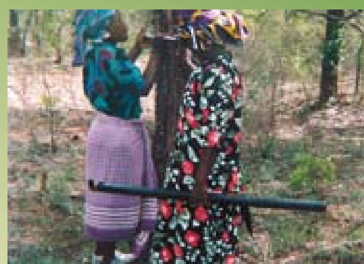
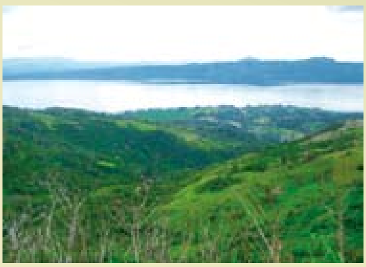
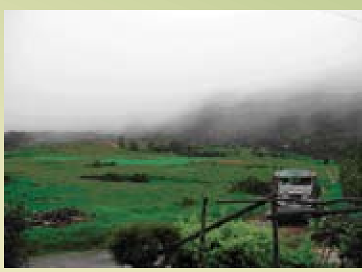
Community Forest Management as a Carbon Mitigation Option

Case studies







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Preface

Community-based forest management has a long history. Countries and communities have had different experiences and have found different ways of creating with institutional settings to nurture this participatory way of managing forest; and there have been success and failure stories. Many of the arrangements were aimed at providing the community with access to public lands so that they contribute to sustainable natural resources management. Timber and non-timber forest products have been the main commodities for their livelihoods including the market mechanisms. To a lesser extent communities have been involved in conservation activities.

The climate change regimes could provide opportunities for smallholder farmers in developing countries to participate in mitigating atmospheric carbon, but this idea has not been well understood and the capacity is not in place. A number of activities have been undertaken by a number of institutions with primary goal to explore opportunities and remove the barriers. Many lessons can been learnt from the activities of formal and informal organisations who have been involved in supporting community-based forest management initiatives.

The materials presented in this publication are derived from research and capacity building projects financed by various funding agencies. These include, firstly, *"Kyoto: Think Global, Act Local"* - an action research for sustainable forest management, financed by the Netherlands Development Cooperation and coordinated by Technology and Sustainable Development Section of the Centre for Clean Technology and Environmental Policy, University of Twente, Enschede, the Netherlands. Secondly, *"Carbon Sequestration through Clean Development Mechanism"* - a Technical Assistance to the Government of Indonesia (TA-4137 INO), funded by the Asian Development Bank (ADB) and coordinated by the Center for International Forestry Research (CIFOR). Thirdly, *"Rewarding Upland Poor for Environmental Services* (RUPES)", supported by the International Fund for Agricultural Development (IFAD) and coordinated by the World Agroforestry Centre (ICRAF) Southeast Asia.

The coordinating institutions and editors wish to thank the funding agencies for their generous support and the numerous partners and individuals of working in the projects described, for their cooperation. The following organisations deserve special recognition for their valuable contribution in the different case studies:

- International Institute Geo-information Science and Earth Observation (ITC) Enschede, Netherlands
- Environnement et Developpement du Tiers-Monde (Environment and Development Action, ENDA), Dakar, Senegal
- International Center for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal
- Department of Geography, University of Dar es Salaam, Tanzania
- The University of the Philippines at Los Banos (UPLB), Laguna, the Philippines
- The Land Management and Grant College, Bogor Agricultural University (IPB), Bogor, Indonesia
- Winrock International, Washington DC., USA.

Each of these organisations has in turn involved local organisations in the research, including the King Mahendra Trust for Nature Conservation in Nepal; the Central Himalayan Environmental Association in Uttranchal, India; Sokoine University of Agriculture in Tanzania; the PROGEDE project in Senegal and the Mali Folk Center in Mali; Kalahan Education Foundation Inc., Philippines; Conservation International - Philippines; CARE International, Philippines; *Nagari* Paninggahan-Solok District, Indonesia; Amandit Cooperative, Indonesia; Green Law, Indonesia; and Lestari Foundation, Indonesia. We are most grateful to Neil Bird of the Joanneum Institute for his insightful comments and critiques on Case Studies 1 to 6.

The views expressed in this publication are those of the project members and do not necessarily represent those of the funding agencies. It is hoped that by putting these experiences in the public domain, the potential of activities such as those carried out by the communities represented in the case studies, will be made known to the rest of the world. These communities have shown themselves to be receptive to the new idea of 'carbon forestry' and have the capacity to negotiate to improve their livelihoods while at the same time being part of the solutions to the global problem.

Daniel Murdiyarso
Margaret Skutsch

Promoting Carbon Benefits from Community Forest Management

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Introduction

Deforestation in the tropics is a major source of carbon emissions and an active contributor to global warming. The Intergovernmental Panel on Climate Change (IPCC) estimated that 1.7 billion tons of carbon is released annually due to land use change, of which the major part is tropical deforestation (IPCC 2001). This represents 20%–25% of current global carbon emissions. Deforestation emissions from Brazil and Indonesia alone are equivalent to the entire reduction commitment of the Annex 1 countries during the first commitment period.

Under the current agreements in the Kyoto Protocol and the Marrakech Accords, this enormous source of emissions is not addressed. Possibilities under the protocol's Clean Development Mechanism (CDM) are limited to afforestation and reforestation, known as AR CDM. In other words, they allow for planting of new trees to establish additional sinks, but they do not allow crediting for reduction of emission from existing sinks through sustainable forest management. To date almost 1000 CDM projects are undergoing or have undergone the approval process, but almost all of these are in the energy sector. Of the 39 approved methodologies only three are from the forestry sector, and of the 11 million CERs[1] issued so far, none is from the forestry sector. Thus as far as AR CDM is concerned, precious little progress has been made.

Time is running out; huge strides have to be made if the reduction target agreed for the first commitment period is to be reached. It is essential that the role of forestry in emissions, and the potential role of forest management in mitigating climate change,

[1] CER stands for Certified Emission Reduction, a CDM 'currency' that buyers will obtain after paying CDM project hosts in developing country for a certain amount of certified tons of carbon. The price ranges from €5–15 per ton CO_2 depending on the project risks.

is taken more seriously. How can the contribution of AR CDM be strengthened, and are there alternatives to CDM? What could the role of non-Kyoto-compliant projects be? What opportunities do bundling of ecosystem services (payments for watershed protection services and biodiversity conservation together with carbon) present? What type of approach could be scientifically sound, economically viable and politically correct, and achieve sustainable development in keeping with the objectives of CDM?

In response to calls from a number of parties to revisit deforestation in the climate agenda, the Eleventh Session of the Conference of Parties (CoP11) to the United Nations Framework Convention on Climate Change (UNFCCC) in December 2005 initiated a-two year process for the consideration of a policy for 'reduced emissions from deforestation' (RED). This debate is ongoing, and covers political issues, methodological challenges and alternative financial mechanisms that might be employed if such a policy were to be adopted. A workshop on carbon forestry held by the Center for International Forestry Research (CIFOR) in 2005 (Murdiyarso and Herawati 2005) addressed many of these issues, and the current publication takes the discussion further.

The collection of case studies presented in this document attempts to explore opportunities to promote the participation of local communities in various countries with a range of socio-economic settings and institutional challenges. They fall into two groups. The first considers cases of communities that are already involved in community-based forest management in a variety of settings and have been trained to make assessment of the changes in carbon stock in these forests over time. The forest-dependent communities were earlier unaware of carbon benefits but have shown themselves well capable of monitoring these. The purpose was to enable them to access emerging voluntary carbon markets (Murdiyarso 2004) or, in the long term, to engage in processes that could be rewarded under RED initiatives. The second group concerns small-scale AR CDM projects. It is shown that while maintaining climate integrity, these small-scale AR CDM projects with simplified procedures should be able to promote rehabilitation of degraded lands if they obtain financing through Kyoto markets. In both sets of cases, the main barriers are institutional ones and the transaction costs incurred. Bundling several projects that are physically close to one another may be a way of reducing these barriers.

Deforestation and Degradation

The global forest resources assessment affirms that deforestation continues at alarming rates. Latest figures show that 13 million hectares are lost annually, accounting for a net loss of 7.3 million hectares per year for the period 2000–2005, which is less than the 8.9 million hectares per year of the previous decade (FAO 2005). There is no doubt that deforestation, the conversion of forested land to non-forested land, is occurring on a large scale in many non–Annex 1 countries and images of this—fire-devastated slopes, massive chainsaws felling large buttressed tree trunks in tropical jungles—appear frequently in the popular media in an appeal to people's innate love of nature. To counter deforestation effectively, however, it is important to understand the underlying causes and drivers.

Much deforestation is the result of planned activities necessary for development. It is an inevitable (though regrettable) side effect of rational choices made by governments and individuals, which bring about land use change for the sake of greater production. The expansion of area under cultivation for food crops and under pasture may be a priority for economic growth, for feeding the growing population and for earning export income. Conversion of forest to plantation crops increases national income. Logging provides essential funds for investment in development. Cities grow and infrastructure is constructed as part and parcel of modernization and the increasing scale of the economy. These are *governed* activities, which for the most part cannot and should not be stopped; they are essential for development. At best, the impact on forests may be softened by ensuring good coordination between sectors and overall land use planning, the use of more sustainable timber extraction methods and the encouragement of agricultural systems that retain as much carbon as possible.

Yet there is a great deal of what may be called 'ungoverned' deforestation going on as well. In many places, this starts with degradation, the gradual reduction of stocks of biomass within the natural forest. Degradation results from extracting more biomass from the forest than it can sustainably produce. Levels of biomass—and therefore of carbon—dwindle; slowly at first, but gradually the forest thins out more and more until one can say that in essence the area is deforested. Often this is not the result of a single or coordinated and rational decision to clear the forest, but of a number of processes that have to do with the livelihoods of people nearby. Grazing of cattle within the forest prevents regeneration of saplings and shrubs; overharvesting of wood for the production of charcoal to sell in the cities overstresses the productive capacity of forest; slash-and-burn agriculture, a traditional and normally sustainable forest land use, becomes devastating if the fallow cycle is too short to allow the forest to recover.

Local people are well aware of the impact of these activities on the forest and of their negative implications. There are two sets of reasons why they continue to carry them out. First, there is usually no alternative means of making an income, and second, the forest is to all intents and purposes an uncontrolled resource. The state owns the majority of the forest, but apart from heavily protected areas such as nature reserves, most is *de facto* open access. With no rules for usage, or no enforcement of rules, each individual makes the most of his or her opportunity, because if not, someone else will—the tragedy of the commons, or, as it may more correctly be described, the tragedy of the open access resources.

How much of the global loss of forest biomass is due to full deforestation and how much due to creeping degradation? This is difficult to know, not least because most countries do not monitor degradation at all—it is not easily visible by remote sensing—and therefore do not report it to the Food and Agriculture Organisation (FAO 2005). There is no operational monitoring system for forest degradation, but pilot projects have demonstrated capabilities to monitor degradation. The key constraint is data continuity of high resolution imagery (DeFries *et al.* 2006). What we can say is that both deforestation and degradation contribute significantly to global carbon emissions, and for that reason 'reducing emissions from deforestation and degradation' (REDD) is the most appropriate general term for actions designed to curb these processes.

Community Forest Management for Reducing Degradation

In recent years the inability of the state to control degradation of forest has been recognized in many countries. Governments are seeing the benefits of handing over forest areas to local communities under a variety of community forest management schemes in Burkina Faso, Cameroon, India, Mexico, Nepal, Papua New Guinea, Peru, Tanzania and many other countries, and it is estimated that around 14% of all forest in developing countries is under this kind of management today, three times more than 12 years ago (White and Martin 2002). Under such schemes, villagers get the formal, legal rights to use and profit from the forest products, under jointly agreed management plans which ensure that off-take is kept at sustainable levels. Communities organise themselves by setting by-laws and by self-regulation as regards access to forest products. Their motivations to take part in such a scheme can be various: to maintain the forest to ensure future benefits is a clear overall reason. For some, it is to ensure a continued supply of firewood and fodder; for others, to enable eco-tourism; yet others participate in the hope that the wild animals that have disappeared from the shrinking habitat will return and provide a means of sustainable subsistence in the future. In a few, sustainable timber off-take is the aim. The benefits are usually small in financial terms, but real and tangible in non-monetary ways. In some countries, like Indonesia, where a social forestry scheme was adopted, status and function of the designated forest lands remain unchanged (state forest lands). The participation of the local community is considered a means to promote sustainable livelihoods and to reduce further degradation of forest resources. The local people obtain the right to utilize forest resources within the context of social forestry, for which special permits from the government are required. Regulatory barriers and lack of any major income-earning opportunity may hinder or deter local communities from participating on a voluntary basis.

But initial experiences of such community forestry are by and large positive. Areas that are community managed are clearly distinguishable from surrounding areas that are not, as natural regeneration appears to be taking place and biomass becomes denser, so that instead of being a net emitter of carbon, the forest becomes a sink. Furthermore, it is probable that without such management, the biomass would decrease, through forest degradation, leading to additional carbon emissions. As the case studies in this book show, the gains could be anything from 1 to about 5 tons per hectare per year, depending on the type of forest. Although this reduction cannot today be credited under the Kyoto Protocol, the studies indicate the potential that this kind of activity could offer as a carbon mitigation strategy in the future.

Small-Scale AR CDM Projects

The small-scale AR CDM project opportunity under the Kyoto Protocol already offers the potential for local communities to reforest areas within their vicinity, with monetary incentives derived from the sale of carbon credits. The second set of case studies demonstrates for cases in Indonesia and the Philippines what the local benefits might be, as well as the estimated carbon mitigation. Several of these studies also consider the potential for bundling incentives for carbon mitigation with other environmental services (catchment protection, biodiversity conservation, aesthetic qualities of the landscape etc.), under Payment for Environmental Services systems. The underlying principle of such payments is that landscapes provide valuable positive externalities to off-site beneficiaries, but that these may not be taken into account by on-site landowners or users unless the beneficiaries pay them. One possibility is that payment from multilateral funds (*e.g.* Global Environmental Facility) might be forthcoming to cover incremental costs of sequestering extra carbon in biodiversity or watershed conservation projects.

If carbon has a monetary value, could payment for reduced emissions from deforestation, or tree planting under AR CDM act as an incentive for this kind of forest management activity at the local level? Would it stimulate more communities to adopt simple management rules over much larger areas of natural forest, to bring rates of extraction into balance with the forests' natural capacity to reproduce, and to plant and maintain trees? If this were the case, then many parts of the forest in tropical areas might be involved in reducing carbon emissions, and very many small communities might earn some income from this new service. Naturally, there would be many additional positive side effects, not least the maintaining of biodiversity, water management, erosion control and the fight against desertification. Many of our case studies address the question of the costs and benefits to local people of engaging in forest management and tree planting activities, in relation to expected monetary values of carbon.

What Do We Need to Know?

In order to assess this possibility in more depth, it makes sense to look carefully at community forest management (CFM) experience and evaluate its impact on carbon stocks. There is a number of questions that would need to be addressed, such as:

- What rates of degradation and carbon loss are typically occurring in unmanaged forests?
- What sorts of management activities are used by communities under CFM schemes and how much carbon is saved as a result?
- Is there leakage to other areas? How much?
- What is the opportunity cost of this management?
- How could the carbon stock changes be measured and monitored in a cost-effective manner?
- What would be the possibility of bundling several environmental services to reduce transaction costs?
- Will small-scale AR CDM be attractive to investors? What would be the potential barriers to be removed?

A research project funded by Netherlands Development Cooperation entitled *Kyoto: Think Global Act Local* has set out to answer these questions and to assess the potential for community carbon forestry, providing the first six cases presented here. Working with local non-governmental organisations (NGOs) and research institutes in Guinea Bissau, Mali, Nepal, Senegal, Tanzania, Uganda and Uttranchal (India), communities already engaged in local forest management have been trained in the use of a small, hand-held computer with global positioning and geographic information systems equipment, which enables them accurately to map the boundaries and the strata in the forest—a prerequisite if carbon savings are to be verifiable. Further they have been trained in standard forest inventory methods, using fixed sample plots, and in entering this data into a tailor-made database on the computer. None of these villagers has more than 7 years of primary education, and none of them had ever seen a computer before, but this is no hindrance. The local NGOs help in the training, maintain the computers and supervise the laying out of sample plots to ensure that carbon measurements meet rigorous scientific standards.

Another set of studies and capacity-building exercises was carried out in Indonesia and supported by the Asian Development Bank (ADB). It involved national and local governments in four districts of West Lampung (Sumatra), Hulu Sungai Selatan (Kalimantan), Sidrap and Bombana (Sulawesi). The main objective of the activities was to technically assist the governments and participating smallholders in developing CDM projects. They are categorized as small-scale AR CDM leading towards preparation of the Project Design Document (PDD).

In order to enhance the livelihoods and reduce the poverty of upland poor in Asia while supporting environmental conservation at global and local levels, another scheme aiming at *Rewarding Upland Poor for Environmental Services* (RUPES) was established. This involved three upland communities in Indonesia and the Philippines through policy support in the form of direct involvement in local governance, implementation of global convention, integrated natural resources and community-based forestry. Local communities in Ikalahan, Laguna and Sierra Madre in the Philippines were engaged, whereas the Indonesian case involved Minangkabau village in Singkarak, West Sumatra.

Having presented all these cases we draw some lessons learned and consider ways forward as regards financial mechanisms that could be used to support community carbon forestry. We hope to demonstrate that carbon payments can act as an important stimulus in the reduction of forest degradation over a large part of the tropics, as well as provide an incentive for local communities to engage in tree planting and tree-based agriculture. In this way, poor, local communities may become directly involved in activities that mitigate global carbon, while at the same time providing a sustainable livelihood for many marginalized people.

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Case Study

1

Kafley Community Forest, Lamatar, Nepal

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Introduction

Community forest plays a prominent role in the hills of Nepal where agriculture and livestock rearing and forest are strongly interlinked. Based on the 1976 National Forestry Plan, the government of Nepal made a policy to involve local communities in forest management, with a view to tackling deforestation and the deteriorating state of the forest all over the country. By 2004 about 25% of all national forests, or around 1.1 million ha, were being managed by Community Forestry User Groups (CFUGs). There are more than 13,000 CFUGs in the country, involving 1.4 million households (*i.e.* 35% of population) (Kanel 2004), mostly in the hilly regions of Nepal. The Federation of Community Forest Users Nepal (FECOFUN) has grown over the years to become the largest organisation in the country.

The impact of this policy in the forestry sector has been positive. Where communities are managing their forests, the degradation trend in the hills has been checked. Forest conditions have improved in most places with positive impacts on biodiversity conservation. Communities have easier access to firewood, timber, fodder, forest litter and grass. Soil erosion has been mitigated and water sources have been conserved in such areas.

As a general rule, members of the CFUGs pay a nominal fee for the various forest products they consume and are restricted from harvesting of forest products for commercial purposes. Timber harvesting in particular is heavily regulated and only conducted under Forest User Committee (FUC) supervision; selling is done through an open bidding process. All income from such sales is retained by the CFUG. Revenues collected by the CFUG from the members and through selling products are mostly reinvested in social infrastructure as requested by the community members. About 28% of the revenue generated from the community forest is expended on forest protection and management.

This case study looks at one example, the community forest in Lamatar, to demonstrate that in addition to other forest benefits, community forest management results in increasing carbon sequestration and also quite probably in decreasing emissions.

Brief History of the Kafley Forest

Lalitpur district has 15,253 ha of forest of which 9,993 ha are managed by 162 CFUGs. Kafley Community Forest is one of these. It is a block of 96 ha which is being managed by the Kafley CFUG, which consists of 60 households. This forest lies at an elevation of between 1,830 and 1,930 m (see **Figure 1.1**) and is dominated by temperate broad-leaved species, particularly *Schima* sp. (katus) and *Castanopsis* sp. (chilaune).

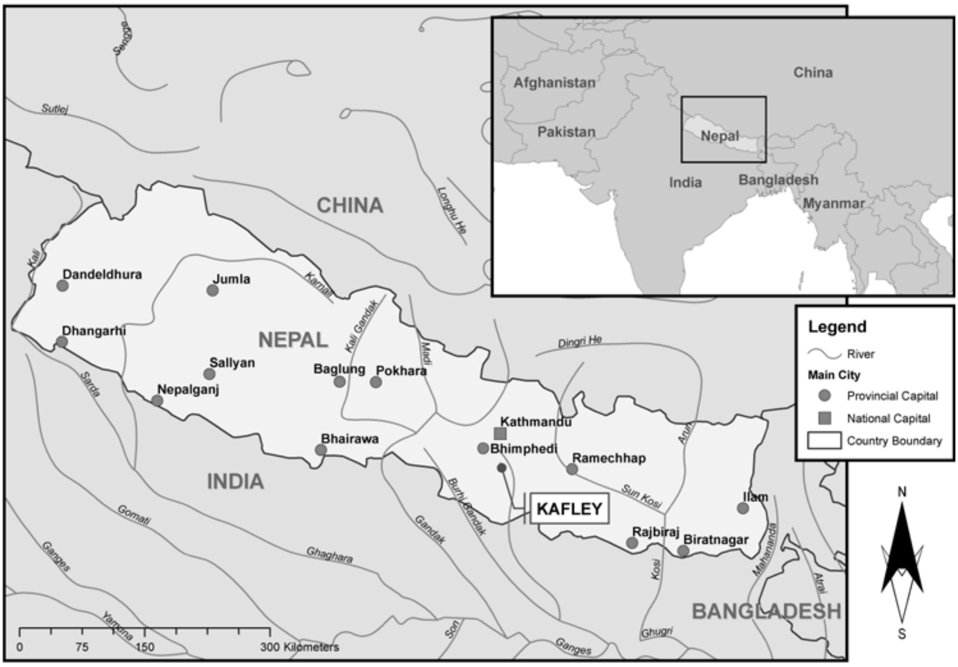

Figure 1.1. Map of Nepal showing location of Kafley

The tradition of community managed forest here is not new, what is new is the formalization of the traditional management practice in modern terms. Villagers recalling the history of their forest management explain that the forest in the Kafley area historically belonged to the Ghimere family, who were Brahmins living to the south of the main valley. They had agricultural lands in the fertile valley below the hills; the hills themselves were unsuitable for agriculture and were covered with forest. They were granted this forest as *Birta*[1] by the State for services rendered. It is told

[1] 'Birta' = land or forest grants from the State

that the forest was rich in biodiversity at that time, as it was well managed. In 1957, however, this forest, like all forests in Nepal, was nationalized. After that, as narrated by the locals, the forest gradually decreased, both by outright deforestation (loss of forest area) and in terms of degradation (loss of biomass within the forest). Noticing this change, the Department of Forestry carried out a reforestation programme in 1978 by developing a sallo plantation (*Pinus roxburghii*) and putting forest guards in place to protect it. But deforestation and forest degradation continued unabated, converting the entire hilly area to almost barren land by the early 1980's. Unregulated livestock grazing and fodder collection were the major causes of forest degradation as they prevented natural regeneration, while unrestricted fuelwood and timber collection were the major cause of deforestation. This was a classic case of the *tragedy of the open access*; anyone and everyone had unlimited access any time because the state owned the resource and it was managed by their staff, to whom the local people did not feel answerable.

The scenario at Kafley was occurring all over the country which meant that Nepal was losing forests at a rapid rate especially in areas adjacent to settlements. In the late 1970's however a paradigm shift occurred, when foresters began to realize that forest protection and management was not possible without involvement of the local people. Between 1975 and 1993, a series of milestone decisions brought about the community forestry policy that we see practiced so widely in Nepal today. Most of the handing over of forests to the local communities took place in the 1990s. In Lamatar this happened in 1994, a year after the formation of the Kafley Community Forest User Group. Since then, forest has been managed effectively with strict restrictions and user guidelines and norms. Forest degradation and deforestation have been checked and forest regeneration (which is mainly natural regeneration) is taking place after stringent protective measures were deployed by the local people through the CFUG. Today the forest is recuperating ecologically and already has a rich diversity in tree species. One of the most important resources obtained from this forest is water. This forest has several springs which are carefully protected and used by the village for drinking purposes, at no charge to the users. It has been reported that the flow of water has markedly increased with the rejuvenating forest ecosystem.

