The baseline estimate the amount of carbon that would have been sequestered in the forest *without* the project.

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 Kempff 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).

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 (so-called '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 the best solution. It is in any case clear that much of the cost is start up cost – determining the baseline, submitting the project as a CDM or other carbon related investment – and that regular monitoring may be less costly.

The general conclusion from the small number of studies that have already been made is clear. It is evident 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 under the Kyoto regime for eventual approval.

It is also worth mentioning that there is at least one example of a project in which communities have been involved themselves in measuring carbon savings (Tipper, 2002). This was not in community forest management, but in agroforestry 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. Interestingly, 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. 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.

### **3. Methodological approach to the research**

Logic implies that if community based 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, 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 development benefits in addition to the carbon saved
- 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 necessary data and preparing inputs to the project proposal, need to be assessed, compared with the same work being done by professionals
- For adaptation projects, it needs to be shown that development benefits associated with CBFM can help people to adapt to changing climatic conditions
- The institutional arrangements and implications as regards conditions under which communities might themselves be the ‘owners’ of projects – rather than just the subjects of projects, responsible for cheap data gathering – need to be considered. What kinds of intermediary organizations would need to be involved and what would their roles be? What sort of sharing arrangements could be considered among different stakeholders (community, state, other users)?

The first conceptual step that the research takes 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 testing whether community participation in data gathering, based on local knowledge and local perceptions of sustainability, combined with other sources eg from 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 Shrestha, 1998). In such exercises, it is important to understand that knowledge, and its translation via such media, may not be universal but may be 'captured' by some groups (for example village elites, or NGOs), and the implications of this need to be observed<sup>13</sup>. One underlying purpose is to assist people to connect their own perceptions and understandings of local situations to outside demands for information,

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<sup>13</sup> At a presentation of an earlier version of this paper, a comment was made by an experienced Indian researcher to the effect that we had better stay right out of the business because "as soon as it is shown that there is any money to be earned from carbon in the forest, it will just be taken away from the forest-dependent people: please just go away with your carbon idea!". There are undoubtedly such dangers in some settings, but it is our belief that although undoubtedly there is still much to struggle for, these kinds of interventions, which are internationally visible, will in the long run strengthen the rights of local people over forest.

and to make use of these technologies to 'legitimate' ITK outside the local area.

Another is simply to lower the transaction costs associated with community based forest management projects. A third, longer term purpose is to consider whether these kinds of data collection schemes could lead on to more empowerment of people over their forests. Such empowerment is, of course, a process, which is at different stages in different places, for example in Nepal there has been more and more community control over forests over the last 20 years. Providing high tech means to map forest areas and record biomass increases to the communities may strengthen this process.

Thus while the general aim of the research may be to enable community based forest management projects to access funds under the Kyoto regime, the concrete outcome which we hope to reach is *convergence of technical and scientific requirements and local level knowledge and skills regarding CBFM under the Kyoto regime*, and the short term objective or purpose is *identification of potential methods to enable cost effective monitoring and evaluation of carbon and development impacts of community based forest management*.

### **3.1 Hypotheses**

The research hypotheses being tested include:

- Community based CBFM results in higher levels of carbon sequestration than unmanaged forest
- The costs per ton of carbon are equal to or less than those of reforestation and afforestation schemes

- Community involvement in the gathering of data on carbon and on other development indicators can considerably reduce the transaction costs
- Indicators which are based on the community's own sustainability indicators will give reliable, cost effective information
- Use of handheld electronic equipment will facilitate the communities' collection and storage of data, when combination with existing sources such as satellite images, and enable them to present such data effectively and at low cost
- The use of such electronic equipment will increased the ease with which projects can claim climate status (both by simplifying the flow of information, and by increasing the perceived reliability of such information)
- Such information can be used to change international policy in a positive way as regards the acceptance of CBFM under the climate treaties
- Communities will be able to retain at least part of the profit if transaction costs are lower than the market price of the carbon saved.

### **3.2 Research procedure**

At the local level, research is taking place in communities which are already undertaking CBFM under a variety of schemes. Two sites have been identified in Tanzania, one in Uganda, two in Nepal, two in Himalayan India, one in Senegal and it is hoped that two more will be taken up in Mali, with the possibility a further one in Burkina Faso.