Management Regime

Membership of the CFUG is not compulsory but all villagers who need forest products are members, to ensure their access to the forest. The Kafley CFUG has a constitution and a five-year operation plan that indicates how and for what purpose the forest will be managed. The CFUG is headed by a FUC consisting of 11 elected executive committee members (of whom six women), which makes day to day decisions and calls the CFUG meetings. The primary mission of the Kafley CFUG is to increase the harvesting capacity of fuelwood, timber and fodder through better management of forest resources for the benefit of the local CFUG members and to make the CFUG a self-sustaining institution. But in addition, the CFUG aims to conserve spring water sources, soil and biodiversity and promote environmental stability in their village area. The CFUG also assists in raising living conditions from the use and access of forest resources, and is trying to develop this area for recreation and tourism uses.

Community management of forest entails numerous tasks which the locals perform. Technical ones are undertaken with the support from the government forest rangers. Community management practices witnessed in the Lamatar area can broadly be classified into protection, administration, harvesting and forest management.

Protection is a major task and often the most expensive as well. CFUG has not hired anyone for patrolling the forest but is divided into subgroups taking the responsibility for patrolling on a rotational basis. While working at home or in the field below the forested hill, people keep an eye on the hillside and watch their forest for irregular movements, such as illegal logging, animal grazing or forest fire. In the past, people have been able to fight forest fires after seeing them from the field and rushing to the site immediately. It is compulsory for all members of the CFUG to participate in putting out fires, with penalties for failure in this regard. Penalties are in fact used for deterring all kinds of unsustainable forest resource extraction. Monetary fines are fixed by the CFUG meeting, with different rates for the illegal collection of fodder and litter, sand, gravel and stones, timber and fuelwood and bamboo, at times when such activities are not permitted. Hunting is permanently banned; grazing livestock and charcoal making likewise. Fencing as a protective measure is however not found here. It is the promulgation of these restrictions on use that has been the main management intervention and which has resulted in avoided forest degradation and deforestation.

The willingness of the community to implement these forest protection measures is related to and dependent on the pay-back they derive. It is clear to people in the Lamatar area that strict conservation measures, which are designed to maximize natural regeneration, in practice result in the harvesting of greater quantities of forest resources, and this is the incentive to cooperate in forest management under the CFUG.

Community forestry also entails numerous administrative tasks such as calling and organizing meetings, conducting elections, recording and minuting meetings, maintaining accounts, getting accounts audited, etc, as well as those directly connected with forest activities such as setting dates for extracting resources and circulating the information, and developing the management plan and five-year operational plan with the assistance of a ranger. In Lamatar, such official administrative processes were found to be conducted rather professionally although not all CFUGs in Nepal are able to maintain such high standards in this regard.

Table 1.1 shows the balance accumulated by Kafley CFUG which over the last seven years, which overall has been increasing.

Annex 1 shows the financial flow of the Kafley CFUG between fiscal years 2001/2002 to 2004/2005. From it we see that 13% of the financial income from 2004/05 was spent on school and Red Cross activity in the village, while in the year before that 16% was spent on college and school building repairs.

Harvesting is done by all members. The main products extracted are timber, fuelwood (dried and green), fodder, litter, nigalo, (small bamboos: *Drepanostachyum intermedium, D. falcatum,* and *Sinarundinaria falcata)* and other non-timber forest products (NTFP). Of these, timber is the most heavily regulated; a decision to harvest is taken by the FUC together with the local forest range officer via an official

Table 1.1. Kafley CFUG financial balance

Annual savings of Kafley CFUG	
Fiscal year	**Rs.**
2004/05	22,699
2003/04	6,910
2002/03	19,285
2001/02	3,081
2000/99	17,245
1999/98	6,254
1998/97	81

process, and the timber is sold through a bidding process to anyone, including people from outside the village. Fuelwood, fodder, litter, nigalo and NTFP on the other hand can be collected by CFUG members when the forest opens; the FUC decides on the days and dates on which harvesting of these products is allowed in the different seasons and accordingly informs all CFUG members. Members pay a small fee for firewood and bamboo, but fodder and litter are free. From records held by the CFUG, it appears that each household extracts about 1000 kg of green fuelwood, 500 kg of dry fuelwood, 500 kg of grass fodder, 1000 kg of leaf litter and 500 kg of nigalo every year. On special occasions such a marriage, religious ceremony or funeral, 350 kg of fuelwood can be harvested by any CFUG member for the same price. Products extracted collectively after an operation such as thinning or clear cutting are distributed equally among the users. Members of the CFUG may sell any of their personal excess of these products to non-members within the village, but they may not be sold commercially outside the village. Sale of timber is the largest source of income for CFUG, followed by fuelwood fees, as shown on **Annex 1**. But unlike timber, fuelwood is extracted by the CFUG members only for fulfilling their subsistence needs and that of their fellow villagers, and though financially it is lower in value in terms of its contribution to the CFUG income, volume-wise it is the main resource extracted.

Most locals in Lamatar have their own clear understanding of silviculture as they have been interacting with forest even before going to school. Some of the locals can identify all the tree species in their forests, though the older men seem to be more knowledgeable on this than younger ones. Some of the activities they conduct on a regular basis include weeding, cleaning, pruning/branch cutting, singling, thinning, clear cutting and regeneration management. The CFUG has maintained demonstration plots using modern techniques to propagate a number of species such as Chilaune (*Schima wallichii)* and Jhingane *(Eurya acuminate)* as well as several additional varieties of NTFPs (*e.g*. cardamom, fodder grass). In future Kafley CFUG intends to develop a forest nursery and also increase the number of medicinal plants in the forest.

Forest Inventory

As a result of participation in the *Kyoto: Think Global Act Local* project, members of the CFUG were trained in forestry inventory and mapping and conducted their own forest carbon stock assessment. Data from this is now available for two consecutive years. The figures in **Table 1.2** show very high number of stands and yet a low biomass per hectare (91.76 t ha^{-1}) indicating that the forest is mostly at a young stage with vigorously regenerating saplings. However, in addition to the above-ground biomass as measured by the community, it would be possible to calculate the below-ground biomass using standard biometric equations, which would augment the annual carbon gains.

Table 1.2. Biomass data for Kafley CFUG in Lamatar

Lamatar	Units	2005	2006
Above ground live biomass in 8 plots	kg	7,236.68	7,444.37
Above ground live biomass per ha	t	90.46	93.05
C per ha[2]	t	45.2	46.5
Increase in C per ha	t/year		+ 1,30
Carbon dioxide equivalent	t/year		+ 4.78
Total tree count in 8 plots		152	159
Tree per ha		1,900	1,988
Average dbh per tree	cm	9.33	9.39
No of species		22	21

This is also verified by the looking at distribution of dbh (diameter at breast height) measurement as shown in **Table 1.3**, where it is clear that most of the trees are relatively young (nearly 75% have dbh ranging between 5 to 10 cm). This is because the forest was only handed over in 1994; it is only since then that forest protection measures were taken up by CFUG, allowing the forest to regenerate.

Table 1.3. Percent distribution of tree dbh class in Kafley CFUG

	Dbh Classes (cm)							
	5 -10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	> 70
Year 1	71.71%	22.37%	3.95%	0.66%	1.32%	0.00%	0.00%	0.00%
Year 2	72.96%	20.75%	5.03%	0.63%	0.63%	0.00%	0.00%	0.00%

Although the data must be viewed as preliminary – more years of data are needed before a clear trend can be established - the data indicates that there has been an increase of total carbon stock of more than 1 ton per hectare, which represents around 2% growth annually of the carbon stock. This is equivalent to over 4 tons of CO_2 per hectare per year.

[2] Carbon stock based on above ground biomass in trees of over 5 cm diameter only (carbon in other pools such as shrub layer and litter layer, soil etc is not included).

If further analysis shows that this trend persists, it means that the CFUG is responsible for the additional sequestration of around 440 tons of carbon dioxide per year over its total area of 94 ha, which assuming a conservative price of $2 after transaction costs could bring in an income of some $880 per year (Rs. 58,400 at $1 = Rs. 73) – a significant cash income for the community, comparing this to their financial statement where the total annual financial income has never been more than $600[3]. This is in addition to the reduction in emissions that would have occurred if there had been no forest management and the forest had continued to deteriorate in the way it was going before the CFUG started its work. It also excludes the fact that if the forest had been allowed to degrade, dependency on and consumption of imported fossil fuel for cooking would probably be much more than now. Whether the community might also claim for this carbon, would depend on how the baseline would be constructed, and over what historical period it would rest. For example, if it were based on the rates of deforestation and degradation prior to 1994 which were on the order of 5% loss of biomass per year, the total carbon stock increases would be around 7% per year or 3-4 tons carbon stock, with corresponding financial implications.

Since community forest management has been promulgated for many years in Nepal, with about a quarter of all national forest now managed in this way, it would be difficult to argue that the forest management activities of villages like Lamatar are truly 'additional' in Kyoto terms. On the other hand, it is clear that there is very little leakage, since all the forest in the area is managed by other CFUGs on more or less the same terms. There is simply no forest around in which the leakage could occur.

Would there be then, in principle, justification for CFUGs and their members to claim the monetary value of all the carbon that is being sequestered, and/or the carbon that is retained rather than lost to deforestation, if a policy for crediting reduced emissions from deforestation is adopted by UNFCCC? Or should payment only be claimed for increases over an above what has been achieved in the past?

These questions do not yet keep the members of the CFUG awake at night, but they are questions that need to be answered in a fair and environmental sound way in the very near future.

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[3] A price of $2 per ton carbon dioxide has been used in all the cases studies under the Kyoto: Think Global, Act Local project (cases 1-6), for illustrative purposes. The current market price is around $5 per ton of carbon dioxide (CER), but credits for forestry projects are at present temporary carbon emission reduction (tCERs), and these have a much lower market value than regular CERs. We have selected a conservative value to indicate that even with these assumptions, forest management for carbon makes economic sense.

Annex 1. Financial Statement of Kafley CFUG

2004/2005

Income titles	Rs.
Membership charge	550
Sale of firewood	869
Sale of timber	18,558
Sale of ghaga	7,090
Interest from Bank	6,527
Service charge	2,040
Prize from VDC and DDC	6,100
Rent of cooking utensils	120
Total	41,854
Expenditure titles	**Rs.**
General assembly	3,600
Stationery	1,069
Forest User Committee	350
Advertisement of timber sale	5,186
Transport	750
Bamboo plantation	350
Tax for interest	316
Le pa charge	50
Depreciation	266
Miscellaneous	1,157
Donations	
1. School	5,200
2. Red Cross	400
Total	18,694

2003/2004

Income titles	Rs.
Membership charge	920
Sale of firewood	2,726
Sale of timber	11,039
Sale of ghaga	1380
Interest from Bank	5402
DDC training fund	19,070
Total	40,537
Expenditure titles	**Rs.**
General assembly	3,607
Stationery	647
Forest management	1077
Training	17,570
Range post coordination committee	820
Auditing charge	300
Tax for interest	316
Construction of chautaro	1,294
Depreciation	282
Miscellaneous	1,088
Donations	
1. School	1,125
2. College	5,501
Total	33,627

2002/2003

Income titles	Rs.
Membership charge	610
Sale of firewood	2,417
Sale of timber	18,095
Sale of ghaga	671
Interest from Bank	3,780
Sale of dry twigs	412
Sale of tree	1,536
Total	27,521
Expenditure titles	**Rs.**
General assembly	1,231
Stationery	722
Member charge in kalyankari	1,379
Educational tour	670
Road construction	2,000
Acc. Closing charge	100
Banner	120
Loss of daak	233
Depreciation	135
Donations	
1. School	1,600
Total	8,190

2001/2002

Income titles	Rs.
Membership charge	1,990
Sale of firewood	3,338
Sale of nigalo	100
Sale of forest product	760
Interest from Bank	1,566
Sale of dry twigs	346
Grant from VDC	1,000
Dried and burnt tree	796
Total	9,896
Expenditure titles	**Rs.**
Inventory	542
Stationery	698
Forest User Committee	100
Training	3,120
Range post coordination committee	100
Banner	1,335
Purchase dade	160
Depreciation	238
Miscellaneous	682
Total	6,975

Case Study

2

Handei Village Forest Reserve, Tanzania

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Introduction

Community Forests Management initiatives were introduced in Tanzania in the early 1980's with some experiences of success stories from Nepal and India. The practice is already legitimized by the parliament through the current forest act (2002). Under this act there are mainly two main ways in which communities are involved in forest management: these are Joint Forest Management (JFM) and Community Based Forest Management (CBFM). Under JFM, the government involves local communities in carrying out different forest activities (such as patrolling, fire fighting and boundary clearing), as such forest ownership remains with the government while local communities are duty bearers and in turn get use-rights and access to some forest products and services. On the other hand in CBFM the local communities are the owners, as well as right holders and duty bearers. Most of the CBFM forests are demarcated as part of village general land. Thus they are also called village forest reserves. To date there is a total of 994 different areas involving 2009 villages with a total area of about 3 million ha under community forest management in the country. However, current statistics also reveal that the remaining forest area in general land is about 18 million ha. These forests are "open access" characterized with insecure land tenure, shifting cultivation, harvesting for wood fuel, poles and timber, and heavy pressure for conversion to other competing land uses, such as agriculture, livestock grazing, settlements, industrial development. In addition, the lands are subject to wildfires which are caused by human activity. The rate of deforestation in Tanzania which is estimated at more than 500,000 ha per year is mostly impacting such general land forests. Therefore there is a room for many more community forest management activities that may alter the observed high rate of deforestation in the country.

Handei Village Forest Reserve

Handei village forest reserve is located in the Eastern Usambara mountains in Tanga region and is just outside the Amani Nature Reserve (**Figure 2.1**). It consists of 156 ha of sub-montane evergreen forest characterized primarily by *Parinari excelsa, Sapium ellipticum, Cynometra* sp. and *Alanblackia stuhlmannii*. Part of the forest is on hanging rocky cliffs harboring *Saintpaulia usambarensis* (African violet) species that attracts ecotourism. The forest has been under community based forest management by residents of Magambo-Miembeni village since 1996. Formerly, the forest was under open access and suffered considerably from agricultural expansion and uncontrolled harvesting mainly for commercial timber and building material, the consequence of which were changes in microclimate of the area and drying up of important water sources to the local communities.

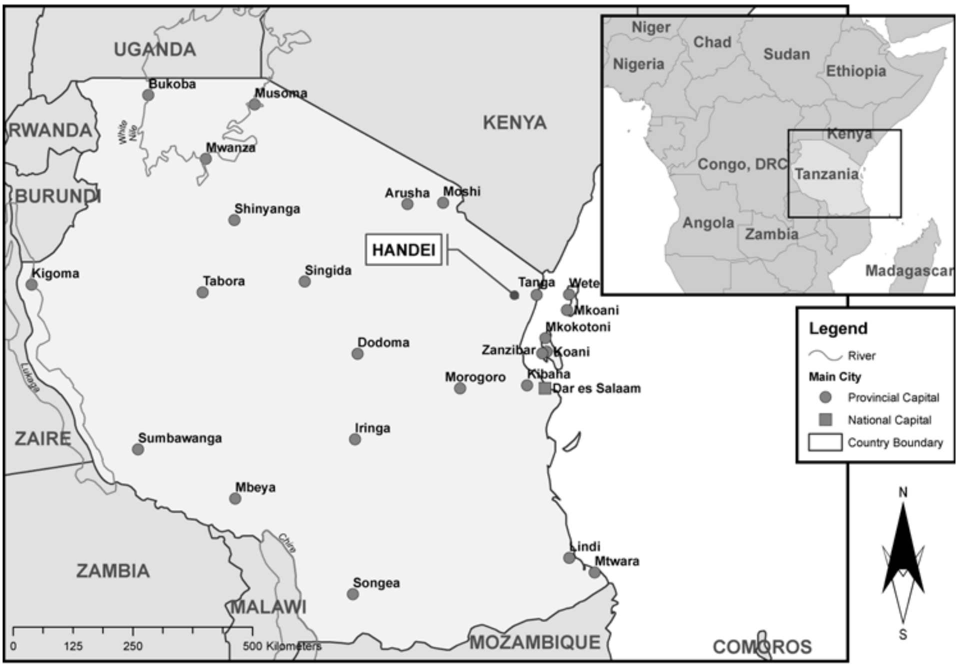

Figure 2.1. Map of Tanzania showing location of Handei

With current management, utilization is confined to a buffer zone of 50 m from all sides of the forest boundary, the interior part of the forest is for protection without utilization. Uses permitted in the buffer zone include: ecotourism, timber harvesting, collecting dry firewood, vegetable, mushroom and collection of traditional medicines. To ensure proper utilization, the village has set down various bylaws on how and when these forest products can be utilized, the general idea being that utilization is done in a sustainable manner.

There is a village forest committee composed of twelve members (currently four women and eight men) operating under the village government that manages the forest. The committee is responsible for all activities regarding the forest, these include: selecting forest guards, monitoring of all activities conducted in the forest such as enrichment planting in open areas of the forest, provision of permits for various activities such as harvesting of timber and collection of fees from ecotourism. It is also responsible for following up on legal issues pertaining to the management of the village forest reserve.

The committee reports on a monthly basis to the village government, district forest officer and a local supporting organisation (the Amani Nature Reserve conservation office). The role of the district forest officer and the supporting organisation is to provide technical support to the forest committee and interpretation of policy guidance.

Carbon Stock Changes as a Result of Management Activities

As a result of participation in the *Kyoto: Think Global Act Local* project, five members of the Forest Committee (three men and two women) were trained in mapping techniques using GIS/GPS on a hand held computer and in standard forest inventory methods as described in the IPGG Good Practice Guide (Penman *et al.* 2003). They established 19 sample plots of 5.6 m radius, laid out at intervals of 218 m using transects separated by 286 m. Locally derived allometric equations were used to calculate the total biomass and to convert this into tons of carbon stock. Below ground carbon stocks were not estimated but in principle could be calculated and added to the total.

Table 2.1 shows the stand parameters for Handei village forest reserve. Observed stem numbers in this forest are comparable to other forests in similar (protected) site conditions while volume, biomass and carbon per hectare are generally lower. This is probably because the forest is still regenerating following previous disturbances including agricultural fields with few trees. However, analysis of data between 2005 and 2006 shows that the forest is growing and has sequestered about 3 tons of carbon per hectare in the year interval between the two measurements. Data for several more years will need to be collected before a growth curve can be drawn, but the evidence is clear: the forest is increasing in carbon stock as a result of the management practices used by the villagers.

Table 2.1 also shows that the tree stocking in terms of volume, biomass and carbon in the general land of this village (unmanaged forest) is about half of that in the reserve forest. The reserved forest has fewer trees, but these are of large sizes with

Table 2.1. Stand parameters for Handei Village Forest Reserve

	Year	N (stems/ha)	V (m^3/ha)	Biomass (t/ha)	Carbon (t/ha)	CO_2 (t/ha)	Area (ha)	Total CO_2 (t)
Handei VFR	2005	926	261.2	151.5	74.2	278.3	156	42,480.1
Handei VFR	2006	643	272.0	157.9	77.4	284.1	156	44,311.6
Unmanaged forest outside the VFR	2006	1,914	139	81	40			

correspondingly large volume, biomass and carbon contents compared to unmanaged forest, which in contrast has many very small trees. These unmanaged areas are forest in which some subsistence agriculture is being done, particularly on small hillside plots. These small farms are not fully cleared but retain some trees as part of the local agroforestry practice. These are also alternative sources of fuelwood and timber for construction.

The managed forest clearly shows an increase in carbon stocks due to the suppression of unsustainable harvesting of fuelwood and charcoal, of around 5 tons CO_2 per hectare per year. The village forest management regime is thus sequestering a considerable amount of carbon as shown above. From the data so far available, it is not clear to what extent emissions are being reduced in addition, since the rate of depletion of forest in the unmanaged area has not yet been established. In order to make an accurate assessment of this, data over several years will be required, and any leakage from the managed area will have to be accounted for.

It is the intention of this research project to continue monitoring carbon stock changes to establish annual rate of carbon loss and predict future carbon stocks. This will form the baseline scenario against which carbon benefits of the reserved forest will be compared.

Conclusions

This case has provided some facts on the growth trends in both the unmanaged land and the village forest reserve that is under community management. These preliminary findings provide promising positive evidence on the effectiveness of the village forest management against open access regimes. The growing stock differences between the two will be the carbon benefit the communities are creating from their forest management, and for which they might claim carbon credit compensation in the future.

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Case Study

3

Kitulangalo Forest Area, Tanzania

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Introduction

Kitulangalo forest area lies about 50 km to the east of Morogoro town, on the side of the Dar es Salaam-Morogoro highway (**Figure 3.1**). This is a relatively dry area with an average annual rainfall of about 850 mm. Formerly the forest was part of the Kitulangalo Catchment Forest Reserve. The high level of accessibility to the highway made this area a prime charcoal production area for the supply of the nearby Morogoro municipality and Dar es Salaam city. But in addition the forest suffered from timber extraction through the activities of local pit-sawyers, and from cutting of tree stems for building poles. The human resources of the Forest Department were insufficient to maintain control over the area and to prevent the over use of this important catchment forest. It was *de facto* an open access resource.

In 1995 however, part of the forest (600 ha) was made over to Sokoine University of Agriculture (SUA) as a Training Forest Reserve; it is now used for training students and for research purposes, although protection was a major reason for its new status. This part of the forest is under joint forest management with Gwata village, which means that the land is still owned by the government, but the management is mainly in the hands of the local community, following jointly prepared management guidelines. In 2000, another 420 ha was demarcated for the village community, and is now called Kiminyu village forest reserve. As a community forest, the land is now the property of the village, which has full responsibility for management. Both areas are characterized by Miombo (savanna woodland) and the predominant species are *Brachystegia* sp. and *Julbernardia* sp.

Different Management Strategies and Rules

The fact that two different management regimes are operating next door to each other in essentially the same type of forest makes the Kitulangalo forest a particularly interesting one to study.

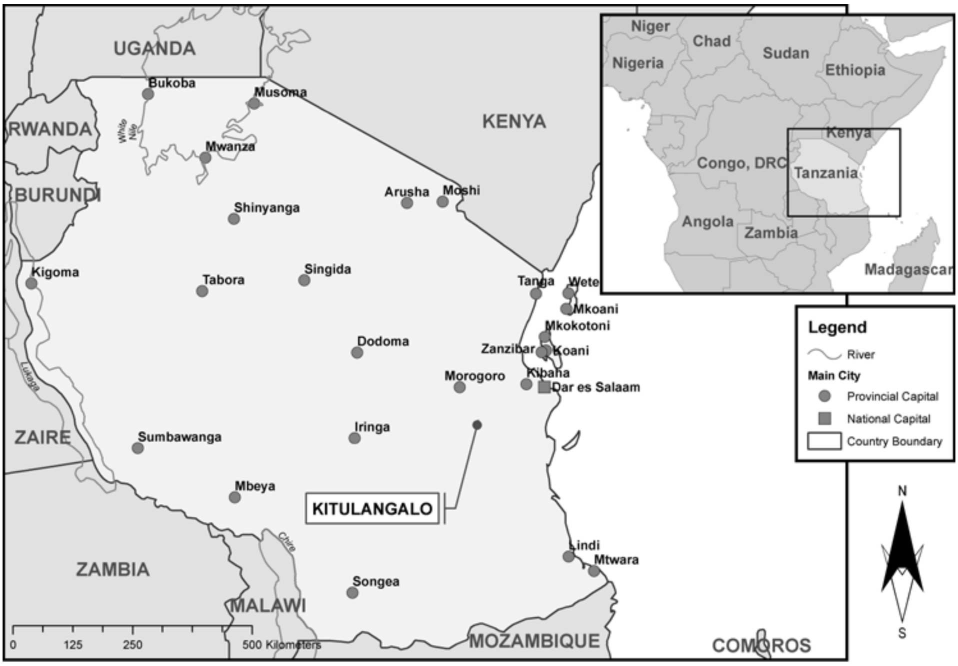

Figure 3.1. Map of Tanzania showing location of Kitulangalo

In Gwata village an environmental committee has been established and given the responsibility for supervising the management of the forests on behalf the village government. This committee has been established to look after all forest management activities in the villages. The committee members are selected by village government and approved by general village assembly. The considerations for selection to the committee are: village residence, married person, and ability to work. Intrinsically, gender balance is also carefully considered in order to involve women in the management of the village forest reserves. To institute its mandate, the committee sets up bylaws that are approved by the village general assembly. These bylaws are also approved by the responsible district authority and are recognised by the court of law. They consist of different penalties charged against offenders who violate the rules regulating sustainable forest management and use in the village. These bylaws are applicable in both village and government owned forests in the village.

Sokoine University manages the training forest jointly with the village government through the village environmental committee. Two members from the committee are employed by the university as forest guards for the forest. These are responsible for making routine patrols and they supervise different silvicultural activities that are done by villagers who receive daily wages in return. For example, the university involves villagers in clearing of forest boundaries to safeguard against fire. This is normally done during the dry season when the grasses are dry and vulnerable to fires. In the same boundary lines, villagers plant trees, which are used to demarcate the reserves and general village land. If there is fire outbreak, the villagers are also involved in extinguishing it. However, it may be noted that incidence of fire outbreak in the Training Forest Reserve have considerably reduced in recent years since local people have been involved in forest management.

The village environmental committee bears full responsibility for managing the village forest (Kimunyu Forest). It mobilises local people, and selects villagers to patrol the forests every day and report to the village government through the committee. Although this forest is being managed for production purposes, currently there is no tree harvesting allowed. There are not yet enough large timber tree species in the forest, and the only product that could be extracted at present would be charcoal. However a decision has been made to stop charcoal production and to allow the forest to regenerate naturally. The result is that currently, there are higher trees stocking levels in this forest compared to the adjacent public land that is under open access management.

Growing Carbon Stock

The improving health of the forest can also be seen from the point of view of carbon stock. In Gwata village, six persons (four women and two men) were trained in mapping and forest inventory techniques as in all the other study sites under the *Kyoto: Think Global Act Local* project, with the help of two forest guards who are employed in connection with training forest reserve. In the Training Forest Reserve, 89 plots were set out at intervals of 150 m along transects set 300 m apart: in the Kiminyu village forest reserve, 43 plots were set out at distances of 170 m, on transects separated by 500 m. The number of sample plots was in each case calculated based on estimates of standard error, based on preliminary sampling as outlined in the IPCC Good Practice Guide (Penman *et al.* 2003) and the Winrock/Biocarbon Fund Sourcebook (Pearson *et al.* 2005).

Table 3.1 shows the results of the forest inventory carried out by the villagers.

Table 3.1. Stand parameters for the forests at Kitulangalo

	Year	N	V (m^3/ha)	Biomass (t/ha)	Carbon (t/ha)	CO_2 (t/ha)	Area (ha)	Total CO_2 (t)
Training Forest	2005	694.9	55.3	35.2	17.2	63.1	600	37,874.4
	2006	638.9	63.0	39.3	19.3	70.8		42,498.6
Kimunyu	2005	845.5	78.9	40.5	19.8	72.6	420	30,519.7
	2006	817.2	88.2	45.0	22.1	81.1		34,064.9

What is clear is that over a period of one year, management activities have resulted in a considerable tree stock change. Although the number of stems per hectare (N) has decreased, the tree volume has increased, and therefore also the biomass and corresponding carbon. In this one year there has been an increase is stored carbon dioxide of about 7 tons per hectare in both of the sites.

To draw firm conclusions concerning rate of carbon sequestration, data over more years will be required. However it may be borne in mind that, had the forest been left without community management, carbon stock would certainly have decreased, as had been the pattern over earlier years. The rate of forest loss and of degradation can be determined from studies that were carried out in areas in the vicinity of Kitulangalo, which show that the rate of loss of forest is strongly related to distance from the highway (**Figure 3.2**). Over a period of six years stock levels dropped by as much as 80% in sites up to 5 km from the highway, but only by 20% at 10 km. This is the result firstly of charcoal production and later of wholesale clearance for agriculture.

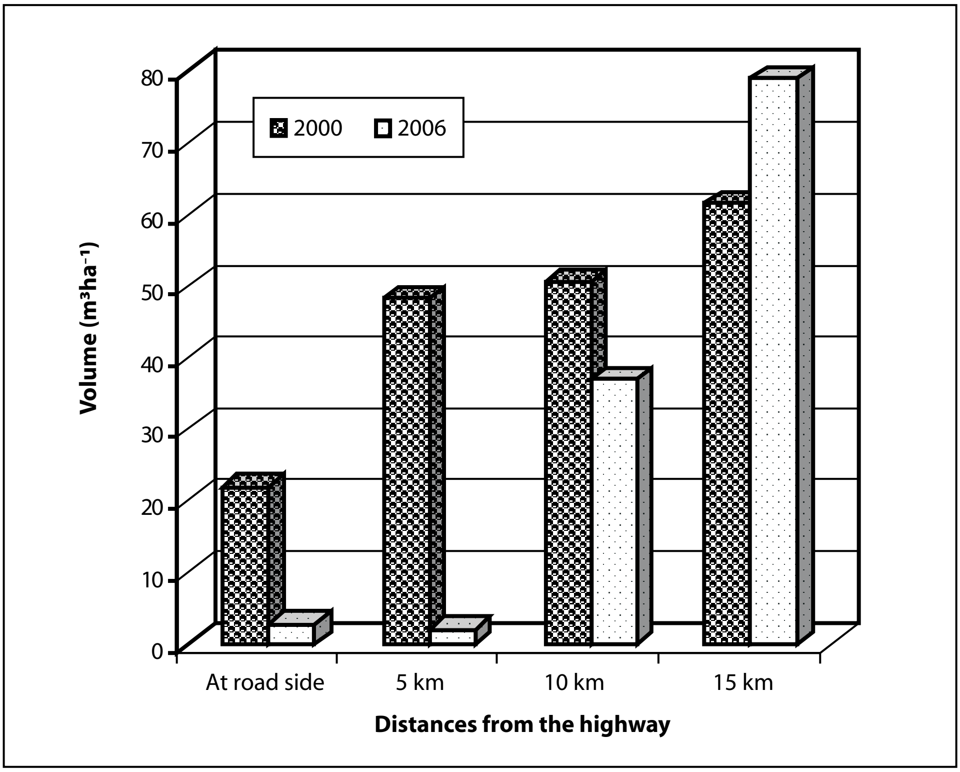

Figure 3.2. Rates of degradation in forests similar to the Kitulangalo forest (Malimbwi *et al.* 2005)

The increase in standing volume at 15 km is due to the fact that this area is now under community management for some years (this is the area that is now Kimunyu village forest). If a conservative estimate of 5% biomass loss per year was to be assumed as the average baseline, then the net gain in carbon terms as a result of community forest management would be on the order of 10 tons per hectare per year. At a nominal value of $2 per ton[1] after deduction of external transaction costs (*i.e* non-local costs involved in verifying and certifying the carbon gains), this would be equivalent to an annual income of $20 per hectare or $8,400 for the Kimunyu forest alone.

[1] This is a conservative price for carbon; please see footnote 3 in Case Study 1 for explanation.

It might be expected however that there is some leakage, in the form of displaced activities, from these sites. Villagers in this village collect firewood and building materials from the general land that is at close by distances from their homes. Only tree felling for commercial timber extraction and for charcoal making could be assumed to be displaced somewhere else. However, there are no evidence of villagers' migration to other areas to deforest. Of course, it could be argued that the charcoal may still be produced elsewhere, by other people, to meet the urban market demand for this vital product, and thus represents a form of leakage, but it is difficult to prove this or to estimate its impact.

Local Transaction Costs

Measuring biomass stock to determine changing carbon levels itself involves costs, which are considered to be local transaction costs. At Kitulangalo the costs involved were recorded. A comparison of costs of carbon assessment by local communities against the professionals reveals that it costs twice as much to hire professionals for carbon assessment in the village forests studied, as to engage villagers to do this, including the cost of technical assistance and training, which is considerable in the first year of assessment. It is to be expected that the villagers will be able to undertake the same work at progressively lower cost in the preceding years as the cost for training and supervision are reduced (**Table 3.2**). It is assumed that from the fourth year, the villagers can work on their own with assistance only from staff from their local supporting organisation. It is also clear that it is more cost effective to work with villages which are managing large forest areas, since the cost of training is a fixed cost.

Table 3.2. Estimated local transaction costs for monitoring carbon

Activities	If carried out only by professionals		If carried out only by local communities with a little assistance from professionals				
	No. of Days	Cost (€)	No. of Days	Cost (€)			
				1st Year	2nd Year	3rd Year	4th Year
1. Pilot and Inventory Planning	3	640	10	2,597	1,343	525	-
2. Field Assessment							
- Kitulangalo SUATFR	10	2,475	10	2,597	1,800	1,470	975
- Kimunyu VFR	6	1,460	6	1575	1,080	915	585
- Without Project Case	5	1,210	5	1,312	817	653	375
3. Data punching and analysis	10	2,250					
4. Consultation fees							
- Inventory specialist	34	6,120					
5. Institutional fees (10%)		1,410					
Total		15,565	31	8.081	5.040	3,563	1,935
Costs per hectare ($)		15		8	5	3.5	2

Conclusions

Although more data would be needed to strengthen the case, it is evident that community involvement in management, both under joint forestry and in full community forest management, have resulted in significant reductions in degradation together with significant increases in sequestration of carbon in both types of forest in Kitalangulo. The local transaction costs, though much lower than costs of profession measurement and monitoring, represent a not insignificant proportion of the likely financial benefit, but nevertheless it seems there is still a good margin of profit to me made. This is particularly important since the other financial benefits from such forest management are small. This is particularly the case since charcoal production has been banned, meaning that this source of income has been totally stopped, at least for the present time. The conclusion may be drawn that carbon as a 'non-timber forest product' could offer a real incentive for this community to continue with its forest management activities, and for more communities to become involved in managing their forests.

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Case Study

4

Dhali Village, Utranchal, India

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Introduction

Uttaranchal, the newly formed hill state of India, is situated in the Indian Central Himalayas. The total geographical area of Uttaranchal (UA) is 5,563,174 ha, of this agricultural land is 792,000 ha (about 13% of the total area) and 3,671,695 ha is forest (about 66%). At present there are more than 12,000 Van Panchayats (VPs), the local forest councils responsible for forest management in UA occupying nearly 0.5 million ha of the total forest area (**Table 4.1**).

Table 4.1. Distribution by district of VPs in Uttaranchal

Sl	District	Number of VPs	Area (ha)
1.	Almora	2,199	69,854
2.	Nainital	496	28,068
3.	Pithoragarh	1,661	87,054
4.	Champawat	629	31,233
5.	Bageshwar	822	38,783
6.	Pauri Garhwal	2,430	52,184
7.	Chamoli	1,073	167,310
8.	Rudraprayag	574	20,702
9.	Uttarkashi	643	5,510
10.	Dehradun	205	7,659
11	Tehri Garhwal	1,332	14,932
	Total	**12,064**	**523,289**

Note: Haridwar and Udham Singh Nagar districts do not have any VPs
Source: Uttaranchal Forests Department, July 2005

From Uttaranchal a number of major rivers originate and nurse the great Gangetic Plain of the Indian subcontinent. Forest cover found in the Himalayan belt is not only an important habitat for high altitude flora and fauna, but also crucial for providing hydrological benefits downstream. The water resources from the Himalayan region of Nepal and India that flow to the Gangetic Plains support over 500 million people and sustain the agriculture system in one of the most densely populated parts of the world.

History of Van Panchayats

The history of VPs dates back to the British colonial period. The restrictions imposed by the British on the customary forest rights of people towards the end of the 18th century and beginning of 19th century were resented by the locals. These acts of government led to alienation of the local communities from the British government.

Between 1911 and 1917 vast areas of forests were burnt down by the people in protest against the imposed restrictions. In 1921, the government appointed a committee known as the Kumaon Forest Grievance Committee to enquire into the rights of people over forests resources. It was on the recommendation of this committee that the British government decided to introduce Van Panchayats (forest council or forest committee) to Kumaon in 1930's. The landmark VP Act 1931 handed over the control of the designated forest to elected VP members in place of the State Forest Department (SFD).

The VP probably represents one of the largest experiments in decentralized management of common property in collaboration between the locals and the state (both SFD and State Revenue Department). The VP, an elected body, holds responsibility for harvesting, conserving and managing the village forest resources. However, the various activities performed by the VPs are under the regulations of the SFD and the Revenue Department, the former also provides technical backstopping as and where necessary. The village forest is a resource used by a definite user group (the village people) that is liable to degrade when over exploited. Though called village property, the land is owned by the State; however, village people consider it as a collective property as they are allowed the usufruct rights and resent government interference.

Most community forests were initiated on degraded lands, officially on a kind of Civil Soyam forest, falling under administration of Revenue Department. But unlike Civil Soyam forests the community forest are not open-access forests. Depending on a number of households in a village, there are generally 5-9 elected members in a VP, who elect a *"Sarpanch"* (chairman) from among themselves. Elections are held every 5 years.

Gender Issues in VPs

The prevailing rules state that the Van Panchayat shall consist of nine members; four seats are for representatives of Schedule Castes and Schedule Tribes, out of which one must be a woman. Though state rules require that at least one women from the village is in the VP (Van Panchayat Rules 2001; Uttaranchal Government), this forced inclusion may not foster genuine participation in the VP. The female representatives often send their sons or husbands to the VP council meetings as they are reluctant to attend the meetings due to work load. The most obvious constraint is the heavy workload involving household work, collection of fuel wood, fodder, litter, water collection, taking care of children and performing agricultural activities. In this hilly region the village women have to travel 4-5 km daily to fetch drinking water, while simultaneously contributing almost 70-80 percent of agriculture work. Also, they feel that they are not encouraged by men to attend the meetings. In recent years this issue has been raised repeatedly and men in some cases seem to welcome women participation, but much progress has yet to be made.

Dhaili Van Panchayat

The Dhaili Van Panchayat is located at an altitude of about 1830 m above sea level (**Figure 4.1**). The area under this VP forest is about 60 ha, of which 56 ha is good forest (more than 58% crown cover). The Dhaili Van Panchayat was formed in 1999 and comprises of even aged oak (*Quercus leucotrichophora*) forest with undercanopy of *Myrica nagi* and *Rhododendron arboretum.* The average canopy cover of the forest is close to 60%.

Of the 1050 people living in Dhaili, 514 are males and 536 females, in 105 families. The average literacy of Dhaili village is 50%, with male and female literacy being 70.0 and 30.0%, respectively. The main source of income for the people is

Figure 4.1. Map of India showing location of Dhali

by working as daily labourers, and agriculture is secondary. The average income per family is about Rs. 32,422/year which in the Indian context is considered close to or below the poverty line.

The present strength of VP council is seven, with all male members. Fresh election for the Village VP council in light of new Forest Panchayat Rules is pending and hopefully will take place in the near future. The VP meetings are generally held once a month. The main source of the income for the VP are the sales from dry fodder at Rs. 10 per family, and green fodder at Rs. 30 per family or Rs. 10 per head load. In addition to sales of fodder, the imposition of fines also generates some income for the VP. The total income generated by the VP was Rs. 9,500 from the sale of permits and fines in the year 2004-2005.

After the formation of VP, the people of Dhaili accepted that the condition of their forest has improved, as indicated by the reduction of distance travelled for collection of fuelwood, fodder and drinking water. Some 150 temporary small earthen ponds (water percolation micro reservoirs) dug during 2003-2004 in the catchment of 4 major springs have increased water discharge in the springs during lean summer months. The VP of Dhaili also has a forest guard who is paid around Rs. 600-800/month which is met from the income generated by the forest and many people have been fined in last five years. The VP also carried out plantation of bamboo, bhimal (*Gravia optiva*), and utis (*Alnus nepalensis*) in about 6 ha in 2004-2005 with the help of villagers. The villagers also clear the fire lines for the protection of forest during the dry summer season. No fire has occurred in this forest in the past 10 years. However, there is no control of grazing in Dhaili VP.

In Dhaili VP all the families are using fuelwood for cooking and heating purposes. Though LPG is available in the area no family is using it. The daily requirement of fuelwood is 6-8 kg of dry fuelwood per family. The pattern of collection of fuelwood shows that about 85% is from VP forest, 10% from trees on private areas and 5% from government or reserved forest. Other non-timber products, for example, resin, medical plants, and lichens are rarely extracted from VP forest.

Impact of the Project: *Kyoto: Think Global, Act Local*

The village level investigators (selected members of the VP) have become trained in forestry measurements and mapping of the forest area. The measurements of biomass stocks and carbon sequestration rates of Dhaili VP are given in **Table 4.2**. This forest

Table 4.2. Carbon stock and carbon sequestration rates in forest types of Dhaili VP forest in Uttaranchal, India

Dhaili forest strata/ types	Above ground Carbon Stock (t/ha)		C sequestration rate (t/ha/year)	CO_2 equivalent (t/ha/year)
	2005	2006		
Even aged banj oak forest	172.1	176.5	4.4	16.2
Dense mixed banj oak forest	255.7	260.2	4.5	16,5
Mixed banj oak chir pine degraded	18.8	20.8	2.0	7.3

is sequestering carbon at the mean rate of around 12 tons carbon dioxide per hectare per year. As the area of this VP forest is 60 ha, it is sequestering a total of 720 tons carbon dioxide annually, worth US $1440 annually at a nominal rate of $2 per ton.

The situation in other VPs of Uttaranchal is similar. These VPs are using their forests on a sustainable basis and meeting their requirements of fuelwood and fodder. Their forests are sequestering carbon at a reasonable rate but with increasing population pressure from the village, the forest resources are under constant pressure from deforestation and degradation, and the situation could quickly reverse so that the forest becomes a source of carbon if care is not taken. To maintain these forests as carbon sinks it is essential that community forestry is given recognition under the climate change agreements. The importance of community forest management as a carbon sequestering measure should be recognized before it is too late.

Case Study

5

The Regeneration of Tomboroconto Forest, Senegal

Libasse Ba

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Introduction

Senegal is a country which is for the most part Sahelian, with a semi-arid climate. It has about 6 million ha of classified forests, representing 21.6% of its total area. In addition to the 213 classified forests, it has 20 silvo-pastoral reserves, 6 national parks, 8 special reserves and a number of so-called protected forests, which all together represent 31.7% of the total land area. In addition to conservation activities in these areas there is a significant amount of reforestation going on.

At the same time there are other forest areas, in harsh climatic conditions, which have a tendency to be over-utilised. These supply the fuelwood needs of part of the rural population and the growing urban population. In addition they are used by pastoralists for grazing. Some places are subject to salinization, various forms of erosion, wild fires and desertification. All these factors together result in an estimated deforestation rate for the country of 50,000 ha per year.

The area selected for this study was Tomboroconto (**Figure 5.1**), a community forest in the district Kedougou, south of the Niokolo-Koba National Park.

Participatory Forest Conservation Activities in Tambacounda

In Tambacounda region, the relatively favourable climatic conditions have resulted in a forest of considerable significance for the whole country. In Kedougou district the forest vegetation is abundant, but more and more species are threatened and in some places they have already disappeared. At first sight this does not appear to be too serious, but it hides a process of exploitation in which selected trees disappear completely. Species like 'ronier', a type of palm called 'siboo' in the Mandingue

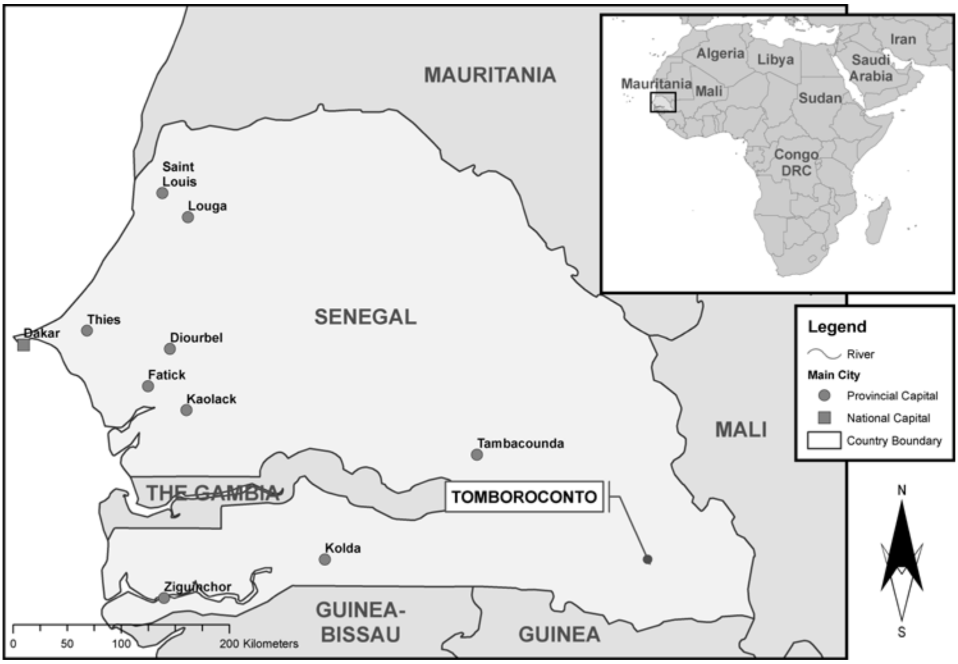

Figure 5.1. Map of Senegal showing location of Tomboroconto

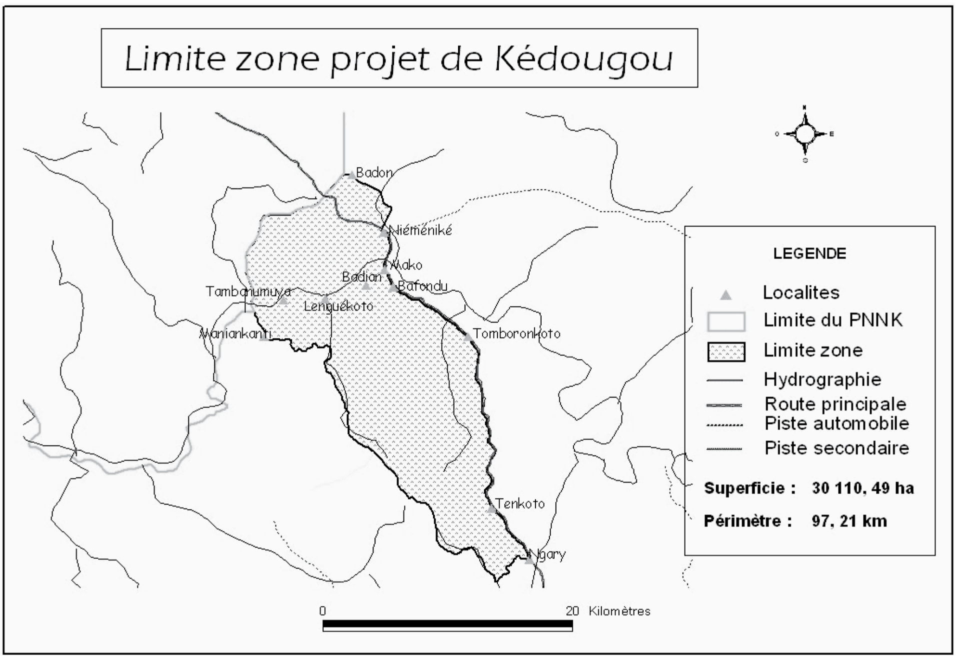

Figure 5.2. The map of Kedougou districts showing the location of villages managing Tambacounda forests

language, are almost extinct in these areas. Of the 160 tree and shrub species, 46 are in grave danger and a further 25 are likely to be so soon.