The aim is 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, since for the assessment of carbon sequestered by above ground biomass in the forest, an accurate measure of change in volume of plant matter is required. Ideally changes in soil thickness should be measured, since it represents usually one third of all carbon stored in the forest.<sup>14</sup> Biomass stock assessment can be done using standard forestry methods (dbh measurement and allometric methods). Sampling systems are based on preliminary forest classification by local indicators. Locations of transects and/or sample plots are being identified by local people. A handheld computer, in which remotely sensed, geo-referenced GIS data has been installed, in combination with a GPS, enables careful plotting of the locations of the transects and immediate entry of the data on tree volumes (see Box 1). These tasks are not in principle difficult and do not require computer literacy (or even, necessarily, 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 this way reliability and cost comparisons can be made.

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<sup>14</sup> The role of soil carbon in forests may be of very great importance, since loss of soil – for example, by deforestation and subsequent erosion – may result in the release of vast quantities of carbon into the atmosphere. If this factor were to be properly accounted for, the carbon value of avoided deforestation would be seen to be much higher.

**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 the DFO and the ANR, 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 from 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.

## **4.1 Discussion**

### **4.2 Complications that need to be dealt with**

The question of reducing transaction costs is central: the hypothesis is that community data gathering will reduce transaction costs. However, we have to face the possibility that this may not be so. The forest inventories that are carried out by Forest Departments are largely the work of low-paid employees, although the work is supervised by more senior and well-paid officers or by international consultants. It remains to be seen what cost savings can really be achieved by the community itself making the measurements and preparing the reporting that is necessary.

#### ***4.1.1 Baselines***

There are further, technical, difficulties. Establishing the baseline – the first step in formulating a CDM project - is not a simple exercise. In Kyoto terms a baseline is not just the state of the forest as it is now, but involves predictions about what would happen in the future in the ‘without project’ scenario – that is to say, the ‘business as usual’ case. There are various possible ways of doing this, one of which might be to make comparisons with areas that have earlier undergone the types of process (of deforestation etc) that could be expected in the planned project area. The alternative is to build models based on reasonable assumptions concerning ongoing processes related to the forest area. Obviously this sort of exercise may be fraught with difficulties, and no standard, let alone simple, methodology has yet been developed to cope with it. It is possible that *standardized baselines* might be accepted under UNFCCC guidelines, such that for a whole ecological zone, typical figures for the current biomass volumes, and for biomass volume under typical community management, are accepted. This would be quick and much cheaper than making individual project based baselines.

However, such benchmarks would be set rather low (conservative estimates of gains in carbon), to protect the investors, and they would not reward the best carbon management cases, indeed the incentive for good management is essentially removed.

#### **4.1.2 Leakage**

A further methodological hazard is *leakage*. One of the great difficulties is that carbon saved somewhere may be lost elsewhere, and if the two things are related, both have to be counted in the net carbon off-set calculations. For example, if cows are prevented from entering the forest, such that tree growth greatly increases, one has to take into account where the cows go to instead. If they simply relocate to graze in a nearby forest, then this second forest will be losing vegetative cover and this has to be deducted from the gains in the 'treated' forest. This problem of *leakage* is very difficult to deal with (and indeed is one of the practical problems that has dogged the whole issue of sinks and particularly of CBFM as a sink mechanism<sup>15</sup>). The jury is still out as regards whether inclusion of sinks in a country's carbon regime should involve a complete inventory and monitoring of all land uses everywhere within the nation's boundaries (over even beyond). It is possible that 'project boundaries' could be set up which do define the real limits of the carbon flux, by taking livelihood systems in given ecological and geographical systems as the basis for the 'boundaries' rather than the forest area itself. In fact, there is evidence that deforestation is relatively easy to predict as a function of road and market proximity, topography and agroclimatic suitability (Pfaff 1999, Deininger and Minten 1999, quoted in Chomitz 2002). Baselines would of course have to be constructed to cover the whole area affected by the project, not just

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<sup>15</sup> However, this is in reality not just a problem for forestry CDMs. As Chomitz (2002) points out, the same thing in principle occurs in energy projects, which are supposed to be immune from it: for example, the replacement of a coal fired electricity plant by renewable energy will lower the demand for coal at that location and thus also its price; thus increasing the demand (causing leakage) elsewhere in the economy. Econometric calculations show that such effects are by no means negligible.

the formal forest boundaries. It is hoped that the research will be able, on the basis of the case studies, to come up with some proposals as regards methodology to deal with these issues.