In this district, local populations in 11 different villages have recently been involved in natural resource management under a programme called PROGEDE[1], with the aim of halting the degradation of the Tambacounda forests (**Figure 5.2**). Firstly, they have been trained in silvicultural techniques such as nursery management, assisted regeneration and reforestation. Water catchment areas are being protected and village grazing areas have been set up. Remaining forest areas have been protected and forest tracks have been maintained. These activities have provided the means by which the local populations can earn more than they previously gained from charcoal production and firewood sales to the cities. Clearly, from a climate change point of view, the advantage is that the carbon stock in the area is increasing, which in the long run could be an additional source of income. It was for this reason that research was started to assess the potential of these kinds of activities for REDD carbon mitigation.

Development of Above-ground Carbon Stocks

In Tomboroconto, villagers were trained in 2005 to map forest areas under management using the hand held computers and to do forest inventory work, in a similar way as reported for the cases in Nepal and Tanzania. Here, protection activities have been carried out by villagers for the last five years. For comparison, secondary data for a site of very similar forest conditions and population density (Dialamakhan, in Kedougou district) is given, for the period before the management was started (2000), as data for Tomboroconto is not available for earlier periods. Although one has to be careful in comparing different locations, this does give some idea of the magnitude of the carbon stock changes that result from community forest management (**Table 5.1**).

Table 5.1. Above-ground carbon stocks (t/ha)

Type of forest	Dialamakhan in 2000 (before community management)	Tomboroconto in 2005 (after community management)
Forest	19.8 (72.6)	31.1 (114.1)
Woody savanna	8.0 (29.4)	18.1 (66.4)
Shrub savanna	8.2 (30.1)	18.2 (66.8)

Note: Numbers in brackets are the CO_2 equivalent

From these figures it appears that there has been an annual increase of about 10% in carbon stocks, or more than 7 tons carbon dioxide per hectare per year, as a result of management activities, although this varies by vegetation type.

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1 Programme de gestion durable et participative de énergies traditionnelles et de substitution

Conclusions

It is evident that the management activities are having a major impact on the restoration of ecosystems in the area. Although detailed ecological inventories have yet to be made, according to local people biodiversity is improving, as threatened species are present in larger numbers and some which have been absent for years are beginning to return.

It may be noted that the integrated forest management programme is having three major effects other than just increasing the carbon stocks and the fuelwood and timber supply. (1) As far as cattle raising is concerned, the management of forest track and water sources has improved production (2) Honey production has increased considerably due to the use of improved hives and (3) The provision of high quality poultry stock means the local population is not dependent anymore on hunting wild birds for protein.

Although the management was not carried out for the purposes of carbon sequestration, it is clear that there is an enormous potential for increasing sequestration in the future using quite simple participatory forest management techniques. From the figures on growth rates so far obtained, and assuming a price of $2 per ton of carbon net of transaction costs, an income of about $15 per hectare per year could be earned.

Case Study

6

Chitwan, Nepal: Will Poor People and Women Benefit Too?

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Introduction

In Nepal community managed forest has been seen not just as a tool to improve forest management but also as a means to alleviate poverty and promote equity in communities living in the periphery of the forest areas. Nepal is an agrarian society and from high land to the low land rural population is highly dependent on the land they cultivate and the forest from where they derive their basic needs. Forest is a source of livelihood, and most particularly for the poorer sections of the population. It is also a source of energy for the women, providing their supply of cooking fuel. Thus improved management by communities under the Forest User Group (FUG) system is envisaged as a means to help these groups particularly.

The concept of community forest was introduced in the late 1970's and over the last two decades it has proliferated over the whole country, with about 25% of the national forest area now under management by FUGs. The programme in Nepal is considered to have been successful over the years and several other countries have adopted the general concept. There are many studies which indicate success in terms of the overall physical improvement of the forest (Neupane 2003; Nurse *et al.* 2003), but up to now there have been almost no studies looking at the evidence for improvement in the local livelihoods, particularly of the poorer sections and as regards women.

If forest management which reduced degradation and deforestation were to be eligible for financial rewards in proportion to the carbon savings, as per the current discussion concerning reduced emissions from deforestation, then Nepalese community forestry might become eligible for carbon credits. The issue that is discussed in this chapter is whether the benefits of such payments would be likely to reach the poorer parts of the village community and in particular the women.

To make such an assessment, one needs to look carefully at the distribution of the benefits of forest management today.

Women and Marginalised Groups in Nepali Rural Society

Nepalese society is strongly hierarchical. Caste, religion and ethnicity are dominant social structures which traditionally effect control over, and access to, common resources such as forests. Furthermore, Nepalese society is patriarchal; most of the decisions, domestic as well as social, are made or influenced by men. As such women have less power in decision-making and in the case of women from poor and low caste groups, their voices are not heard or are simply ignored. It is common therefore in social studies of Nepali villages to differentiate between families of the higher castes, who tend to be richer, and so-called 'marginalised groups', lower caste or tribal people who are in general much poorer. Although the social status of women from high caste groups is also high, their power in practice is low because of the traditions within the family. Often women in general and the marginalised population groups are referred to as 'weaker social groups'.

The Organisation of Forest User Groups

A characteristic of the organisation of community forestry in Nepal is that the FUGs are socially heterogeneous, with members from both the dominant and the weaker social groups. The statutes require democratic decision making within the FUG, so this would seem to offer a vehicle for more participation of women and of poorer and marginalised groups and thus also an equal share in the benefits. The question is, whether this is the case in practice.

Several authors (Hobley 1996) have suggested that women are not equally represented in FUG decision making, since each household is normally required to send one member to meetings, which in most cases will be the male head of household. Others (Nightingale 2002) say that despite the principle of heterogeneity of FUGs, there remain power relations which result in more benefits reaching the more powerful members. In order to investigate whether these claims are valid, a case study was made in Baghmara Buffer Zone Community Forest (BZCF) in Chitwan, which is around 185 km to the south-west of Kathmandu.

The Community Forest in Chitwan

Baghmara BZCF is in Bachhauli Village Development Committee (VDC), located on the northeast boundary of the Royal Chitwan National Park. The area is surrounded by the Rapti River in the south, the Budi Rapti River and Khagedi River in the northwest and the human settlements in the east (**Figure 6.1**). It is under the jurisdiction of Department of National Park and Wildlife Conservation (DNPWC). Prior to the handover of the Baghmara Buffer Forest as community forest it was heavily degraded and deforested by illegal activities such as timber felling, unsustainable collection of fodder, over grazing etc. Since this area was an extension habitat for the wildlife and in order to stop further degradation and deforestation and to conserve the forest, a plantation programme started in 1989 and in 1995 the DNPWC handed over Baghmara Buffer Zone Forest as a community forest to the people living near the forest area. Baghmara BZCF has 215 ha comprising mono plantation, mixed plantation, natural regeneration, indigenous tree species such as sissoo (*Dalbergia sissoo*) and khayar (*Acacia catechu*), grasslands and lakes. The FUG currently has 780 households as members, and these come from all castes and tribes: high caste Brahmins; middle caste Giri and Shresthas; low caste Darai, Pariyar, and Kumal together with people from ethnic groups or tribes (Bote, Majhi, Tharu, Tamang, Musahar and Magar). The Bote, Majhi and Musahar are the lowest in this social hierarchy; they are all well below the poverty line and are illiterate. For the members who joined at the start (in 1996) there was no charge for membership, but for new members, the membership fee is Rs. 3,000 (wealthy class), Rs. 1,500 (middle class) and Rs. 300 (poor class).

Figure 6.1. Map of Nepal showing location of Chitwan

Involvement of 'weaker groups' in FUG Decision-making

Baghmara BZCF operates in accordance to its constitution and annual work plan approved by DNPWC. An executive committee is the apex body and is accountable for every activity that the FUG undertakes. Currently there are 13 members in the executive committee and these committee members were selected by the FUG members. The executive committee of Baghmara BZCF is socially heterogeneous and has representation from wealthy, middle and marginalised groups. According to the constitution of Baghmara BZCF, it is also mandatory to have at least two women members in the executive committee. Decisions made by the committee are first put in the general meeting and if two thirds of members agree, they are implemented. It is important to understand that in addition to daily management of the forest, the FUG is also responsible for the distribution of the forest products including any financial benefits that result from sale of forest products. In theory the executive committee works democratically and in a participatory manner, listing all the decisions to be made on an agenda for the general FUG meeting and accepting only those decisions that receive majority consent.

However, people of the Musahar tribe, a poor, marginalised group who are mainly involved in fishing activities, expressed their unhappiness as regards the composition of the executive committee. No Musahar has ever sat in the executive committee since the establishment of Baghmara Buffer Zone Community Forest. Currently, there are 23 Musahar households in the village and all live together in one part of the village in houses constructed by a Dutch NGO. Their children's education is funded by the same Dutch organisation. The adults in this group are illiterate and it is said to be for this reason that they have been excluded from the committee. They themselves do not often attend the general meetings of the FUG: they say that even when they are present, nobody listens to what they have to say. Their perception of the way the FUG works is that it is only nominally participatory, and that most decisions are made by the committee members or by the affluent members, and the general meeting is simply told what has been decided, rather than consulted.

There are 4 women on the executive committee, and these members are not from the high castes but from the better-off families of the marginalised groups. However, most of the decisions are made by the men members. The women have portfolios for particular tasks such as maintaining ledgers and organising meetings, and are involved in suggesting income generation activities that could be set up for other marginalised and poor women members, but weighing of the firewood during harvest and collection of money from eco-tourism is mainly done by the men.

Before a general meeting of the FUG, the members are informed about the agenda and the issues which are going to be discussed, but they are not consulted about it or asked whether there are other issues they would like to include. Most of the members have no idea or interest in what is in the forest management operation plan. Their concern is rather with the decisions on the use of money that flows from the forest management activities. Many members stated that most of the decisions taken by the executive committee relate to community development investments such as schools, road and embankment construction, installation of water taps, training for income generation activities such as bee keeping, stitching, goat and pig farming, and individual loans for biogas construction. By no means all of these decisions are discussed in the general meeting of the FUG, and it is the executive committee that controls what is on the agenda of these meetings.

It is perhaps not surprising then that attendance at these meeting is low, and many people leave the meeting early. Most of the poor members say they do not fully attend the meeting for two reasons: firstly, as already mentioned, because the important decisions are made without any consultative meeting beforehand, but also secondly because the meetings are long: they waste one full day's work, meaning that poorer members have to go to bed without food. One poor man from a marginalised group commented that the meeting date is pasted on the executive committee's office board but that he does not participate in any meeting called by the executive committee since it does not solve his livelihood problem, on the contrary, it makes life more difficult. For example, members of the FUG have been prohibited from fishing. Earlier they used to fish in the river for free but after the area was incorporated within the community forest, the executive committee has barred them from this activity, to protect the aesthetic view of the river. As for women: when asked why they did not attend the meetings, most of them responded that they do not like to attend the meeting because they sit at the back and don't hear what is being discussed and even if they put forward some ideas for discussion, their agenda is ignored. The result is that these "weaker groups" are little exposed to new information and knowledge in forest management, a fact which has been noted by other researchers in Nepal (Neupane 2003).

Distribution of the Forest Products

Power relations are crucial within community forestry because in many user-groups it is the socially dominant individuals who are influential within the management committee, yet it is believed to be the more marginalised members who are more dependent on forests and harvest the majority of the forest resources (Nightingale 2002). All members pay membership fees and collection fees for forest products. In Baghmara BZCF the members are allowed to harvest firewood twice annually, and this is usually done during the big festivals (*Dasain* and *Maghi*). For every 100 kilos of firewood a member has to pay Rs.50. On the other hand, grass and fodder may be collected throughout the year and there is no fee attached to this activity.

In the case study area, it seems that firewood collection is carried out by both better-off and poorer families, although some poor families sell part of their share to middle class and wealthy members. Other studies in Nepal indicate that the better off families may in fact be collecting much more firewood than poorer families (Neupane 2003). However in Baghara some women from poor and marginalised groups commented that they are unable to pay the collection fee as they don't have enough money. A few claim that that the Chief Warden of the Park has instructed committee members to distribute firewood free of cost to the poor members but that the committee has not done this. A number of women of the Musahar tribe say that although after paying the fee they are allowed to go inside the forest to collect firewood like all women members of the FUG, their group is instructed not to collect large branches, while women from more affluent groups collect large branches with impunity. If they are caught with larger branches, then the committee people reprimand them, and tell them they have to pay extra money. This is despite the fact that they do not have sharp sickles and are thus unable to cut as much wood as the high caste women. Their men folk cannot afford the time to collect wood because they have to go to work. Two days of patrolling and other forest work is obligatory for all male members, who in return are allowed to take a load of firewood on those days, but according to informants of the Musahar tribe the amount of firewood allowed is so little that it hardly lasts a few days for a large family.

Although grass and fodder may be collected throughout the year, and no fee is charged, even this does not always result in an equitable distribution. Unlike other groups, the Musahar do not gather fodder from the forest, since they do not possess cattle. Since fodder is, in term of volume, the major non-timber product of the forest, and given their complaints about the way they are hindered in firewood collection and fishing, some Musahar women are beginning to question whether it is worth being a member of the FUG at all. Yet the Musahar are the most vulnerable group in the whole community and depend more than any other group on natural resources. Evidently, the regulations and system of fees that have been introduced by the FUG are not really conducive to participation by this group, and create asymmetry in the sharing of resource benefits. It seems that even after ten years of operation, the Baghmara FUG is unable to address this problem.

Distribution of Other Benefits of Forest Management

Apart from firewood and fodder, which are direct products, considerable income is derived from the forest from the sale of timber, from the collection fees, from eco-tourism, and from funds from other organisations. For example, in 2006 Baghmara BZCF was awarded the prestigious King Gyanendra Nature Conservation Award, with prize money of Rs.100,000, by the Royal Nepal Academy of Science and Technology (RONAST), for contributing to sustainable development by promoting eco-tourism and conservation of biodiversity through community forest management.

These funds are used to support a variety of community development projects. Many of these are of a general nature and in principle benefit the village as a whole (road improvement, embankments, schools *etc.*), but others are targeted towards individuals, in particular the projects for training in income generation activities. These include bee-keeping, seasonal vegetable farming and animal farming. In addition, financial support is given to individual families for construction of toilets, rice husk stoves and biogas plants, in the form of loans.

These benefits do not reach all families equally. The Musahar women mentioned that they have not received any kind of training, only few are enrolled in adult literacy classes. In any case they do not have sufficient money to start any micro enterprise and cannot raise animals as they do not have land. So although the programmes devised by the executive committee are intended for poor and marginalised women, they are often in practice of little relevance to them. Most of the training sessions and workshops are in fact attended either by the wealthy or the middle class groups. "Weaker groups" are unable to attend as they are day labourers, and their families will go hungry if they miss a day's work (the workshops generally provide a meal for the participants, but the families of these participants of course do not get fed). One woman member of the executive committee explained that they try hard to bring poor and landless people into income generation training but they do not come. Most marginalised people, the poor and particularly poor women indeed leave their houses early in the morning to work as labourers in the road or building construction industry in the city and return home only after dark.

As regards the issuing of loans for the purchase of equipment, particularly for biogas, the "weaker groups" say that they do not benefit at all. The research showed that biogas is mostly installed in wealthy and middle-class houses, which is not surprising as the loan only covers part of the total cost, and only these families are able to pay the extra money needed for the installation. Moreover, it is only the wealthy and middle class that have enough cattle to supply dung for a biogas plant, and can afford to stall-feed them close to the house, which is necessary for transferring the dung to the biogas plant. The poor have fewer (or no) cattle, and lack the space to build stalls close to their houses, and the time to gather fodder for stall feeding. The poor do not take loans for other equipment such as toilets and husk stoves because they do not have any collateral and in any case they often have difficulty paying back the interest.

From this one can conclude that distribution of the benefits of the community forest management effort are not equally distributed within the community. It is not necessarily the case that this mal-distribution is deliberate on the part of the FUG and its executive committee, although the exclusion of the Musahar people does seem to indicate on-going bias. It is more that there is deep-rooted, structural inequality within the village already, which is very difficult to overcome. Indeed it would be very surprising if a single programme like community forest management were able to totally change these economic and social relationships, although recognition of the problems, and efforts to design community forest management procedures which take them better into account, could certainly be improved.

The Fate of Carbon Funds in the Future

If the local community were to be rewarded in financial terms for the carbon saved as a result of their forest management, would principles of equality hold, and would the poorer and less powerful part of the population, and women, benefit at all? The preliminary findings from the case study in Baghmara BZCF as regards the current distribution of benefits indicate that particularly as regards financial benefits, it is the richer parts of the population who gain most, even though most of the poorer people (Musahar excepted), and women, get a fair share of the products in terms of fodder and firewood. This outcome is not surprising since it is the men of higher caste and income that get to make the main decisions, despite the idea that the FUGs are supposed to be run on democratic lines. Whether this pattern would be repeated if a greater financial reward is entered into the system through sale of carbon sequestered or deforestation avoided, is not entirely clear. For example, one of the main reasons why the richer families benefit is because they are able to take loans for certain equipment from the community forestry fund; they have the means to match loans and collateral against the repayment. If money for carbon were not handled in the form of loans but (at least in part) distributed to members directly as an annual payment, then this problem should be overcome, and indeed the poor people would stand to earn a welcome, if small, additional income. It remains to be seen whether rules on membership would be tightened to limit membership in some way, if the financial rewards from carbon credits were considerable. At present membership is all inclusive. All this implies is that if equity goals are to be taken seriously, some serious consideration needs to be made regarding how the whole system of rules and procedures for internal payment of carbon services is to be designed, and that particular attention needs to be paid to how the needs and rights of the "weaker groups" will be guaranteed.

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Case Study

7

The Ikalahan Ancestral Domain, the Philippines

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Introduction

Long before the concept of Kyoto Protocol and terms like 'carbon sequestration' were popularised in the Philippines, the Ikalahans (literally, 'people of the broadleaf forest') were far ahead of them. How was that possible? This paper presents the project *Rewarding Upland Poor for Environmental Services* (RUPES) they provide in Kalahan, Nueva Vizcaya, Philippines and the activities of the Ikalahans for carbon sequestration.

The Ikalahans - Building the Foundation

The Ikalahans are the indigenous people in the province of Nueva Vizcaya in the northeast of the Philippines. They belong to the Kalanguya-Ikalahan tribe, which inhabits the Ikalahan ancestral domain. The domain, which includes the Kalahan Forest Reserve, covers 38,000 ha in Nueva Vizcaya plus about 10,000 ha in Nueva Ecija. The entire area is mountainous. It receives rainfall from 3,000 to 5,000 mm per year. Much of the area is forested, mostly with dipterocarp species, although the western edge is mostly pine. Some of the forests are primary, but most are secondary. Broad areas in the east are barren because of logging done by outsiders several decades ago[1].

The Ikalahans are known for their 'indigenous knowledge practice systems', which are environmentally sustainable. For generation after generation, the indigenous practices were transferred, protected and maintained. Among these practices are the

[1] KEF 2003 Kalahan forest service project proposal for RUPES action research, Kalahan Educational Foundation, unpublished. 14p.

day-og and g*engen*, which are ancient composting techniques on level and sloping land respectively to restore fertility of the soil in the period of three months. The *pang-omis* is a method of expediting the follow that was invented by one of the tribal elders while *balkah* is a contour line of deep rooted plants which trap eroded topsoil at the belt line (Rice 2000). With these, thousands of hectares of forestlands were preserved from further land conversion.

In 1973, Ikalahan tribal elders organised the Kalahan Educational Foundation Inc. (KEF) to protect communities from possible eviction by land grabbers. The foundation was used as an instrument since the government at that time was unable to negotiate for their rights. The KEF mission is to promote the education and protect the environment of the Ikalahan people and their ancestral domain. Among its aims is to provide sustainable forest-based livelihoods, improved watersheds and biodiversity (KEF 1993). Since then, KEF is considered a community-based organisation or a community-led organisation. It represents the legal personality of the Ikalahans in their Community-Based Forest Management Agreement as pioneers in the Philippines.

The foundation engaged heavily in community resource management and set up rules and regulations for resource use. The 'Ancestral Domain Sustainable Development and Protection Plan' strongly expressed their connection with conservation. It states:

> We, the Kalanguya-Ikalahan tribe, invariably equate land and the resources within it with life itself. We nurtured our indigenous systems for our land and resources management that have endured the test of time. For this reason, the recognition of our indigenous ability to sustainably manage our ancestral domain was made a matter of policy.

In 1994, the carbon stock measurement was set up. They promoted the Forest Improvement Technology (FIT) to expedite the growth rate of indigenous trees within the forest to improve carbon sequestration. According to Espaldon (2005), their activity is an indication that the forest management in the reserve is about 10 years ahead in terms of measuring ecological benefits of protecting forest ecosystems.

RUPES Programme Connects Payments

The RUPES programme, which aims to enhance livelihoods and reduce poverty of the upland people while promoting environmental conservation, recognized the efforts of the KEF. In 2003, Kalahan was chosen to be the first pilot site in the Philippines for the development of a carbon sequestration payment mechanism. RUPES tries to build working models of best practices for successful environmental transfer agreements from this case.

For this purpose, the RUPES in Kalahan focused on the continuation of the carbon sequestration study set up in 1994 by the KEF. The main objective is to examine the rate and extent of carbon sequestration potentials of the Kalahan Forest Reserve in the ancestral domain, and to look for potential buyers of this ecological service. With RUPES, the efforts of the Ikalahans to sequester carbon are recognized and could be rewarded through market-based mechanisms. Assessment and projection tools are implemented with different partners to further understand the possible environmental service rewards.

RUPES Kalahan in Action

The Ikalahans' community-led approach accounted for achieving the main objective of the RUPES Kalahan. RUPES Kalahan, through KEF together with the World Agroforestry Centre (ICRAF)–Philippines, is actively working to implement the five main strategies of RUPES.

Quantifying Environmental Services

In 1978 KEF started measuring the biomass in its old growth forests. The Ikalahans have their own community foresters who are continuously monitoring the growth of trees. From these records, carbon stocks were calculated. The accuracy of the calculations, however, was uncertain. It was not until 2003 under the RUPES project that improvements in the quantification of carbon stocks were made. The records from 1994 to 2004 are being updated. Also, the KEF started to quantify its watershed functions.

Developing Environmental Service Agreements

The legal identity of the KEF as a corporation and foundation (registered with the Security Exchange Commission) not only obtains the right to control the Ikalahans' ancestral domain, but enables them to negotiate effectively with local and international potential buyers .

To develop environmental service agreements, tools such as the Forest Agroforest Low Value, Landscape or Wasteland (FALLOW)[2] model were implemented to better understand the environmental service of the Ikalahans and equip them for the process of negotiation and development of agreements.

Supporting an Enabling Policy Environment

The Indigenous Peoples Right Act of 1997 (R.A. 8371) is a law that strengthens the rights of the Ikalahans to their ancestral land, and in 1999 ancestral domain claims were approved for a total land area of 58,000 ha.

Also, the Memorandum of Agreement No. 1 of 1973 is an agreement between the KEF and the Bureau of Forest Development that recognizes the right of the Ikalahans to manage their ancestral land and to 'utilize the area to the exclusion of all other parties not already "subsisting" within the area at the time of signing'. The agreement established 14,730 ha of land to be managed by the occupants through the KEF for a period of 25 years, renewable for another 25 years.

Moreover, the Philippines signed and ratified the Kyoto Protocol in 2003.

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[2] The FALLOW model is a spatial model of landscape dynamics. It is expected to capture annual dynamics of people's livelihoods by simulating how livelihood activities extract natural stocks and how natural stocks replenish, among others (Van Noordwijk 2002).

Figure 7.1. Raising awareness of farmers on the value of carbon sequestration in the ancestral domain (photo: KEF).

Raising Awareness of the Value of Environmental Services

The Kalahan Academy is the educational arm of the KEF. Through this, the KEF conducts ecology seminars and training activities in and around the domain. Subjects like ecosystem services and the Ikalahan indigenous practices are part of the curriculum for high school students. Special ecology seminars and training are given to farmers (**Figure** 7.**1**).

Forming Effective Partnerships

Most of the carbon buyers are international firms and/or groups. Though the KEF has already established partnerships with international research organisations, it is still widening its links as much as possible to tap carbon buyers. Promotional activities such as the publication of information kits about Kalahan are carried out.

The Ikalahans developed FIT, a technology to expedite the carbon sequestration of their old growth forests through that resembles natural culling and whose goal it is to improve the forest. Trees are cut continuously in small numbers every year by a local resident or forest farmer. In this way, the forest ecosystem is maintained and in the long run will lead to more sustainable income. The Ikalahans are confident that with this technology, carbon sequestration can be doubled in their forests.

The Counting Continues

Currently, the Ikalahans are developing two markets—the Kyoto and the non-Kyoto markets. The efforts they allotted since 1970s to measure the biomass of their old

Box 7.1. Forest Improvement Technology

FIT follows the natural rejuvenation process of the forest. Trees die or are felled by storms, while new seedlings will sprout and develop. Mature trees that have stopped growing are removed to create favorable conditions for forest rejuvenation. If this is done every year, the forest will continue to develop and improve. The removal of individual trees does not hurt the forest or its environment and provides first class lumber.

Each year the forest farmer makes a selection of trees to be cut. The farmer checks for crooked, damaged or crowded trees that need to be removed to improve the forest. Simple equipment is used, and the sawdust, tops and branches are left to rot because they restore fertility to the forest soil and help maintain biodiversity. The farmer does not separate the potential crop trees from the other trees because he knows that all trees have a role to play in the forest.

If there are large open spaces, a forest pioneer species will be planted first. Agricultural crops are not planted between the trees because they would bother the other plants that need to grow to make a good forest. Enrichment planting can increase the population of one or two species of large or small plants. This can be highly favorable as long as the forest is not turned into a plantation. The forest farmer will cut only a small amount of growth, allowing the forest to improve each year.

When the forest finally has its proper amount of wood, which is approximately 270 m^3 per ha, the farmer can begin to remove an amount equal to the total growth rate of 15 to 20 m^3 per ha per year. The farmer will have to do that to allow the seedlings to grow.

The growth rate presently expected in Philippine forests is about 4.5 m^3 per ha per year. Under proper management, using FIT, the forest can produce as much as 15 to 20 m^3 per ha per year. Such a forest still retains the characteristics of a natural forest.

It still has high biodiversity and is an effective watershed with a high percolation rate. It will also provide a sanctuary for many kinds of wild orchids, animals, birds and insects. If each forest farmer cares for 5 ha of good forest, he may harvest up to 80 m^3 of first class lumber every year without damaging the forest. That would provide him with higher cash income than many professionals and he would still have plenty of time to produce his own food on the farm. Once the forest has developed, it can be sustained indefinitely.

Source: Rice (2000)

growth forest are not wasted. With improved formulas for the quantification of carbon stocks, results can be utilized to negotiate for the non-Kyoto markets.

> The KEF began monitoring the growth of its forests. Its methods were not very accurate but they were helpful. When the RUPES consortium entered the picture and offered to help, we made contacts with a carbon expert at the University of the Philippines Los Baños (UPLB) who helped us to improve our computations to include branches and tops of the trees, not just the trunks. We discovered that we had underestimated the efficiency of the Ikalahan forests by at least 60%. (Delbert Rice, KEF director for research)

In 2002, KEF estimated around 38,383 tons of carbon dioxide were recycled by the Kalahan forests[3]. To date, the KEF is analyzing the 1994–2004 data using the improved formulas to quantify carbon stocks. Also, forest inventories are being carried out in the 62 blocks (approx. 10,000 ha). It is a huge task but the Ikalahans are confident that by the time they finish the project, they will able to compare the growth rates of three forest types (dipterocarp, pine and oak forests) and the carbon sequestration rates of 15 indigenous tree species.

In the meantime, the RUPES Kalahan team is preparing the CDM Project Design Document for the Kyoto market. The Kalahan forestry team, with technical assistance from ICRAF, also prepared the 'Forestry Project Idea Note (PIN) on Sequestration Project in the Ancestral Domain of Ikalahan'. The PIN proposes a carbon sequestration project on the 900 ha grassland portion of the domain. Among the activities conducted was the field measurement of carbon stocks in the grassland areas, which was carried out by the Kalahan forestry team.

The grassland areas to be reforested have been covered with grasses at least since 1990, and without the project activity they are expected to remain so. Thus the project sites are expected to regenerate as they have for decades, at a level considered insignificant under the CDM. For cropland areas, a similar baseline situation applies. These areas have been under cultivation with annual crops for decades and are expected to be planted with annual crops (Lasco *et al.* forthcoming).

The environmental service (carbon sequestration) to be provided by the project has been estimated under three rates of growth scenarios (**Figure 7.2**). The simulation was done based on the tree growth rates using the Philippine derived values (Lasco

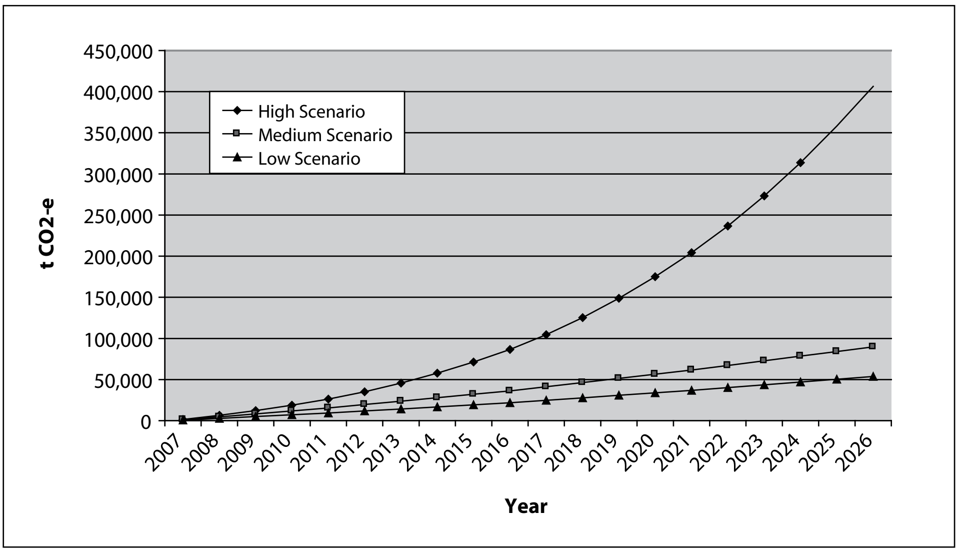

Figure 7.2. Estimated net cumulative CO_2e removals by the proposed Kalahan Reforestation Project, the Philippines

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3 KEF 2003 Kalahan forest service project proposal for RUPES action research.

et al. 2004) plus other assumptions and projected them using MS Excel program. The main purpose of the exercise was to assist the Kalahan indigenous people in obtaining funding for carbon sequestration services they could provide. For this purpose the estimated carbon sequestration rates will suffice since the objective is to show potential buyers the expected range of benefits.

In 2004, the KEF established two nurseries producing seedlings of various tree species for reforestation within the Kalahan Reserve and the adjacent communities covered by the ancestral domain. A total of 89,702 assorted, mostly indigenous forest trees were planted on approximately 40 ha within the ancestral domain, and enrichment plantings were done in many other portions of the forest. The Kalahan Forestry team initiated reforestation and rehabilitation activities in the grasslands, brushland and open areas.

Conclusions

The Ikalahans initiated all the project activities described for their aspiration of sustainable development of forests on mountainous terrain. They are working hard to achieve rewards from this environmental service. 'The Ikalahans carry all of the burdens while the people in the lowlands receive all of the benefits', as one local resident exhorted. And Rice (2004) points out, 'It seems that most of the needed legislation to enable the Ikalahan people to be remunerated for the forest services which they provide is already in place. The next step is to begin the dialogues with the beneficiaries of the forest services to convince them to pay for the services rendered.'

Although monetary payments are not yet realized, KEF's hard work is nevertheless well recognized. With the RUPES project, it builds the capacity of indigenous communities to begin the negotiation. It will also increase awareness and participation in carbon sequestration and other related issues in and around the ancestral domain communities through public education programmes. The KEF is looking forward that its efforts will soon be compensated with the best rewards.

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Case Study

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Laguna Lake Basin and Sierra Madre Community Forests, the Philippines

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Introduction

Climate change is one of the primary concerns of humanity today. The third IPCC assessment report concludes that there is strong evidence that human activities have affected the world's climate (IPCC 2001). The rise in global temperatures has been attributed to emission of greenhouse gases, notably CO_2 (Schimell *et al*. 1995). Forest ecosystems can be sources and sinks of carbon (Watson *et al*. 2000). Deforestation and burning of forests releases CO_2 to the atmosphere. Indeed, land-use change and forestry are responsible for about 25% of all greenhouse gas emissions. Forest ecosystems can, however, also help reduce greenhouse gas concentrations by absorbing carbon from the atmosphere through the process of photosynthesis. Of all the world's forests, tropical forests have the greatest potential to sequester carbon primarily through reforestation, agroforestry and conservation of existing forests (Brown *et al*. 1996).

Philippine forest ecosystems have likewise been a source and sink of carbon (Lasco and Pulhin 2000, 2003). Since the 1500s, deforestation of 20.9 million ha of Philippine forests contributed 3.7 billion tons of carbon to the atmosphere, 2.6 billion tons of which were released last century (Lasco and Pulhin 2000). Present land-use cover, however, also absorbs carbon through regenerating forests and planted trees. The vast areas of degraded land in the Philippines in fact offer great potential for carbon sequestration through rehabilitation activities such as reforestation and agroforestry.

In recent years, there has been an increasing interest in forestry projects under the CDM in the Philippines. The objective of this paper is to present two community-based AR CDM projects being developed in the Philippines. These are the Laguna Lake basin project and the Sierra Madre project. As these projects are still under development at this time, some aspects may change in the future.

The llda-Tanay Stream Bank Rehabilitation Project

Background

The Laguna Lake basin is one of the most important and dynamic land and water formations in the Philippines. It straddles Metro Manila and the fast developing region of Calabarzon (composed of the provinces of Cavite, Laguna, Batangas, Rizal and Quezon). It is an important source of agricultural commodities and industrial raw materials. Laguna Lake is considered to be the freshwater 'fish bowl' of Metro Manila and is also important for irrigation, transportation and energy production.

Because of its proximity to urban and industrial centres, the land and water resources of the basin are under severe stress. The total basin area is 382,000 ha, of which 198,640 ha are under some form of agriculture (LLDA 1995). Forest lands occupy 73,000 ha, of which only 19,000 ha are actually covered with forests. The rest are mainly denuded lands with grass and annual crops. The impact of land degradation processes is heavily felt in the lake. Siltation of the lake bed is one of the most serious problems that threaten the capacity of the lake to provide goods and services. The volume of water in the lake is essential for power generation, irrigation and navigation. It is roughly estimated that the rate of sedimentation is in the order of 1.5 million m^3 per year.

The Tanay microwatershed covers the municipality of Tanay. It lies at 14°30′ N and 121°17′ E. The municipality is 56 km east of Manila. It is bounded in the north by the towns of Antipolo, Baras, Teresa and Montalban in the province of Rizal. In the east, it is bounded by Quezon province, on the south by Sta. Maria, province of Laguna, and Pililia, Rizal, and in the west by Laguna de Bay.

The main proponents or sellers of this project are the municipality of Tanay and the Laguna Lake Development Authority (LLDA). The implementers will be farmers in the Tanay watershed, many of whom belong to indigenous groups (Santos-Borja *et al.* 2005). The local governments will, through multistakeholder river councils, identify and implement the subprojects. They will also be responsible for the collection of monitoring data to verify carbon emissions reductions and through participatory, transparent processes, and will allocate the revenues from the subproject emission reductions (ERs) to activities in the microwatershed and participant communities.

The main objective of the project is to reduce greenhouse gases (*i.e.* CO_2) in the atmosphere while helping rehabilitate the Tanay watershed and providing socio-economic benefits to the local people. Specifically, the project aims to

- reforest 70 ha of private lands,
- establish 25 ha of agroforestry farms on public lands and
- sequester 10,000 to 20,000 t of CO_2 from the atmosphere in 20 years.

It is expected that local communities will be the prime beneficiary of the project.

Farmers could benefit in at least two ways. First, by planting fruit trees, they are expected to gain additional income from harvesting them. The income from fruit trees could be significant since the area is in close proximity to Manila, the largest market in the country. In addition, it is expected that farmers will benefit from the proceeds of the sale of carbon credits. The exact mechanism for this is still being discussed.

Project Development Methods

The project is being developed through a World Bank grant to the LLDA, which is already implementing an existing World Bank watershed project, and the local government units in the watershed. The basic idea is to superimpose production of carbon credits on the existing project components. An information campaign was conducted in the various local government units (LGUs) to increase their awareness of the potential to gain carbon credits through their project activities. Initially, the municipality of Tanay was the first LGU to develop AR CDM projects for carbon credits. The project has three components: stream bank rehabilitation, ecological enhancement and agroforestry.

Stream bank rehabilitation: The purpose of this activity is to increase the riparian forest cover of the Tanay river in order to reduce erosion. Under this component, owners of private lands will be encouraged to plant trees along river banks within their property. Seedlings will be given for free after an information and education campaign and a pledge of commitment to the project. Provision of seedlings and support services will be contracted through Katutubo, an upland village consisting of indigenous Dumagat and Remontado groups. A total of 20 ha will be reforested.

Ecological enhancement in upland areas: The purpose of this second subcomponent will be to reforest upland areas near the headwaters of the Tanay river in order to reduce erosion. A total of 50 ha of denuded and grassland areas will be reforested. Provision of seedlings, planting and maintenance will be implemented by the village of Katutubo. The species will be chosen by the community and will provide them timber, fruit and medicinal resources.

Agroforestry orchard: The purpose of this subcomponent is to provide income for Katutubo through agroforestry while reducing erosion in the upland areas. This component will be undertaken in an area of 25 ha of communal land belonging to this indigenous community. It will integrate mango trees at 10 x 10 m spacing with cash crops using an alley cropping design.

Preliminary Results

Expected greenhouse gas benefits: The expected greenhouse gas (GHG) benefits were calculated using a high and low scenario. For the project period (2004–2014), the project will have total net carbon benefits of 3,204 tC (11,759 tCO_2e) and 1,424 tC (5,230 tCO_2e) under the high and low scenarios, respectively (Santos-Borja *et al.* 2005). The anticipated total emission reduction purchase agreement value is US$31,380 for the low scenario and US$70,554 for the high scenario. Total carbon sequestration for the 20-year project duration is shown in **Figure 8.1** under various scenarios.

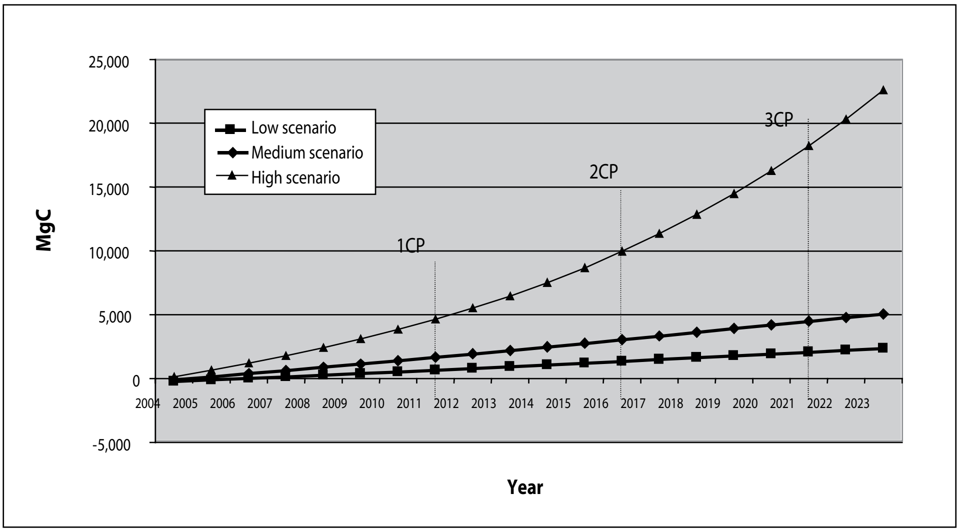

Figure 8.1. Net carbon sequestration under various scenarios of the LLDA project in Tanay, Rizal

Expected buyers of carbon credits: In the Philippines, the World Bank is the only firm buyer thus far of emissions reductions from sinks project through its LISCOP project with the LLDA. The BioCarbon Fund will purchase the emission reduction units. The BioCarbon Fund provides carbon finance for projects that sequester or conserve greenhouse gases in forests, agro- and other ecosystems (www.carbonfinance.org). It is designed to ensure that developing countries, including some of the poorest countries, have an opportunity to benefit from carbon finance in forestry, agriculture and land management. It is expected to help reduce poverty while reducing greenhouse gases in the atmosphere. The BioCarbon Fund is testing how land use, land-use change and forestry activities can generate high-quality ERs with environmental and livelihood benefits that can be measured, monitored and certified, and stand the test of time.

Intermediaries: For the LISCOP project, LLDA will act as the carbon financing intermediary and technical advisor for the proponent local governments in the Laguna de Bay watershed. During preparation, LLDA will act as technical advisor, ensuring the subproject is technically sound, meets environmental and social safeguard policies and undertakes the necessary analysis and administrative requirements for carbon finance. It will monitor the execution of the subprojects from a technical, environmental and social perspective and act as intermediary in monitoring and verifying emissions reductions and channelling revenues from carbon credits back to local governments.

Compensation mechanisms: The BioCarbon Fund is expected to pay US$4 per ton CO_2e, which is on the high side of carbon prices offered by the World Bank's other carbon funds. The details of the compensation mechanism are still being worked out at the time of writing. Key issues are: (a) how will the carbon income be divided among stakeholders? (b) will farmers receive their share individually or as a group? (c) what types of projects, if any, will the carbon income finance? and (d) what is the role of LLDA in fund administration?

Current Status

At present, other LGUs in the watershed have expressed interest to likewise develop AR projects. These projects will be bundled together to form one small-scale project (with less than 8,000 tons of CO_2e removal per year). The Project Design Document (PDD) of the project is currently being validated.

The Sierra Madre Project

Background

The Sierra Madre Biodiversity Corridor (SMBC), covering approximately 1.7 million ha, is one of the most biologically important areas in the Philippines. It includes 15% of the remaining closed canopy dipterocarp forests in country as well as 47% of the remaining mossy forests. Aside from the diverse habitat types, the corridor is also home to the endangered Philippine eagle. Part of the SMBC is the Northern Sierra Madre Natural Park, the largest protected area under the National Integrated Protected Area System of the country. The park is one of the few areas in Asia that contain a high concentration of threatened species. Seventy globally threatened or near-threatened species of wildlife have been recorded in the park. In addition, it harbours the largest remaining lowland forest in the Philippines.

The proposed carbon sequestration project is part of Conservation International (CI)—the Philippines' concerted efforts to build alliances with local communities, private sector, government agencies and nongovernmental organisations (NGOs) to facilitate the management of the SMBC and strengthen enforcement of environmental laws. It uses a multifaceted approach to alleviate threats and to restore and protect 12,500 ha of land within the corridor.

The ultimate objective of the project is to demonstrate that a properly designed and implemented carbon offset project not only offers an economically attractive, risk-managed portfolio option, but also generates multiple benefits such as biodiversity protection, watershed restoration, soil conservation and local income generation. It will also demonstrate that tradeoffs such as soil erosion, water table decrease and loss of livelihoods can be avoided. Specifically, the project has the following initial objectives:

- To reduce pressure on the natural forest and provide incentives for local communities, the project will work to establish an agroforestry project on 2,000 ha brushland that will supply a more stable income to the population and lessen the reliance on forest projects.
- To facilitate the sequestration of carbon dioxide from the atmosphere and increasing the connectivity of sensitive habitats for the world's most threatened species, the project will restore 5,500 ha of grassland areas to original hardwood forests using a mix of fast-growing species and native species.

The main strategy of the project will be community-based forest management. The key stakeholders of the project will be the local community, local NGOs, LGU, the Department of Environment and Natural Resources (DENR), the project monitoring team, and the funding organisation. The project is located in Quirino province about 400 km north of Manila between 16°15′00″ - 16°27′30″ N and 121°40′00″ - 121°52′30″ E.

The following discussion is based on the preliminary study conducted to explore the feasibility of implementing a CDM project in the area.

Project Development Methods

The site development technologies to be used are common to the Philippines. There has been a long history of reforestation and tree planting in the country, and it was more than 100 years ago that the first reforestation project was implemented.

Reforestation: Reforestation will be done by planting a combination of indigenous and fast-growing species in grassland areas. Ideally, preference should be given to the use of indigenous species as these are better adapted to the site, but the approach of combining fast-growing and indigenous species is deemed to be prudent in this case for two reasons. First, the sites for the project activity are open and marginal grasslands. Fast-growing species have proven ability to compete with Imperata grassland. They could then provide a better microclimate for indigenous species, which could be introduced either naturally or artificially in the understorey once the grass is suppressed. Secondly, there is minimal experience in planting indigenous species in open grasslands. Using a combination of indigenous and fast-growing species thus improves the chance of success and mitigates risk to the project.

Agroforestry farm development: Upland farms are widespread in the project site. They usually involve planting of annual crops such as rice, corn and vegetables for subsistence and/or cash. They have high soil erosion rates and are therefore not sustainable, especially in steep slopes. They will eventually end up as degraded grassland area without any intervention.

The main strategy in stabilizing these farms will be by agroforestry development. Agroforestry involves the planting of woody perennials in conjunction with agricultural crops. Many forms of agroforestry exist in the Philippines, ranging from alley cropping to multistorey systems.

Fruit trees will be introduced in upland farms that are devoted to annual crops. This will help reduce erosion and increase income of farmers. Farmers will be given a choice of species to plant. The following fruit trees have been identified as suitable for the area: avocado, caimito, jackfruit, mango and pummelo. Trees will be planted at a 10 x 10 m spacing to allow for intercropping of annual crops. In this way, the current practices of farmers will not be radically changed.

From the carbon sequestration point of view, the main advantage of fruit trees over forest trees is that only the fruits are harvested so that the bulk of the carbon in the biomass is conserved. In addition, it is in the best interest of the farmers to prevent fire because they want the trees to bear fruit, unlike in a purely reforestation project where the main income is derived from planting trees. There is also little chance of farmers allowing their own farms to be converted to forest tree plantations because of bureaucratic red tape associated with getting permits for harvesting trees. In contrast, no such regulations govern the harvesting of fruit trees.

Stakeholder participation: Comments from local stakeholders were solicited through a series of two workshops early in the development of the project. During the first workshop, which gathered representatives from government agencies, NGOs and academia, the concept of CDM and eligible projects were discussed. The workshop also provided an opportunity to orient stakeholders on the proposed CDM forestry project. After receiving an overview of the CDM concept and of the proposed forestry project, participants were asked to identify criteria in choosing specific sites. The criteria identified by local stakeholders and that established by the CDM were used to identify specific sites for the project activity.

The second workshop involved the local communities inside the proposed project site. The main objective of the workshop was to increase awareness of the project on the part of local communities and to solicit support and participation from them. Similar to the first workshop, the second workshop began with the presentations of papers to provide the participants with an overview of the concept of CDM, eligible projects under the CDM and the proposed forestry project. After the presentations, a forum was provided to express issues and concerns on establishing the CDM forestry project. Towards the end of the workshop, a resolution was drafted, discussed and finalized. The resolution signed by the local communities is an indication of their support of the implementation of the carbon sequestration project.

Preliminary results

After 30 years, it is expected that a total of 512,000 tC will be sequestered by the project, most of which will come from the reforestation component (**Figure 8.2**).