#### **4.1.3 Additionality**

A further question concerns *additionality*. As defined at present, a project can only get CDM status if it is additional – that is to say, if it would not have been funded or taken place otherwise. This is to prevent businesses from claiming saved carbon when they would have invested in the energy (and thus also carbon) saving equipment in any case, in the so called ‘business as usual’ scenario. Businesses do adopt energy saving technology on purely economic grounds and will continue to do so, and this cannot be counted for carbon-offsets. By the same chalk, if CBFM is self-financing already – without carbon finance – it cannot claim eligibility under CDM. The trick may then be to demonstrate that it is the carbon gains that make the whole enterprise financially viable. As noted above, it may be the promise of monetary rewards for carbon, that tips the balance for many communities, and makes CBFM a worthwhile enterprise, with many other - non-monetary, but positive - outputs, in addition

#### **4.1.4 What tasks could be done by the community itself?**

It is unlikely in the short run that communities themselves will be able to deal with all the data requirements that surround these kinds of issues. All we hope to show by the end of the first year is that involvement of community groups in the definition of sustainability indicators, and in the classification of forest types and conditions, and in use of PRA type methods for forest volumetric measurements and assessments on development indicators, short cut *some* of the procedures that have to be carried out in formulating climate projects. Also to show that such short cuts will considerably reduce

project transaction costs. This does not however rule out the possibility that by the end of the research period, we may be in a position to push the process much further, with a view to involving the communities much more deeply in the project formulation and monitoring, in line with the idea that communities themselves could in the long run become the owners and initiators of such climate projects. It is already clear from past experience with CBFM, and for exercises using hand-held computers, that communities learn rapidly when they see the intervention as being in their own interests.

#### **4.2 Uncertain effects**

We also hope to look at some of the (potentially negative) side effects of this kind of intervention. It is possible, for example, if carbon turns out to have a significantly higher financial value than other products which are harvested, that the nature of local forest management might change to maximize this, to the detriment of other goods and services. For example, there might be a loss in biodiversity if the regeneration of fast growing, carbon producing species are encouraged instead of larger, mature plants producing local medicines. This raises the question: who should have the ultimate right to decide the character of the forest and the character of the forest produce?

On the positive side of this same question, one outcome might well be that the electronic systems that we are introducing with a view to gathering data for the Kyoto requirements, might in fact lead to a much better control by the local community themselves in a more general sense, giving them the opportunity to use this data for other purposes than only the carbon question. It would provide simple mapping capability and a forum around which other issues could be discussed. This could open

the door to great advances in local and community ability in forest management in the more general sense, giving them the tools to optimise their own objective functions as regards forest products and services (creation of forest development blocks, etc).

Another factor relates to the fact that for any carbon agreement, a long term contract would have to be drawn up – a management strategy spanning a minimum of 20 years would have to be agreed upon, which would of course limit the options of local people, even if a fixed price for the carbon is agreed upon at the beginning, covering the entire period (which is not necessarily possible, but could be negotiated). The question is whether it is ethical to tie people now to a resource management practice which they may regret later. Possibly there could be provision (under an accounting system using temporary carbon removal units) that would allow more flexibility in this.

Then there is the question of who actually would benefit from the carbon finance that is gained. Would (mal)distribution of these profits strengthen existing power inequalities within the community, and is this any concern of the outsider? What proportion of the funds would actually come to the community in any case, would large amounts be creamed off by local or national governments or by other elites and what could be done to prevent this? And (*pace* Prof. Chopra, mentioned in footnote 12), what is the probability that the forest would simply be alienated from the local population if it did begin to bring carbon dollars? Further, if scale questions, and the fact that any one community's forest area is too small to justify the costs of carbon measurement, lead to some kind of federation of communities in one large CDM, what will this mean for local control?

Finally, a problem that has not been addressed is that carbon (in the form of carbon dioxide) is only one of the many greenhouse gases that will be affected by forest management activities. Burning of vegetation produces also nitrous oxides and carbon monoxide, while decaying vegetation produces methane. Any changes in forest management will also change the emission of these gases, but not simply in proportion to the total standing biomass volume. It is not at all clear how the change in the emissions (positive or negative) of these other gases could be accounted for.