The project's long-term social development outcomes are related to the watershed-wide benefits of reduced sedimentation in the rivers, reduced flooding (*e.g.* less damage to assets and less time lost) and reduced topsoil erosion (*e.g.*, improved

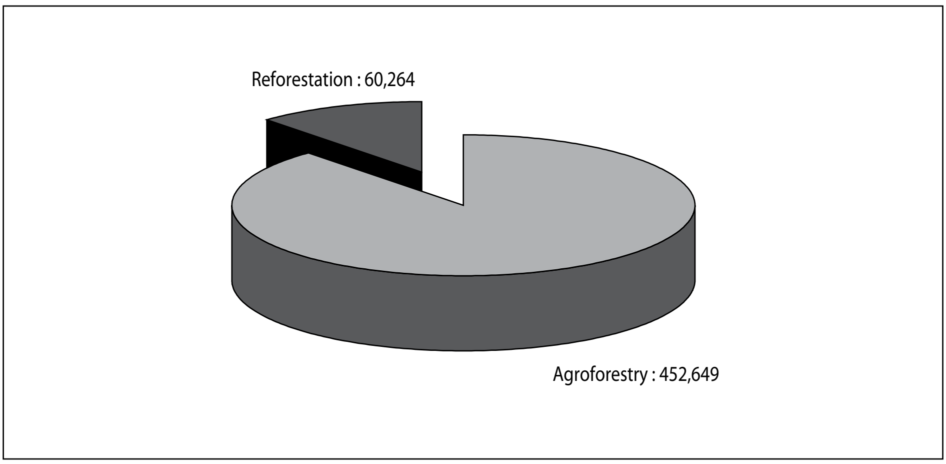

Figure 8.2. Total net carbon benefits (in tC) of the reforestation and the agroforestry components of the project

agricultural production in the long term). In the short term the project will result in livelihood improvement (through agroforestry), aesthetic improvements and reduction of localized erosion problems.

Local communities will benefit from the project. Reforestation components offer substantial employment opportunities for residents in the area. In addition, the agroforestry component has the potential to provide a long-term source of income.

Current Status

After two initial studies since 2001, the PDD is now being prepared. There were initial consultations with the Designated National Authority (DNA) and it is expected that the PDD will be completed in early 2008.

Opportunities and Challenges

There is great potential for carbon sequestration projects in the Philippines owing to its biophysical condition and the presence of land areas that could and should be reforested (Lasco *et al.* 2001). There are literally millions of hectares in the uplands that pose ecological and economic threat if forest cover is not restored. There are, however, challenges that need to be overcome in order for the full potential of the carbon market to come to fruition.

To date, the DNA has not endorsed a single AR CDM project to the United Nations Framework Convention on Climate Change (in contrast more than five energy projects have been endorsed). Recently, there is the positive signal that the government through the DENR is finally moving to pave the way for AR CDM projects in the country. A technical evaluation committee for AR CDM projects is being constituted and capacity building activities are currently underway. It is highly likely that the two projects presented here will be the first ones to seek DNA endorsement.

The key challenge is to streamline the DNA procedures so that potential project developers are not discouraged. Early signs are encouraging. The DNA promises to reach a decision within 21 working days upon submission of a PDD. After more than a century of trying to reforest the Phillipines' denuded areas, the country has little success to show for it. The CDM offers a way of funnelling new resources that could assist in achieving the vision of a green Philippines.

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Case Study

9

Singkarak: Combining Environmental Service Markets for Carbon and Watershed Functions?

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Introduction

The hills surrounding Lake Singkarak at the equator in Sumatra are a mosaic of natural forest, strongly degraded forest, grassland, failed reforestation projects, home gardens and agroforestry systems, separated from the lake by a zone of intensive paddy rice cultivation. There are clear opportunities for an increase in carbon stock through trees that farmers want and expect to gain the benefits from. A substantial part of the grasslands belongs to the community, and negotiations over resource sharing for reforestation on the state forest land are ongoing.

In 2002, the National Strategy Studies on CDM conducted by the Indonesian Ministry of Environment identified the Singkarak watershed as one of the potential sites in Indonesia for implementing a reforestation-carbon project. Despite its preparedness, the project has not obtained confirmed buyers in engaging in the carbon market. One of the reasons for the difficulties in finding investors is that the project was initiated when most of the rules regarding implementation of the Kyoto Protocol and the carbon market in Indonesia were still in an embryonic stage[1].

[1] Indonesia ratified the Kyoto Protocol in 2004 under Indonesian Law 17/2004 after more than four years of legislative and heated public debates.

An Indonesia-wide study to determine eligible districts for afforestation/reforestation (AR) under CDM categorized the two districts of Singkarak - Solok and Tanah Datar - as a Cluster 1 District (Murdiyarso *et al.* 2005). A Cluster 1 District has low to medium fire risk and still has, given its population density, substantial forest left. The site can well serve as a representative case for this 'cluster 1', as there is a substantial area that was deforested before 1990, while the track record of forest protection is good.

In 2004 the site joined the Rewarding Upland Poor for Environmental Services (RUPES) they provide program as one of six main learning sites for a program focused on mechanisms and modalities for poverty reduction through rewards for verifiable environmental services to the global and national communities. Under RUPES, the Singkarak project is seeking to build the capacity of local communities by developing institutions at relevant scales. As part of Indonesia's decentralization of government, West Sumatra province has restored the traditional form of local government in the form of *nagari* to replace the 'village' as lowest unit. Based on traditions, the *nagari* has broader responsibilities for local natural resource management in addition to the administrative role of 'village'.

Within the RUPES framework, Singkarak is an action research site that combines efforts to more directly link to watershed protection the existing monetary flows from the hydroelectricity plant to provincial and district governments (**Figure 9.1**) with efforts to participate in the global carbon market. By bundling the carbon sequestration and watershed protection as environmental services provided, the Singkarak project is prepared to take part in both local and international tender for its environmental service provision. The concept of bundling services, however, forms a challenge for the CDM concept of additionality and the apparent preference of investors for 'new' sites, where they can be in a more controlling role rather than being part of a 'bundle'. We will first describe the setting and efforts so far.

A Watershed in the Heartland of the Old Minangkabau Kingdom

The Singkarak watershed forms the heartland of the old Minangkabau kingdom. The southern part of the watershed forms Solok district, and the northern part, Tanah Datar. Lake Singkarak is a deep depression in the rift valley of the Bukit Barisan mountain range and covers nearly 10% of the watershed. Its natural outflow via the Ombilin river feeds into the Indragiri river, which flows to Riau province. The total area of the Singkarak watershed is about 129,000 ha. About one third of this area, or 43,000 ha, is considered to be 'critical land' mostly covered by *Imperata* grassland but also including land used for dryland agriculture, paddy fields and housing. Most of these critical lands with high slopes belong to the clan (*Ulayat Kaum*) and local community (*Ulayat Nagari*), whiled only a small part belongs to the state.

In 2002, about 400,000 people lived in the Singkarak watershed, at a density of around 205 people per square kilometre. According to official statistics, about 10% live below the poverty line. Dryland agriculture and fishery are the main income sources for the majority of people around Singkarak lake, while 10% of the people

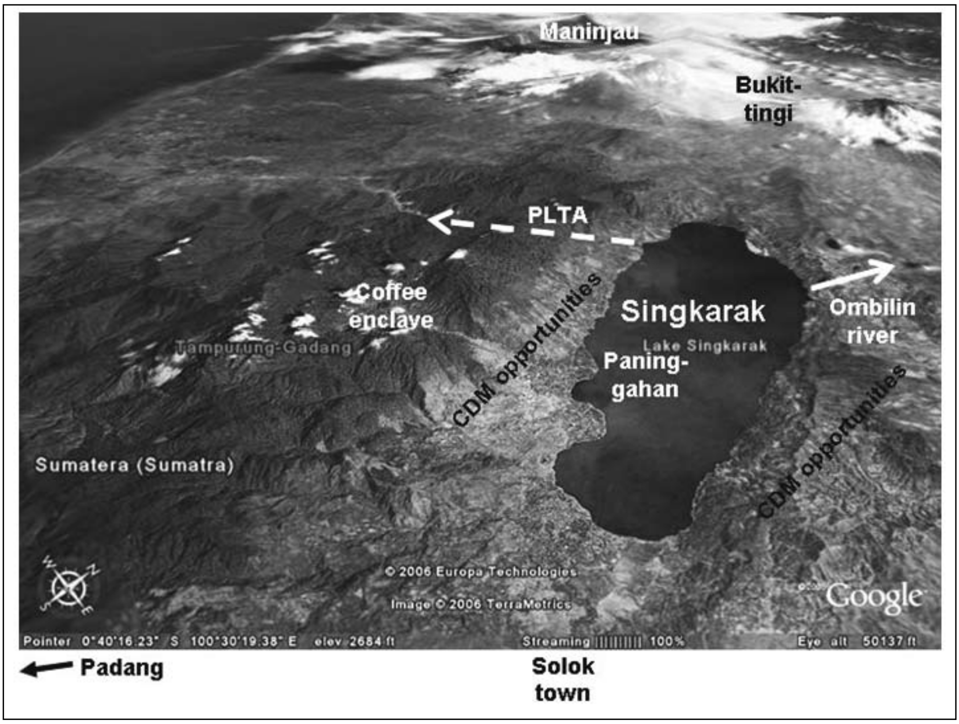

Figure 9.1. Bird's-eye view of Lake Singkarak in the rift valley amidst the Bukit Barisan mountain chain, which runs the length of the island, the forested escarpment that separates the lake from the Indian Ocean on the left (west), the grass covered hills to the east and west of the lake and the rice paddies at lake level; while the natural outflow of the lake to the Ombilin river has been reduced to an 'overflow' channel, most of the water now passes through a tunnel to a hydroelectric scheme (PLTA) to the west; the village of Paninggahan owns a coffee enclave in the natural forest zone

still practice swidden agriculture or shifting cultivation. The watershed is famous for native agriculture products such as good-quality rice, called *Bareh Solok,* and local fish, *Ikan Bilih*. Fish production is declining. The roles of overfishing on the one hand and land degradation and unsustainable land-use practices on the other hand are still under discussion.

Nagari, a Distinguished Local Government System

The 'reformation' era in Indonesia in the beginning of this millennium has benefited the Singkarak communities. New decentralization policies launched in this era have revived the significant roles played by informal leaders in the governance system in West Sumatra, including in Singkarak (Arifin 2005). Unique to other districts in Indonesia, they apply the *nagari* government system, which is an autonomous, locally based institution led by a *wali nagari,* who is directly elected at village level. Each *nagari* government governs and enforces its traditional norms and conventions.

Each *nagari* has representatives or a parliamentary body called *Badan Perwakilan Anak Nagari* (BPAN). It consists of *adat* elders (*ninik mamak*), religious leaders (*alim ulama*) and intellectuals (*cerdik pandai*). The BPAN usually also involves the *adat* women organisation (*bundo kanduang*) and the young generation (*pemuda*). Besides the BPAN, there exist a supreme body of consultative *adat* agency called the village council, or *Kerapatan Adat Nagari*, and consultative institutions, *Badan Musyawarah Adat dan Syarak*. Benda-Beckman (2001) and Arifin (2005) provide more complete reviews of the *nagari* system.

In the beginning of 2000, local authority in managing natural resources had triggered environmental awareness within the communities. In *nagaris* surrounding the lake, they gradually started small-scale land rehabilitation and reforestation efforts, mostly using forms of agroforestry. A rehabilitation effort called Million Trees Planting Program started in February 2003 at Junung Sirih subdistrict, Kanagarian Paninggahan. The target of this rehabilitation program is to restore about 540 ha per year, or about 2,700 ha in five years. Progress is slow, however. Using the community fund, the program is able to rehabilitate only 30–40 ha in six months. Despite the slow rate of progress, the communities have a sense of belonging of their self-initiated efforts in protecting the environment. Current efforts are in stark contrast to previous government initiatives in which community members were seen and treated only as labourers for planting trees under reforestation mega-projects of the government. Therefore, these projects often spent a great deal of money with minimal success.

An institutional study of Singkarak showed that the *nagari* system acknowledges self-ownership both by societal rules and formal state rules (Arifin 2005). These imply that informal rules are well-defined and enforced. On the other hand, the society in Singkarak is generally aware of formal rules enforced by the state. Local people generally understand and comply with no-trespass rules for state-owned forest land, which also apply to land ownership. Land ownership—or more precisely the 'right to use' the land—is governed through locally defined conventions with *kerapatan nagari*, a decision-making institution. The communities generally trust their *nagari* leaders that they will govern and enforce norms and conventions for the sake of overall prosperity. The *nagari* system does enhance social bonding capital and reduces conflicts among community members.

Bundling Environmental Services: Potential Benefit Transfers Exist

In the emerging environmental service markets four environmental services are usually recognized: biodiversity conservation, carbon sequestration, landscape beauty preservation and watershed protection. From the buyers' side the markets for these different environmental services are distinct, as the beneficiaries of services differ by location. From the sellers' side, however, joint production of services is possible and efficient. In other words, investment in the production of one service results in the simultaneous production of other services (Landell-Mills and Porras 2002). In Singkarak, two environmental service reward schemes have high potential: carbon sequestration transfer benefits and watershed protection. The local government, however, has seen that landscape beauty and biodiversity conservation also have potential to be further developed. The tourism office of West Sumatra is now setting up plans to revive commodities that had virtually disappeared, such as Kacang orange (*limau kacang*) and *ulu* coffee (*kopi ulu*); it also supports efforts to domesticate the bilih fish to sustain its production in a lake that is protected from pollution. Through the Ministry of Industry the central government will support revitalization of *Kopi Ulu Paninggahan.*

Participation in Carbon Markets

In 2004, the Indonesian government ratified the Kyoto Protocol and established Designated National Authorities for CDM. These efforts are to allow Indonesia to participate in CDM projects. Carbon benefits generated by CDM projects, such as carbon sequestration projects through AR, can be sold or purchased by developed countries. The Singkarak project is being prepared to take part in an international tender under RUPES.

As previously mentioned, Singkarak lake is located in two districts, *i.e.* Solok and Tanah Datar. The total area of CDM eligible lands in these two districts is about 40,000 ha in Solok and about 30,000 ha in Tanah Datar (Murdiyarso *et al.* 2005). The total area proposed for AR CDM so far is only 15,000 ha, all in Solok district, surrounding Lake Singkarak. These lands have been cultivated as dryland agriculture

Figure 9.2. Condition of land proposed for AR CDM project at Singkarak

since the early 1950s. Erratic rainfall and inherently infertile soil have become the constraints in this cultivation. Most of the land has been abandoned and has turned into grassland and shrubs (**Figure 9.2**). These natural factors combined with financial and technical barriers are the main difficulties communities face in rehabilitating the lands. Therefore, their engagement in the carbon market may afford additional support from external beneficiaries in both land rehabilitation and reforestation.

CDM Project Design

According to interviews, about 45% of farmers preferred to establish an agroforestry system, while 55% preferred monoculture tree systems. To establish the system, about 80% of farmers required financial support, while the remaining required technical support. Furthermore it was found that farmers prefer to have fruit trees rather than timber as the price of timber is relatively low**.** Therefore, species and varieties used as well as planting arrangements in the project will follow farmers' preferences. **Table 9.1** presents the list of species to be used and the areas tentatively allocated to them.

Table 9.1. Species to be used for CDM project at Singkarak, based on farmers' preferences

English name	Local name	Scientific name	No. Household involved	Area allocated (ha)	Rate of planting (ha/yr)
Teak	Jati	*Tectona grandis*	1,500	1,500	300
Mahogany	Mahoni	*Swietenia mahogani.*	1,500	1,500	300
Surio	Surian	*Toona sureni*	1,500	3,000	600
Cacao	Coklat	*Theobroma cacao*	1,500	1,500	300
Manggo	Mangga	*Mangifera indica*	1,500	1,500	300
Durian	Durian	*Durio zibethinus*	1,500	1,500	300
Candle nut	Kemiri	*Aleurites moluccana*	1,500	1,500	300
Avocado	Alpokat	*Persea americana*	1,500	1,500	300
Clove	Cengkeh	*Eugenia aromatica*	1,500	1,500	300
			Total	15,000	

The project will monitor the following carbon pools: aboveground biomass, belowground biomass and soil organic carbon. Deadwood is not considered, as new plantations will not acquire significant deadwood volumes during the project cycle. Similarly, the litter layer will contribute only a small amount of carbon to the total. Some studies (Zaini and Suhartatik 1997; Tiepolo *et al.* 2002) showed that fine litter contributed only 0.6% and 5.0%, respectively, to the total carbon stock in secondary forest and degraded land, while deadwood contributes only 0.3% of total carbon stocks in secondary forest; in primary forest litter contributed 1.7% and deadwood 3.2%. In general it can thus be said that the latter two pools account for less than 5% of the total carbon stock. The crediting period being selected for the project is the renewable crediting period, *i.e.* 20 years with two possible extension of 20 years each. The type of credit being produced is that of temporary certified emission reduction, or t-CER. Baseline and monitoring methodology will follow Approved Methodology 'reforestation of degraded land' (AM0001) with deviation. The methodology is downloadable from the United Nations Framework Convention on Climate Change website (http://cdm.unfccc.int/methodologies/ARmethodologies/approved_ar.html).

The estimated cumulative net greenhouse gas removal by sinks will be about 4 million ton CO_2e. Using the t-CER system, the project will produce about 0.54 million tCO_2e in year 10, 1.7 million tCO_2e in year 15, and 4 million tCO_2e in year 20 (**Figure 9.3**). A study at one of the other proposed CDM sites in Indonesia indicated that even without considering the income from sale of CER, this type of project is financially attractive. Boer *et al.* (2006) found that using a discount rate of 12.7% (interest rate for agriculture project long term loan), without including the sale of CER, the net present value of the project is about US$441/ha and the internal rate of return (IRR) is 32.8%. With the inclusion of CER, the IRR will increase slightly, depending on the price of the CER. The IRR increased by 1.7% at a CER price of US$4/t$CO_2$e, by 3.3% at a CER price of US$8/t$CO_2$e and by 4.6% at a CER price of US$12/t$CO_2$e.

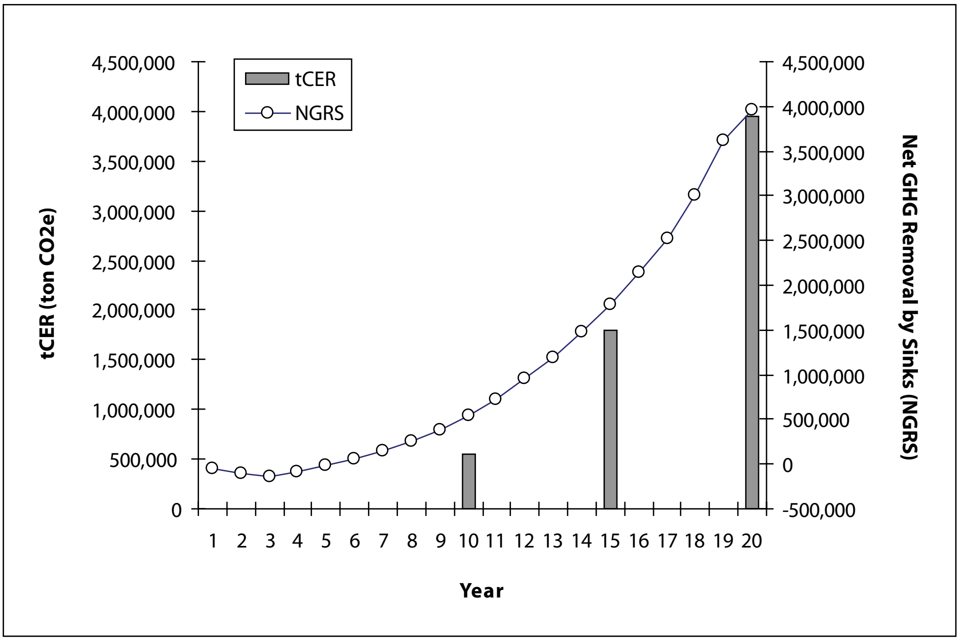

Figure 9.3. Net greenhouse gas removal by sink and t-CER produced by the projects

The main barrier to implementation of this type of project at Singkarak is the investment barrier and the absence of suitable credit facilities. If the AR CDM project is to be implemented, farmers expect the government to provide them with planting materials as well as other agriculture inputs, particularly herbicide for killing grassland. Considering the decision made at CoP11 regarding further guidance relating to the CDM, paragraphs 20 and 21 of which state,

> . . . a local/regional/national policy or standard cannot be considered as a clean development mechanism project activity but . . . project activities under a programme of activities can be registered as a single clean development mechanism project activity . . . [provided that CDM methodological requirements are met. And] . . . large scale project activities under the clean development mechanism can be bundled,

the government may consider Singkarak part of the programmatic CDM. With this scheme the government may provide financial support. Additional funding for investments is also sought from the PLTA Singkarak.

Tapping Transfer Benefits from Watershed Function

The lake contributes to the livelihoods of both people surrounding it and those living downstream. A state-owned hydroelectric power (HEP) company built a water tunnel starting in the western part of the lake and produces about 986 GWH per year. This electricity supply covers two provinces, West Sumatra and its neighbour, Riau. The lake still is the source of the Ombilin river, which irrigates rice paddy fields in four downstream districts.

The HEP cannot escape from the environmental problems caused by degradation of the watershed condition, which potentially aggravate the fluctuations in annual rainfall that are part of the local climate. In a period without rainfall, the water level of the lake can drop nearly 1 m per month if the HEP operates at full capacity. A drop of more than 2 m in level causes the HEP to stop operation and hence causes blackouts in the areas depending on its electricity. Local rice farmers also have to stop operation in dry periods and/or may lose crops in which they have invested.

As part of RUPES, a rapid assessment of hydrological functions of the Singkarak watershed was made, comparing the perspectives of local people, government officials and scientists (Farida *et al.* 2005; see **Box 9.1**). The study concluded that the watershed needs to balance three objectives: to maintain a clean lake, to produce electricity for the two provinces and, most importantly, to meet expectations of the large population residing upland and downstream for productive landscapes on hills and irrigated plains.

Based on national regulations, the local government in West Sumatra has issued its own regulation on the utilization of tax money derived from the use of surface and subsurface water. Such income, as derived from the HEP, is shared among provincial government (30%), the district that produces the tax (35%) and other districts of West Sumatra (35%). Further regulation on how this tax should be used or distributed to the community is unavailable, however. For this year, water tax collected from the Singkarak HEP was about Rp 2.2 billion (US$250,000), and about Rp 777 million (US$88,300) has been distributed to Solok and Tanah Datar districts. The *wali nagaris* expect that most of this tax will be given directly to the local community through the *nagari,* and therefore they also requested the district governments to issue a regulation on tax distribution. The funds gained from such

Box 9.1. Rapid Hydrological Appraisal of Lake Singkarak Watershed Functions

The rapid hydrological appraisal of Farida *et al.* (2005) analyzed perspectives of a range of stakeholders—local communities, researchers and policy makers. A topic that appeared to be controversial is the effect of planting *Pinus merkusii* or other fast-growing evergreen tree species on the quantity of water supplied to the lake. Although these species were favoured by foresters for past 're-greening' efforts, water use by canopy interception and transpiration of such trees reduces total water yield to the lake, and the expected increase in regularity of flow through better soil structure will not fully compensate this effect.

The hydrological model pointed to a strong dependence of HEP performance on variations in annual rainfall and possible increase of El Niño years with long dry seasons under the influence of global climate change. This effect exceeds that of local land cover change. The study pointed to the importance of maintaining water quality in the lake for all stakeholders, with concerns over sediment inflow, as well as nutrients and urban waste.

Reforestation efforts using appropriate tree species and focused on relevant 'erosion hot-spot' locations can lower sediment influx to the lake and improve regularity of water flow. As part of these findings were surprising to some of the stakeholders, good communication is needed to avoid over-responses on perceptions that reforestation is either sacred or evil. It requires 'the right tree in the right place'.

tax distribution may be a source of investment in watershed protection. Use of these funds to maintain sustainable management of the Singkarak watershed will increase both internal and external benefits for the communities. A transparent mechanism for the allocation of such funds is needed.

Institutionalizing Environmental Service Rewards in Singkarak

The process for institutionalizing RUPES at the Singkarak site has followed a number of steps. The first step was the identification of the range of environmental services that can be provided by the landscape managed by the communities, as well as of barriers for the implementation of effective reward schemes. The second step was the establishment of appropriate institutional arrangements for transfer payment, agreements, monitoring system and enforcement mechanisms. An important lesson from the first step involved scale. With the shift towards management of water quality in the lake it became important to have cooperation between all lakeside *nagaris*, and a relevant forum has now started. The third step, currently, is piloting the RUPES program and disseminating best practices and lessons learned from these projects to raise awareness at all levels on how the transfer of payments in delivering environmental services can benefit upland communities.

In its first and second year, the RUPES Singkarak has successfully clarified its environmental services and potential schemes in getting rewards from the external beneficiaries based on scientific data. Main activities in the second step were to identify types of rewards and to set up institutional setting at *nagari* and district level as well as regulations needed to support the implementation of the RUPES program. Activities being conducted in the third step include the piloting of institutional processes for the provision of environmental services and the enabling of the local institutional system to implement an environmental services program.

The regional institutions are the Joint Committee as a means for negotiation between sellers and buyers, the Joint Audit as monitoring and enforcing institution and the Management Body for Singkarak Lake as representatives of sellers at higher level, coordinating all activities and development on the scale of Singkarak lake basin. At the more localized level, an environmental management body has been established for each *nagari* surrounding the lake.

From the stakeholders process it was suggested that the principle of giving reward or compensation for environmental services should follow four principles, namely, (i) an individual or community receiving benefits from the environmental services should pay, (ii) any individual or community being affected by the development activities that damage the environment should get compensation, (iii) any individual or community that contributes to the environmental enhancement should get rewards, and (iv) any individual or community that contributes to environmental damage should pay compensation.

Following these principles, any individual or community giving the rewards will be considered a 'buyer' of the environmental services, while the ones who receive the rewards will be considered 'sellers' of the environmental services. The main difference between rewarding and compensating is that in a rewarding process, sellers have (voluntary) roles in either maintaining or rehabilitating the environment, while in a compensating process, the individual or communities are (involuntarily) affected by environmental damage.

Through a consultation process with related entities and agencies, it was considered that governments (central and local), the private sector (hydropower and electricity companies) and international communities may be buyers, while the community that contributes to the improvement of environmental quality (local and global) in the form of environmental services will be sellers.

In this institutional system, the central institution in Singkarak is the Joint Committee, a forum where buyers and sellers can negotiate and discuss environmental services projects and agree on price and financing system. The community or farmers' group that has a program could prepare a proposal and submit it to the Joint Committee, which could then assist or facilitate the further process such as by finding buyers. When buyers and seller reach an agreement and the project is implemented, there would be a Joint Audit that will evaluate and monitor the achievement of the seller in conducting the project activities. In conducting the activities, the seller or the provider of the environmental services will get supervision from local government or any entity at the local level that has the capacity to do such services. In this case, governments could act as regulators, intermediaries and also as buyers.

At the regional level, the communities surrounding Singkarak Lake represented by the *wali nagaris*, heads of Kabupaten Solok and Tanah Datar districts and representatives from the local House of Representatives discussed the institutional system for coordinating all the development processes at Singkarak Lake. It was agreed that such an institution should be formed and it would be named Management Body for Singkarak Lake (*Badan Pengelola Danau Singkarak*). A series of meetings to discuss the formation of this entity as well as its role and function are being held. It is expected that the management body will play an important role in representing the environmental service sellers at higher levels in engaging the reward schemes.

Institutional Model at *Nagari* Level

In less than two years, the RUPES Singkarak team has succeeded in strengthening the local institutions. Pioneered by Nagari Paninggahan as the core *nagari* for the RUPES Singkarak project, 13 local environmental organisations at *nagari* level have been established. The mission of these local organisations is to become a means for environmental service providers in enhancing the local role in environmental management and directly involving them in any potential environmental services reward schemes. These local institutions have *nagari*-specific structures, which means that local conditions and needs will be the main consideration when making any decisions.

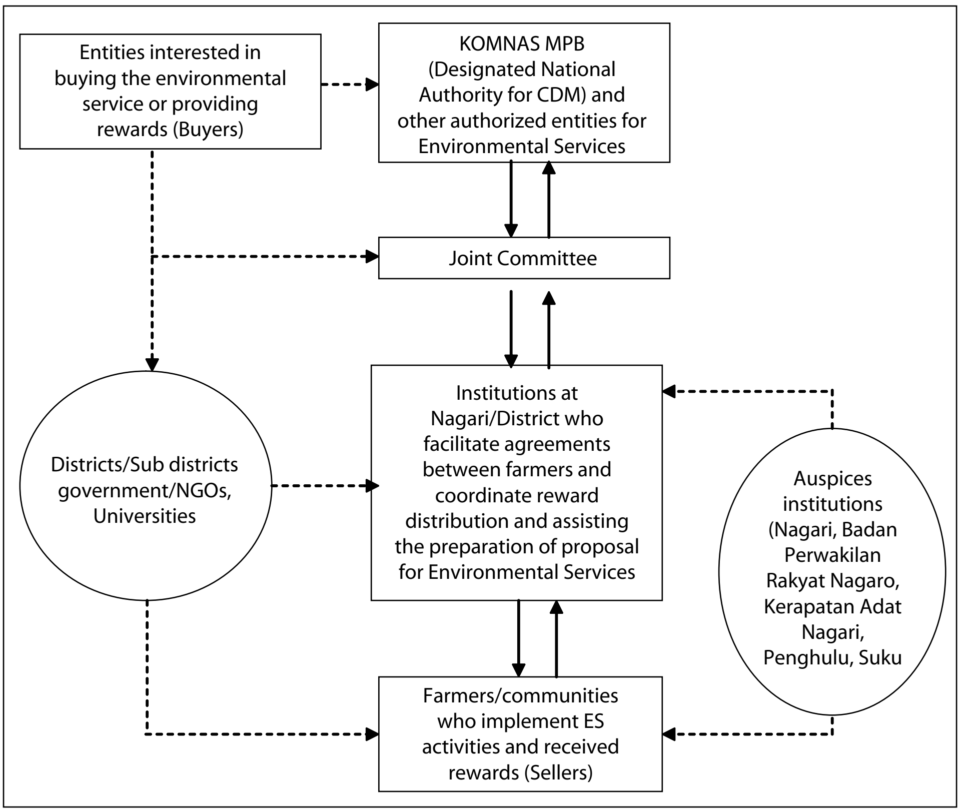

Figure 9.4. Relationships among local and national institutions on environmental services rewards.

The relationship between institutions at *nagari* level and other institutions (**Figure 9.4**) shows that at the national level institutions are being formed by the government of Indonesia that will give approval to any proposal related to carbon services. These institutions are National Commission for CDM, or KOMNAS MPB in Indonesian, which is formed through Environmental Minister Decree Number 206/2005, and CDM Working Group which is mentioned in the Forestry Minister Regulation Number 14/2004.

In order to make the above institutional system operational and sustainable, further activities are still needed. Consultation with government and parliament members should be continued (new local regulations may be needed, *e.g.* rewards distribution system, funding allocation system to communities or villages should be based on achievement).

Conclusions

The Singkarak case shows that to engage in the environmental service markets a site should address not only environmental responsibility but also social responsibility. By prioritizing social responsibility, the success of the project will be ensured. The Singkarak case fits the pro-poor approach and scientific evidence in the management of a watershed. Planting tree-based and agroforestry system with carefully selected species that benefit and comply with the preferences of local communities as well as are able to provide environmental services can become an example.

After clarifying problems at different scales of watershed, its potential environmental services and reward schemes, the Singkarak team under the RUPES program decided that the most critical step was to strengthen institutions at both local, regional and provincial levels. Strong institutions based on specific local conditions and customary systems have proved their effectiveness in governing environmental management and enforcing goodwill for communities' overall welfare, including enhanced participation from communities.

At the local level, the Singkarak case shows the potential to build on the *nagari* system as the core system for establishing more just and sustainable environmental service reward mechanisms, especially for local communities as sellers. This customary based local governmental system is rich in well-defined and enforced informal rules—including ones for environmental protection, society-based collective actions and respect for land ownership. All of this conditionality could reduce conflicts and support credible commitments to supply environmental services, which assumedly can further reduce transaction costs—costs incurred in the creation, alteration, protection or enforcement of property rights for engaging in environmental service markets.

A challenge, however, in current CDM guidelines is that 'additionality' is more difficult to assert if in fact there are multiple reasons for and benefits to be derived from the interventions that will enhance local carbon stocks. While 'synergy' is lauded, we still need a credible answer to the question why such landscape rehabilitation has not happened spontaneously, if its economic rates of return plus local environmental benefits make it attractive. Part of the answer is that a degree of collective action is needed that requires a 'trigger'. Another part is valid especially for the state forest land, where use of conditional tenure instruments has only recently become legally possible.

In getting broader opportunities, the Singkarak project is undertaking the bundling of two environmental services: carbon sequestration and watershed protection. Difficulty in finding proper buyers is one of the challenges faced by the project. Therefore, the maintenance of positive, or at least neutral, environmental service supplies for both watershed protection and carbon sequestration is expected to tap local and international transfer benefits for environmental services.

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Case Study

10

Way Tenong and Sidrap: Tree Planting and Poverty Alleviation, Indonesia

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Introduction

Under the regime of the Kyoto Protocol, the CDM through its window for 'reforestation' projects can facilitate the transformation of lands that were deforested before 1990 into tree-based land use systems. However, any proposed application of the mechanism will have to ensure additionality (increases of carbon stock in the accounting area due to the CDM intervention over and above what would be expected for a location-specific baseline) and account for leakage (negative effects on carbon stocks outside of the accounting area that are causally linked to the CDM intervention). Furthermore, the mechanism will also have to qualify as 'development', by providing positive socio-economic impacts for the local community by alleviating poverty in the landscape. A direct consequence of the multiple administrative requirements that follow from these concerns, however, are the substantial 'transaction costs' (Cacho *et al.* 2002; Cacho *et al.* 2003; Cacho 2006). A specific issue derives from the confounding of 'leakage' and 'additionality'. The use of nearby 'control' areas for appraising additionality assumes that leakage is negligible, while their use for quantification of 'leakage' assumes the absence of spontaneous change. As the multiple drivers of land use and land cover change are hard to predict, the *ex ante* impact appraisal of carbon sequestration projects is difficult and the economic value on the global carbon market only applies to 'certified emission reduction' statements, after the fact. The procedures before the start of a project thus include substantial risks to all parties involved, translated to further transaction costs.

In fact, a number of barriers to adoption of tree-based systems are commonly observed (Van Noordwijk *et al.* 2003), lack of legal access to land and lack of profitability within the current local economy being the most common. Further barriers are based on gaps in farmers' knowledge, lack of community-based fire control, lack of capital availability for investment and lack of direct access to markets for tree-based commodities. Fostering the development of tree-based systems can be achieved by removing those constraints through extension, recognition of land tenure or easing of administrative procedures (set up to control illegal logging) for transport of farmer-grown wood (Van Noordwijk *et al.* 2005). So far, most government initiatives address only the supply of planting material through 'trees planting campaigns', and not the underlying factors of land access. Project scale interventions often revert to subsidies to make tree growing look attractive, rather than to more long-term approaches to increase profitability. Interestingly, removal of constraints to land access and simplification of procedures for market access of farmer grown timber does not cost much, so the need for external investment in CDM is limited. While the farmers can get direct economic benefit from the trees, the local government unit that eased the regulations can later sell the 'certified emission reductions' and use the proceeds to enhance local welfare, without requiring any new benefit sharing mechanisms. In fact, such approach would become similar to the market for carbon credits between countries with a commitment to reduce their net emissions. Our hypothesis is:

> Farmer-led development of tree-based land use systems in response to accessible markets, legal tenure arrangements, availability of reliable technical information and local investment can convert degraded forest lands at low public cost and form an attractive alternative to project-based interventions with detailed prescriptions and planning.

We tested the consistency of the hypothesis with available data for two sites designated for CDM in Indonesia: Sidenreng Rappang (Sidrap) in South Sulawesi and Way Tenong in Lampung. These two sites have been selected from a much larger number of potential sites on the basis of institutional readiness, compliance with formal Kyoto Protocol criteria and interest of local stakeholders to enhance the tree biomass in their landscape (Murdiyarso *et al.* 2006).

For both sites, we explored the plausible effects on farmer income and terrestrial C-stocks for two alternative approaches: a 'reforestation' project design with set prescriptions for planting of specified trees at fixed spacing ('project approach') and a generic removal of constraints to all smallholder tree-based production systems ('programmatic approach'). For this purpose, we used a simulation model, the Forest Agroforest Low Value, Landscape or Wasteland (FALLOW) model, to explore the causality chains of land use changes as outcomes of complex human decision making processes. The FALLOW model simulates landscape dynamics and its consequences on the basis of 'drivers' and 'scenarios'. Farmers' decisions, potentially influenced by top-down interventions (*e.g.* CDM interventions), are translated into their spatial consequences for land use and associated carbon stocks. Detailed description of the model is provided elsewhere, *i.e.* Van Noordwijk (2002), Suyamto *et al.* (2003), Suyamto and Van Noordwijk (2005).

Method

We parameterized the FALLOW model for Sidrap in South Sulawesi and Way Tenong in Lampung and calibrated a number of parameters that cannot be independently measured, as described below. After a 'limited calibration' phase, we initialized with land cover data for 1990 and compared observed and simulated land cover change over a period of 10 years to assess the model's validity. The model's uncertainty in carbon stocks predictions was assessed by separating uncertainty on land cover fractions from uncertainty in carbon stock per land class unit. Accepting the model's validity and uncertainty, scenario-based simulations were carried out to 'evaluate' project-based and programmatic approaches.

Options and Economical Attraction

Available options of land use systems in the study sites were identified based on land use/cover maps derived from Landsat imageries, verified through ground surveys. There are four main land use systems available in all sites: natural vegetation systems, agroforestry systems, tree monoculture systems and agricultural systems. The form of agroforestry systems, monoculture plantation systems and agricultural systems vary between sites. In general, Sidrap is cashew growing area, while Way Tenong is coffee growing area.

Profitability of land use options and off-farm jobs in the study sites were estimated based on rapid surveys and secondary data. Payoffs to labour (Rp/person/day) are used to indicate profitability, and defined as profit earned per total labour employed. Profitability of cashew-based systems in Sidrap is about Rp 58,000/person/day, much higher than the provincial-level wage rate of about Rp 26,000/person/day. *Gmelina*-based systems in this area have potential profitability of about Rp 34,000/person/day. Profitability of coffee-based systems in Way Tenong is about Rp 16,000/person/day, a bit lower than the provincial-level wage rate of about Rp 20,000/person/day. In general, agricultural systems in both sites have potential profitability of about Rp 10,000/person/day.

Labour Capital

Labour was estimated using population data from the year 2003 provided by a census at village level, with assumed annual population growth of about 2.3% per year, labour fraction of about 75% and annual working days of about 220 days per year. Estimated labour for Sidrap and Way Tenong in the year 1989 was 940,830 and 2,343,811 person-days respectively.

Land Capital

Land expansion is restricted by some costs: transportation, land clearing and controlling costs. Transportation cost is determined by road or river. Land clearing cost is determined by slope and floor biomass. Controlling cost is determined by settlements or existing plots. In Sidrap and Way Tenong, land expansion is strongly restricted by land clearing cost, less restricted by controlling cost, and barely restricted by transportation cost. The latter can be explained because the main commodities of the sites, cashew and coffee, do not require massive transportation in harvesting.

Land expansion is also restricted by accessibility for the conversion of grasslands. Accessibility to convert grasslands for other uses is strongly influenced by either land use policy or farmers' knowledge on tree/crop-site matching. Relatively low access to grasslands in Way Tenong (about 40% on average) is confirmed to be closely related to forests conservation policy, while relatively high access to grasslands in Sidrap (about 74% on average) is mainly caused by farmers' misinterpretation of legal tenure rights.

Fire

Based on land use/cover maps, unchanged grasslands for the years 1989–2000 occupied 30% and 18% of the total area in Sidrap and Way Tenong respectively. It is the evidence of fire-climax state due to frequent fire events. Based on a rapid survey, farmers confirmed frequent control burning of grasslands in the study sites as part of pest control.

Aboveground Biomass Growth

Growth of aboveground biomass of natural vegetation systems and tree-based systems was estimated using the general asymptotic function of age $y = y_{max} (1 - \exp[-\beta.age^{\gamma}])^{\eta}$ (Vanclay 1994). The parameters (y_{max}, β, γ and η) were estimated based on secondary data using the nonlinear least squares fitting procedure. Since the temporal resolution of the FALLOW model is yearly, it is assumed that aboveground biomass from agricultural plots is zero.

Project Boundary

Proposed project areas for Sidrap and Way Tenong are about 1,152 ha and 8,943 ha respectively. To estimate additionality and leakage, the model was applied to larger areas: ± 85,365 ha in Sidrap and ±30,576 ha in Way Tenong.

Results

Validity

The validity of FALLOW model was tested by its capability to explain driving factors of previous land use/cover change. The spatial goodness of fit between simulated land cover maps and their references was measured using multiple resolution procedure proposed by Costanza (1989). For Sidrap, spatial goodness of fit of agriculture is 33%; grasslands, 57%; forests, 28%; mixed tree-based systems, 38%; and cashew monoculture, 49%. For Way Tenong, spatial goodness of fit of agriculture is 32%; grasslands, 71%, forests, 88%; coffee multistrata systems, 41%; coffee simple shade systems, 72%; and coffee monoculture system, 21%.

Comparison between simulated land cover maps and their references was also done in terms of area difference. In Sidrap, area difference of agriculture is –14%; grasslands, –10%; forests, +60%; mixed tree-based systems, +10%; and cashew monoculture, +6%. In Way Tenong, area difference of agriculture is –43%; grasslands, –11%; forests, +29%; coffee multistrata systems, +32 %; coffee simple shade systems, –17%; and coffee monoculture system, +124%.

Uncertainty

Uncertainty of the model in predicting carbon stocks was estimated by comparing total aboveground carbon stocks estimated from reference land use/cover maps and total aboveground carbon stocks estimated from simulated land use/cover maps. In this case, uncertainty can be caused by carbon density estimates or by simulated land use/cover. For Sidrap, the uncertainties were +13.16 t CO_2/ha due to carbon density and +6.53 t CO_2/ha due to land cover fraction. For Way Tenong, the uncertainties were +13.31 t CO_2/ha due to carbon density and +5.35 t CO_2/ha due to land cover fraction.

Land Use/Cover Changes

Scenarios were developed to simulate land use/cover changes in Sidrap and Way Tenong for the years 2000–2030, with regards to baseline, project interventions and programmatic interventions. Settings for baseline simulations follow the validation settings. Scenarios on programmatic approaches include removal of constraints to smallholder tree-based production systems by recognizing farmers' tenure rights, improving farmers' knowledge and improving tree-based markets.

Baseline trajectory of landscape in Sidrap would likely maintain grasslands and natural forests, reduced agricultural area and slightly increased tree-based systems (**Figure 10.1A**). Project intervention did not help much in converting grasslands into tree-based systems (**Figure 10.1B**). Through programmatic approaches, grasslands could rapidly be converted into tree-based systems (**Figure 10.1C, D, E**).

Baseline trajectory of landscape in Way Tenong would likely convert grasslands mostly to agricultural lands and maintain current coffee-based systems areas (**Figure 10.2A**). With the relatively large area of the proposed CDM project, the project intervention helped to decrease agricultural lands expansion, although it could not convert all grasslands into coffee-based systems (**Figure 10.2B**). By giving legal tenure right to access grasslands freely and/or by promoting coffee-based systems (through market improvement and extension), grasslands could rapidly be converted into coffee with simple shade and coffee monoculture systems (**Figure 10.2C, D**). By giving legal tenure right to access grasslands for multistrata coffee systems practices and promoting multistrata coffee systems, grasslands could rapidly be converted into such systems (**Figure 10.2E**).

Carbon versus Farmers' Welfare

Consequences of land use/cover changes on carbon additionality, carbon leakage and farmers' welfare (*i.e.* nonfood expense per capita) were estimated. The baselines of Sidrap indicated relatively static carbon stocks (+0.15 t CO_2/ha/year) but a negative change in welfare (– Rp 220,000/capita/year). The baselines of Way Tenong indicated negative changes both in carbon stocks (–0.95 t CO_2/ha/year) and welfare (– Rp 71,000/capita/year).

Carbon additionality was calculated based on the difference of carbon stocks after 'interventions' from the baselines. Leakage was calculated as additionality gained at project scale minus additionality gained at landscape scale, relative to additionality at project scale. Welfare improvement was calculated based on differences of nonfood expense per capita after 'interventions' from the baselines. The CDM project in Sidrap was predicted to cause carbon leakage of about +197%, while the project in Way Tenong was predicted not to cause leakage. In terms of carbon gain or welfare improvement, programmatic approaches were superior to a project-based approach in all sites (**Tables 10.1, 10.2**).