#### **4.3 Subsequent research**

In subsequent years the method will be further tested on more case study sites, and refined. This however still leaves two hypotheses for testing; whether data flows using these methods and electronic equipment increase the probability that such projects actual gain funding from climate sources, and whether international climate policy as regards the rules and regulations on climate projects can be influenced by reference to the 'success' of such enterprises.

This implies that the research should include a study of the way in which international policy is made, the organizations and issues which change it and pathways by which it is influenced. There are both political bodies and technical bodies involved (Jansen et al 2003). The idea would be to identify the key players in this process and develop an understanding of what motivates change, before trying to influence this process.

An important factor is the fact that international policy is being made continuously but input from the South is limited and 'Southern interests' may be underrepresented, partly because of power imbalances but partly also because of lack of information (Gupta, 1997, Sokona 1999). Thus research also needs to take place to understand how the designated authorities in individual developing countries act in the process of climate change policy development, what their knowledge of the technical and political issues (on forest management) is, and how they bring this across. It is hypothesised that increased visibility of the benefits of CBFM, through data storage and presentation in electronic form, will increase not only the interest of these local authorities in CBFM as a viable carbon approach but more importantly their leverage as regards access to funding, and thus increase the regularity with which this strategy is advanced in the international debate.

Beyond this, there are many interesting avenues which the research may pursue. In how far can communities indeed not just act as data collectors for the formulation of a project that someone else will direct, but indeed take the reins themselves and 'own' the project? What are the implications of this as regards the other stakeholders (the state, other public interests, other users)?

Crucial here is the role of intermediaries – for it is clear that at least in the first instance, communities would certainly require support from outside organisations (whether state, NGO, or private). Many possible scenarios could be sketched for future arrangements, from ones in which the community collaborates with the state, with the state as the initiator and general overseer of the project, to those in which the community initiates

the project and hires in any technical expertise it requires, with many hybrid positions between these two extremes. Could the Kyoto funding mechanism lead to real ownership of communities over forest resources in their vicinity, and is this in fact a development that is in the greater interest of the countries involved and the world as a whole?

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## References

- Agrawal, A (1995) Dismantling the Divide between Indigeneous and Scientific Knowledge. *Development and Change* 26, pp413-439
- Bosello, F and R. Roson (1999) *Carbon Emissions Trading and Equity in International Agreements*. FEEM Working Paper 57.99. Mialn: Fondazione Eni Enrico Mattei.
- Chomitz, K.M. (2002) Baseline, Leakage and Measurement Issues: How do Forestry and Energy Projects Compare? *Climate Policy* vol 2, 35-49
- Deininger, K and B Minten (1999) Poverty, Policies and Deforestation: the Case of Mexico. *Economic Development and Cultural Change* vol 47 313-344
- Dianka, M (1999) *Vers une Vision Africaine de la Gestion Durable de al Biomasse-energie*. Paper presented at the Symposium La Biomasse Energie pour le Developpement et l'Environnement: Quelques Perspectives pour l'Afrique. Abidjan, 28 November- 2 December.
- Foley, G.W., G. Madon, E.M. Lawali, P. Montagne and K. Tounou (1997) *The Niger Household Energy Project*. Washington DC: World Bank.
- Foster Brown, I, A.S. Alechandre. H. Sassagawa and M. de Aquino (1995) Empowering Local Communities in Landuse Management; the Chico Mendes Extractive Reserve, Acre, Brazil. *Cultural Survival Quaterly* 18 (3) 391-399.
- Gonzales, R. M. (2000) *Platforms and Terraces. Bridging Participation and GIS in Joint Learning for Watershed Management with the Ifagaos of the Phillipines*. PhD Thesis ITC/WAU.
- Gupta, J (1997); *The Climate Change Convention and Developing Countries - From Conflict to Consensus?* Dordrecht: Kluwer.
- Hobley, M. (1996) *Participatory Forestry, the Process of Change in India and Nepal*. London: ODI.
- Jansen, K., C. Leeuwis, S. Mani, E. Roquas, M. Skutsch and G. Verschoor (2003) *Unpacking and Repacking Knowledge Interventions*. Paper presented to the CERES Pathways seminar, 6 February.
- Jordan, G.H., and B. Shrestra (1998) *Integrating Geomatics and Participatory Techniques for Community Forest Management. Case Studies from the Yarsha Khola Watershed, Dolakha District, Nepal*. Kathmandu: ICIMOD.
- Kerkhof. P. (2000) *Local Forest Management in the Sahel, Towards a New Social Contract*. London: SOS Sahel

- Kerkhof, P. , D. Madougou and G.M. Foley (2001) *A Review of the Rural Firewood Market Strategy in West Africa*. Report prepared for the World Bank.
- Landell-Mills, N. and I.T.Porras (2002) *Silver Bullet or Fool's Gold? A global review of markets for forest environmental services and their impacts on the poor*. London: IIED.
- Locke, C (1999) Constructing a Gender Policy for Joint Forest Management in India. *Development and Change* vol 30 265-285
- Mapande, E.C. (2003) *Local and External Indicators of Sustainable Forest Management: Commonalities and Discrepancies*. MSc Thesis, ITC, Enschede.
- McCall, M.K.(2002) *Nexus of Geodata Acquisition/Analysis and Indigenous Knowledge: Application of GIS to ITK issues*. A Literature Review. ITC, Enschede.
- Pfaff, A.S.P. (1999) What Drives Deforestation in the Brazilian Amazon? Evidence from Satellite and Socio-economic Data. *Journal of Environmental and Economic Management* vol 37 26-43
- Poffenberger, M. E. d'Silva, NH Ravindranath, U. Pingle, I.Murthy and A. Tuttle (2002) *The Clean Development Mechanism and Village Based Forest Restoration, A Case Study from Adilabad, Andhra Pradesh, India*. Community Forestry International, Santa Barbara.
- Poffenberger, M, NH Ravindranath, DN Pandey, IK Murthy, R. Bist and D. Jain (2001) *Communities and Climate Change: The Clean Development Mechanism and Village Based Forest Restoration in Central India: A Case Study from Harda, Madhya Pradesh, India*. Santa Barbara: Community Forestry International and Indian Institute of Forest Management
- Poffenberger, M (1990) *Keepers of the Forest. Land Management Alternatives in SE Asia*. West Hartford: Kumarian.
- Poffenberger, M and B. McGean (1996) *Village Voices, Village Choices. Joint Forest Management in India*. Delhi: OUP.
- Rocheleau, D. and L. Ross (1995) Trees and Tools, Trees and Text: Struggles over Resources in Zambrana-Chacuey, Dominican Republic. *Antipode* 27, 407-428
- Sarin, M (2001) Disempowerment in the Name of 'Participatory' Forestry? Village Forests Joint Management in Uttarakhand. *Forests Trees and People Newsletter* no 44.
- Sirait, M., S. Prasodjo, N. Podger, A. Flavelle and J. Fox (1994) Mapping Customary

- Land in East Kalimantan: A Tool for Forest Management. *Ambio* 232 (7) 411-417
- Skutsch, M.M. (1999) *Mid term review of NOVIB support to the CWS programme on Joint Forest Management, Andhra Pradesh*. Unpublished.
- Sokona, Y. (2000) Is Africa ready for Climate Change? *Climate Policy* vol 1
- Smith, J. and S.J. Scherr (2002) *Forest Carbon and Local Livelihoods; An Assessment of Opportunities and policy Recommendations*. Bogor: CIFOR.
- Thrupp, L.A. (1989) Legitimising Local Knowledge: From Displacement to Empowerment for Third World People. *Agriculture and Human Values* 6(3): 13-24
- Tipper, R (2002) Helping Indigenous Farmers to participate in the International Market for Carbon Services: The Case of Scolol Te. In: Pagiola, S., J . Bishop and N. Landell-Mills *Selling Forest Environmental Services: Market based mechanisms for conservation and development*. London: Earthscan.
- Warren, D.M. (1991) *Using Indigenous Knowledge in Agricultural Development*. Washington: World Bank Discussion paper no 126.
- WRI (2002) *Forest and Land-use Change Carbon Sequestration Projects*. <http://www.wri.org/climate/sequester.html>