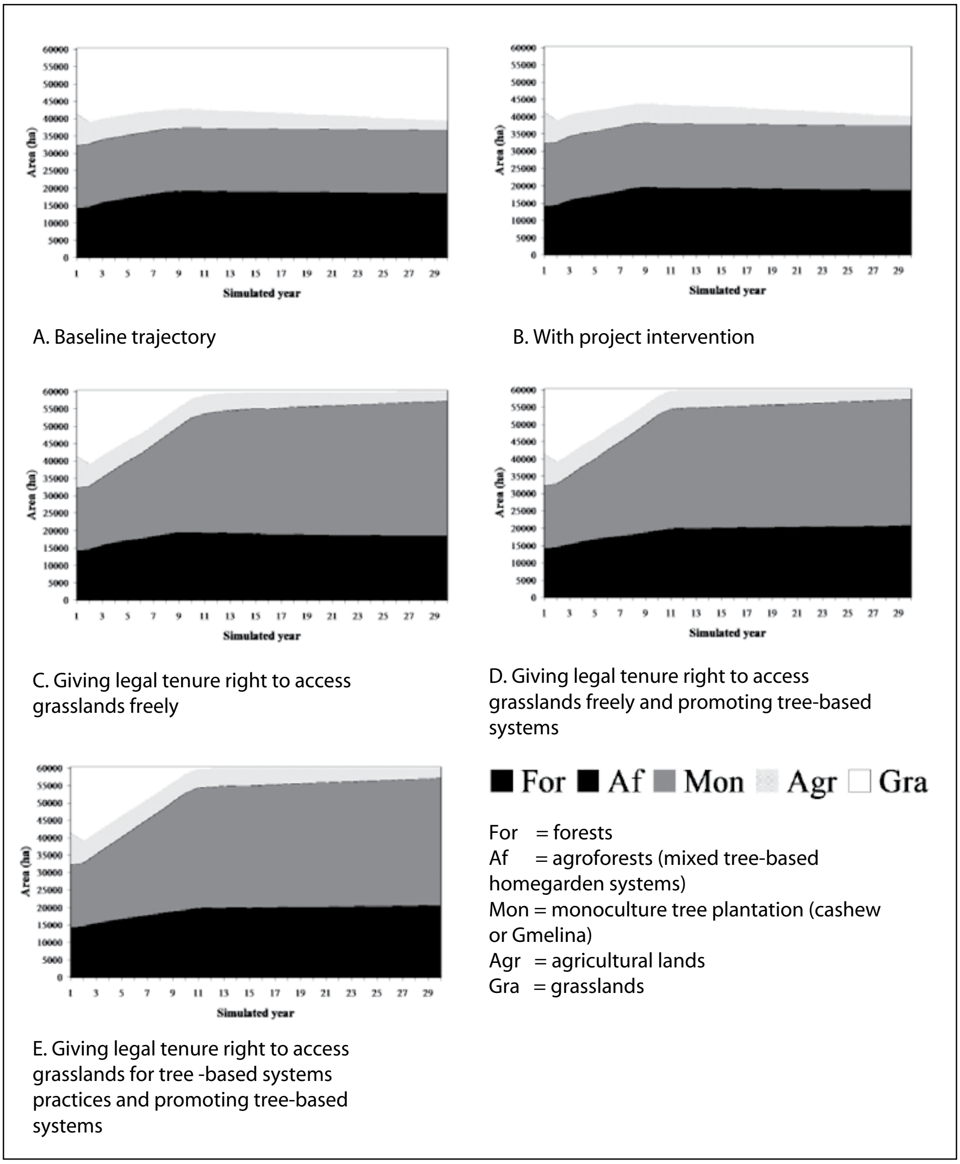
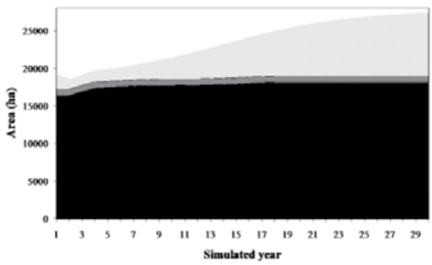
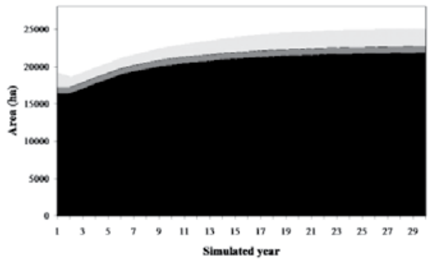


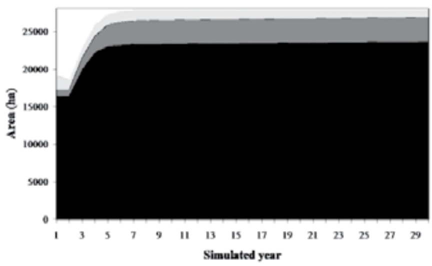
Figure 10.1. Simulated land use/cover change in Sidrap, South Sulawesi for the years 2000–2030 under various 'intervention' scenarios



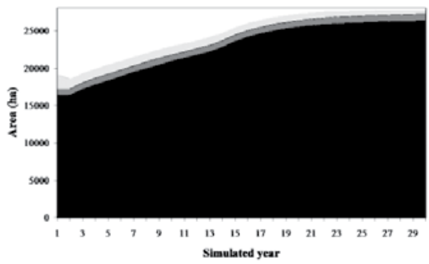
A. Baseline trajectory



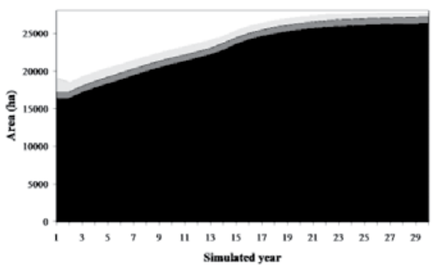
B. With project intervention



C. Giving legal tenure right to access grasslands freely



D. Giving legal tenure right to access grasslands freely and promoting coffee-based systems



E. Giving legal tenure right to access grasslands for multistrata coffee systems practices and promoting multistrata coffee systems

■ For ■ Af ■ Mon ▒ Agr □ Gra

For = forests
Af = agroforests (multistrata or simple shade coffee systems)
Mon = monoculture tree plantation (coffee monoculture plantation)
Agr = agricultural lands
Gra = grasslands

Figure 10.2. Simulated land use/cover change in Way Tenong, West Lampung, for the years 2000–2030 under various 'intervention' scenarios

Table 10.1. Predicted carbon additionality, leakage and welfare improvement in Sidrap for the years 2000–2030 under various 'intervention' scenarios

Scenario	Time-averaged carbon additionality at project scale (t CO_2)	Time-averaged carbon additionality at landscape scale (t CO_2)	Time-averaged carbon leakage (%)	Time-averaged increase of nonfood expense per capita (Rp/capita)
Project-based approach	+25,007	−24,237	+197	−4,000,000
Giving farmers legal tenure rights to access grasslands freely	Not applicable	+472,120	Not applicable	+6,000,000
Giving farmers legal tenure rights to access grasslands freely and promoting tree-based systems through extension, subsidy and market improvement	Not applicable	+226,967	Not applicable	+34,000,000
Giving farmers legal tenure rights to access grasslands for tree-based systems practices and promoting tree-based systems through extension, subsidy and market improvement	Not applicable	+226,820	Not applicable	+34,000,000

Table 10.2. Predicted carbon additionality, leakage and welfare improvement in Way Tenong for the years 2000–2030 under various 'intervention' scenarios.

Scenario	Time-averaged carbon additionality at project scale (t CO_2)	Time-averaged carbon additionality at landscape scale (t CO_2)	Time-averaged carbon leakage (%)	Time-averaged increase of nonfood expense per capita (Rp/capita)
Project-based approach	+117,443	+205,957	−75	−280,000
Giving farmers legal tenure rights to access grasslands freely	Not applicable	+93,353	Not applicable	+1,550,000
Giving farmers legal tenure rights to access grasslands freely and promoting coffee-based systems through extension, subsidy and market improvement	Not applicable	+95,040	Not applicable	+6,130,000
Giving farmers legal tenure rights to access grasslands for multistrata coffee systems practices and promoting multistrata coffee systems through extension, subsidy and market improvement	Not applicable	+221,283	Not applicable	+100,000

Conclusions

- Validation of a simulation model is crucial, especially when we applied the model for extrapolation, aimed at evaluating its 'usefulness' and 'reliability' (Huth and Holzworth, 2005). Validity of the FALLOW model in explaining driving factors of previous land use/cover changes was tested with regard to its accuracy. In this study, the FALLOW model produced relatively low spatial accuracy (about 49% on average) and relatively high area accuracy (about 72% on average). Area accuracy is closely related to complexity of spatial patterns of a landscape, while spatial accuracy is closely related to resolution of spatial determinants in land expansion. At simpler landscape patterns in Nunukan, East Kalimantan, the model resulted in area accuracy of about 89% on average (Suyamto and Van Noordwijk, 2005). In this area, we found that spatial patterns of agricultural areas are associated with spatial patterns of foot pathways, which could not be captured using spatial resolution of the model (*i.e.* 1 ha). Because impacts of land use/cover changes on carbon stocks are additive, area accuracy is considered to overpower spatial accuracy. Furthermore, the model's uncertainty in carbon stocks predictions was assessed. In general, the model overestimated carbon stocks by around +20 t CO_2/ha on average. About 70% of the discrepancy was linked to uncertainty in carbon density and 30% to uncertainty in land cover fractions.
- Extrapolating the models for the years 2000–2030 provided estimates of the dynamic baseline for carbon stocks. The baselines of Sidrap indicated relatively static carbon stocks (+0.15 t CO_2/ha/year) but a negative change in welfare (– Rp 220,000/capita/year). The baselines of Way Tenong indicated negative changes both in carbon stocks (–0.95 t CO_2/ha/year) and welfare (– Rp 71,000/capita/year).
- Leakage due to project-based approach is closely related to area of the projects. The model predicted leakage of about +197% for projects that occupy only 1% of the landscape (Sidrap). At area fraction of about 29% (Way Tenong), the model predicted no leakage. In terms of gain/loss in economical benefits, project interventions were predicted to reduce farmers' welfare by Rp 230,000 and 4,000,000/capita in Way Tenong and Sidrap respectively.
- Win-win prospects on carbon increase and poverty alleviation would likely be achieved using programmatic approach through a generic removal of constraints to smallholder tree-based production systems. This includes efforts to give farmers legal tenure rights to grasslands and to promote tree-based systems through extension, subsidy and market improvement. Through this approach, carbon stocks could likely be increased by 222,597 t CO_2 on average, while farmers' welfare could likely be improved by Rp 13,630,000/capita.
- CDM 'reforestation' projects are made through consensus. Peterson *et al.* (2005) suggest that overuse of consensus-based approaches leads to dilution of socially powerful conservation metaphors by creating multiple meaning with multiple implicit value assumptions, thus resulting in abuse of the term for power interests. Moreover, consensus reduces superficial conflicts of interests among participating groups or individuals, thus legitimizing existing hegemony configurations of

power and precluding resistance against dominant elites. It implies legitimization of further damage to the environment and increasing apathy and cynicism among the public for environmental protection efforts. On the contrary, a programmatic approach respects farmers' freedom to learn and to make choice. This approach is argument-based, which, as argued by Peterson *et al.* (2005), 'will facilitate progressive environmental policy by placing the environmental agenda on firmer epistemological ground and legitimizing challenges to current power hegemonies that dictate unsustainable practices'. Finally, if CDM is just another idea for 'more trees, less poverty', why do we not just put our efforts to remove 'real' constraints to smallholder tree-based production systems with lower risks, lower transaction costs, less concerns about leakage, impoverishment or power abuse?

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Case Study

11

Loksado Grassland Reforestation, Indonesia

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Introduction

Loksado protection forest is located at Loksado subdistrict, Hulu Sungai Selatan district, South Kalimanatan province. Grasslands cover a wide area of this forest land. The grasslands developed as a result of traditional upland rice cultivation practices of the indigenous Dayak tribes. The Dayak community in the Loksado area open a patch of secondary forest or shrubland to cultivate upland rice for 1–2 years, with zero agricultural input (fertilizers, herbicides or insecticides). The land is then fallowed, and traditionally the fallow lasts for 20 or more years. Due to population and other modern pressures, however, the fallow cycle in most areas has been reduced to 5–15 years. As the fallow period shortens, soil fertility on these sites is unable to recover. This is particularly problematic in steep areas, where the soil is inherently less fertile and prone to erosion. The Dayak community sees the natural regeneration of woody perennials on fallowed land as a sign that soil fertility has recovered enough to support a few rotations of rice. Most steep sites have become so degraded that woody perennials no longer regenerate, regardless of the fallow period. Those steep sites are dominated by grasses that have become a climax landcover because of their tolerance of annual wildfires.

The Dayak have a unique traditional custom, *adat*. Every family is required to cultivate 2 ha of upland rice every year. If the family does not comply, they are excluded from the *adat* ceremonies, which are conducted three times a year. The *adat* custom is still strong in the Loksado area. Every family plants 2 ha of upland rice every year, even when the availability of fertile land is limited and stocks of stored rice are adequate. Rice stocks are usually stored in large containers made of thin slices of timber in traditional rice barns. Some stocks are large enough to meet family consumption needs for 15 years, even if they stopped growing rice. Every year the number of families in the community increases and much of the agricultural land must be fallowed to avoid degradation. To satisfy the *adat* 'land cultivation' custom the demand for agriculture land increases every year. It is estimated that 4–10 ha of primary forest are opened each year to fulfil the *adat* requirement.

The younger generation of the Dayak community is quite responsive to innovation as some of them are educated and a few members of *adat* leader families are university graduates. This young generation is eager to change the prevailing farming practices. This change may be a long process, and therefore it is strongly suggested that extension activities be done on a sustainable basis. In the past, extension activities normally ended when the project ended. Under the CDM project, a long-term program for training local people to become extension workers should be in place and farming practices introduced to the people should be in line with their needs.

Besides upland rice, the local Dayak community also cultivates perennial crops, particularly rubber trees (*Hevea brasiliensis*). Rubber trees are frequently planted in rice fields at the beginning of the fallow period. Rubber cultivation practices are nonintensive and no agricultural inputs are used. Trees only begin to produce latex at 8 years. Latex production begins to decrease at 25–30 years. The mature rubber trees are then harvested and rubber seedlings planted; upland rice may be grown during the first 1–2 years of the tree establishment period. Considering this condition, the reforestation project is designed to establish about 2,500 hectares of viable mixed rubber-cinnamon-timber plantations. The project activities are expected to increase incomes of poor communities through the sale of rubber and other tree products starting in the fifth year of the project and through carbon payments (CERs); to reduce pressure on the 'protection forest' in and around the project area by developing the commitment of local farmers to practice sustainable, permanent agriculture; and to reduce run-off, increase water storage capacity and improve water quality of the watershed.

Method

The project will be implemented in three villages, Desa Haratai, Desa Ulang and Desa Lumpangi, of Kecamatan Loksado subdistrict, Hulu Sungai Selatan district, South Kalimantan province (**Figure 11.1**). Project development consisted of a number of activities including establishment of institutional arrangement and technical design of the project, economic analysis, proving the eligibility of land for CDM, defining the additionality of the project and setting up baseline and monitoring methodologies.

The institutional arrangement was set up through focus group discussions and interviews with local communities, nongovernmental organisations (NGOs) and local government. The technical design of the project was based on surveys and interviews of the community and consultation with the District Forest Office. The technology employed was developed primarily by two sources: (i) natural resource

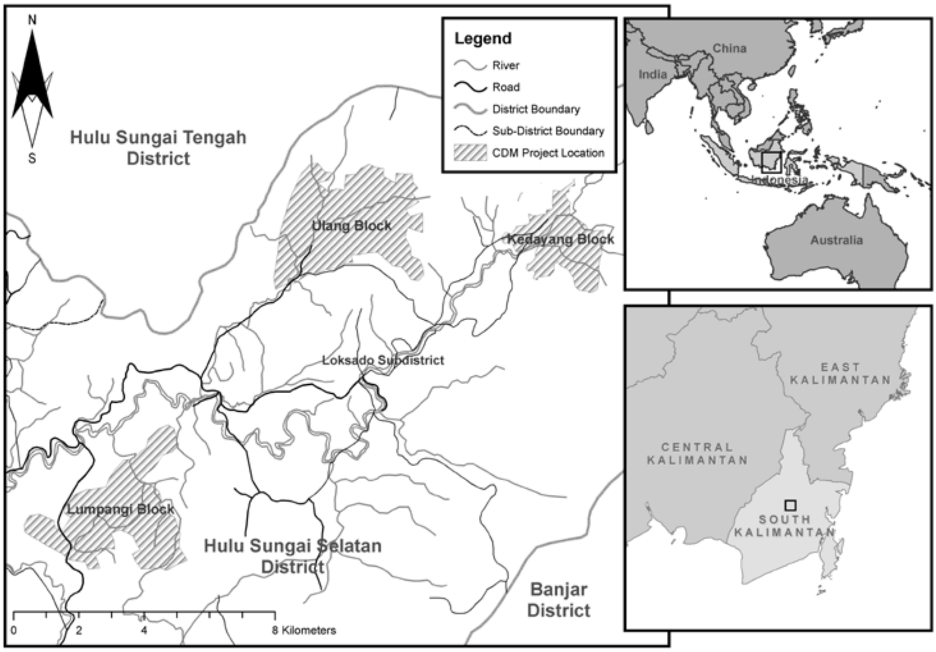

Figure 11.1. Location of AR CDM project in Loksado subdistrict

professionals and rural communities in Southeast Asia working to convert Imperata grasslands to more productive tree-based systems (Garrity 1997; Friday *et al.* 1999); and (ii) the World Agroforestry Centre working to develop rubber production systems that meet the needs and limitations of smallholder farmers in Indonesia. The conditions required for successful use of the technology are (i) secure land and/or tree use rights, (ii) community cooperation in fire prevention and suppression, and (iii) species selection that matches socioeconomic and biophysical conditions. These conditions exist or will develop through implementation of the project activity and technology described here. The economic analysis of the projects was assessed based on net present value (NPV) of benefits and internal rate of return (IRR).

Eligibility of land and project boundaries were assessed using remotely sensed data and a ground survey following steps defined by the CDM executive board. The analysis of the remotely sensed data followed the procedure described in Short (1982) and Sabins (1986). Similarly, the additionality of the project followed the tool for the demonstration and assessment of additonality for afforestation and reforestation (AR) CDM project activities agreed by the CDM executive board (Annex 16, EB21). Calculation of carbon benefits including baseline and monitoring methodologies followed the Approved Methodology 'reforestation of degraded land' (AM0001; can be downloaded from the UNFCCC website at http://cdm.unfccc.int/methodologies/ARmethodologies/approved_ar.html).

Results

Institutional Setting

Based on consultation and discussion with individual farmers, communities in the project areas, local *adat* institutions (*Lembaga Adat*), NGOs, and local government, implementation of the project will be conducted by the Amandit Cooperative. Thus the Emission Reduction Purchase Agreement with the carbon buyer will be made with this cooperative. The Amandit Cooperative will coordinate nine farmer groups. Under an agribusiness approach to the forestry sector (in which input, process, and marketing compose a system), Amandit will develop collaboration with other relevant institutions to strengthen the technical and market capacity of project farmer groups. Specifically, Amandit will develop collaboration with (i) local NGOs to provide technical assistant to farmers groups and (ii) commercial companies to provide marketing support for products. Amandit will manage all project activities including contract negotiations with carbon buyer. The CDM Steering Committee[1] will assist Amandit Cooperative in securing the necessary support from local government during the implementation of the projects, particularly providing all information needed to support extension programs. The Forestry and Estate Office will also have direct linkages with farmer groups to effectively implement technical support activities, such as training. With this arrangement, it was agreed that the project participants share CERs as follows: local government 15%, Amandit Cooperative 40% and farmers 45%. All products produced by the tree-based systems established through the project activity will be owned by the individual farmer producer. It is proposed that, to secure the best price available, those products are sold through the market linkages developed by Amandit Cooperative.

Project description

The proposed project activity will be implemented in an area officially designated as protected forest area, but which has been occupied and cultivated by Dayak tribes for an extensive period. The land was 'abandoned' for agriculture use by the Dayak community before 1990 because the soil fertility was very low and the land was dominated by grasses (**Figure 11.2**). The proposed area is located in three discrete areas (**Table 11.1**). The site of the proposed project activity is remote, 10 km from a main (paved) road. From the main road the villages can be reached only by motorcycle or foot. From the villages the project location can be reached only by foot.

Species selected for the project based on farmer preference are rubber *(Hevea brasiliensis),* cinnamon *(Cinnamomum burmanii*), gmelina (*Gmelina arborea),* and mahogany (*Swietenia macrophylla*). Farmers may plant or protect the natural regeneration of other species. The area allocated per species is 1000 ha (40%) for rubber, 500 ha (20%) for cinnamon, 250 ha (10%) for gmelina and 821 ha (30%) for mahogany. Recommended spacing at establishment is 4 × 6 m for rubber, 3 × 3 m for cinnamon, and 4 × 4 m for timber species. On steep areas farmers may

[1] The CDM Steering Committee was formed to implement CDM projects in the district through the support of Bupati (District Head) Decree Number 23.1/2005.

Table 11.1. Geographical positions of blocks and villages

Name of block	Geographical position		Name of Villages	Area (ha)
	Latitude	Longitude		
Blok Kedayang	2.74°–2.77°	115.53°–115.56°	Haratai	475
Blok Lumpangi	2.81°–2.85°	115.40°–115.45°	Lumpangi	945
Blok Ulang	2.74°–2.77°	115.47°–115.51°	Ulang	1,150
			Total	2,570

Note: The effective area for project implementation measures about 2,500 ha.

Figure 11.2. Current situation of Loksado grassland

choose to plant contour hedgerows to establish terraces. The actual species selection/allocation, tree spacing and plot design will vary according to farmers' objectives and site conditions. The decision to integrate or segregate the planting of the four species is also a decision to be made by individual farmers according to the management objectives. Based on agreement with the government, which will provide support for the seedlings, farmers will harvest only cinnamon. Other tree species will not be harvested until the end of crediting periods (20 years).

Carbon Benefits

Following approved methodology, the project will cumulatively result in 499,463 tons CO_2e of actual net greenhouse gas (GHG) removal by sinks. The baseline net GHG removal by sinks for the first four years is about 13,496 tCO_2e, 26,992 tCO_2e, 40,489 tCO_2e and 53,985 tCO_2e, respectively, and for year 5 and forward

67,481 tCO_2e. While leakage varies from year to year depending on types of activities conducted that contribute to GHG emissions, namely seedling transportation and project outputs and harvesting of cinnamon. On average the leakage is about 18,595 tCO_2e per year. Thus cumulatively, the net anthropogenic GHG removal by sinks is about 402,747 tCO_2e. Using temporary-CER (t-CER) system, the project will produce about 78,467 tCER in year 10, 207,474 tCER in year 15 and 401,784 tCER in year 20 (**Figure 11.3**).

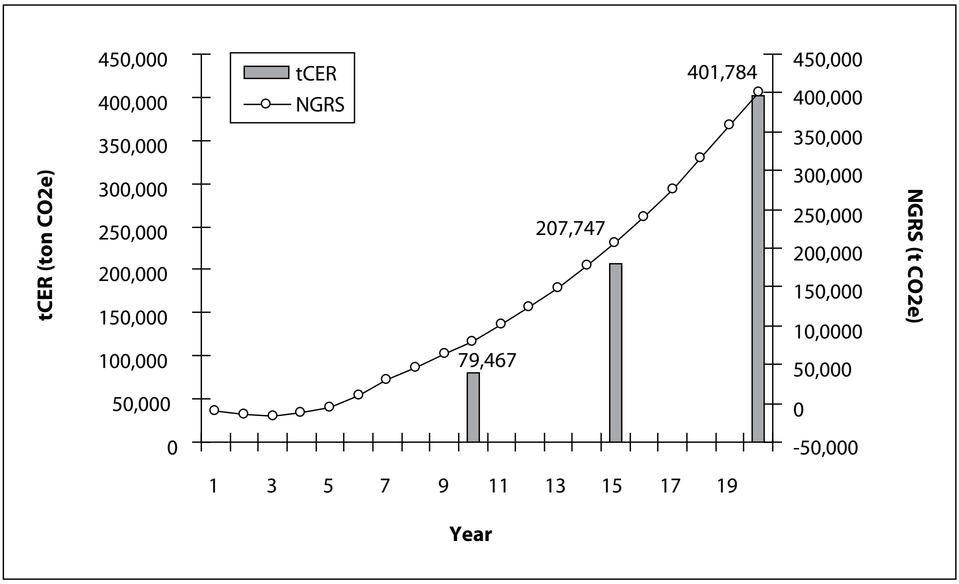

Figure 11.3. tCER and Net GHG removal by sinks

Socio-Economic Analysis

Results of the analysis indicate that the communities that will participate in the proposed AR CDM project activity have a great imbalance in income earnings among families due to unequal distribution of arable land. The majority of community members live below the poverty line and have monthly incomes of roughly US$100. This income is primarily agriculture-based and just sufficient to cover daily subsistence needs. Total monthly expenses are close to US$150, and families struggle to meet these costs. Most farm families may need to expand their land cultivation to meet livelihood needs by an average of 1 to 2 hectares per family. Therefore, with or without the proposed AR CDM project activity, the area of cultivated lands will expand as families try to meet their livelihood needs. Under existing conditions, without the AR CDM project, most of the agricultural expansion will involve traditional slash-and-burn techniques to produce annual crops and occur in forest areas, including the natural forests of Loksado protection forest. Farmers have not yet adapted permanent methods nor developed large areas of tree-based systems, although there is widespread interest. The main reasons why most farmers have not established tree-based systems are lack of capital and lack of technical knowledge (experience).

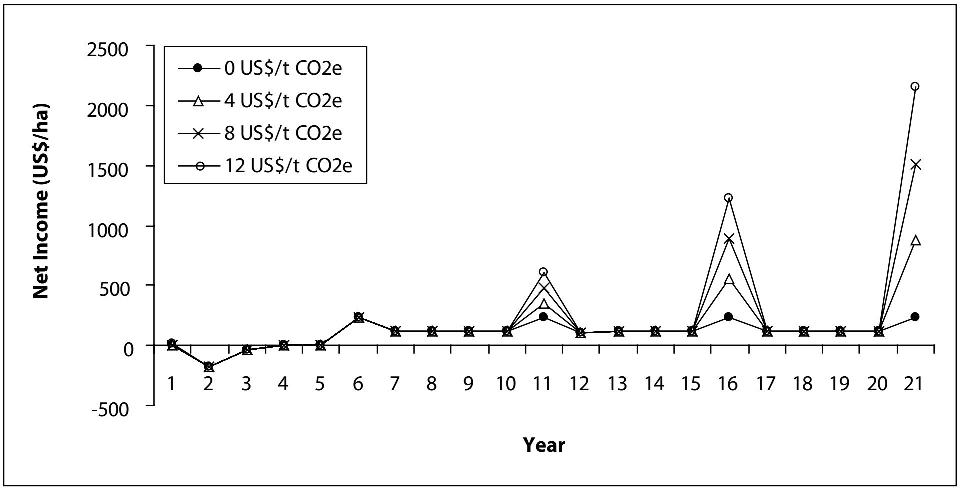

Figure 11.4. Annual cash flow with and without inclusion of income from sale of CER

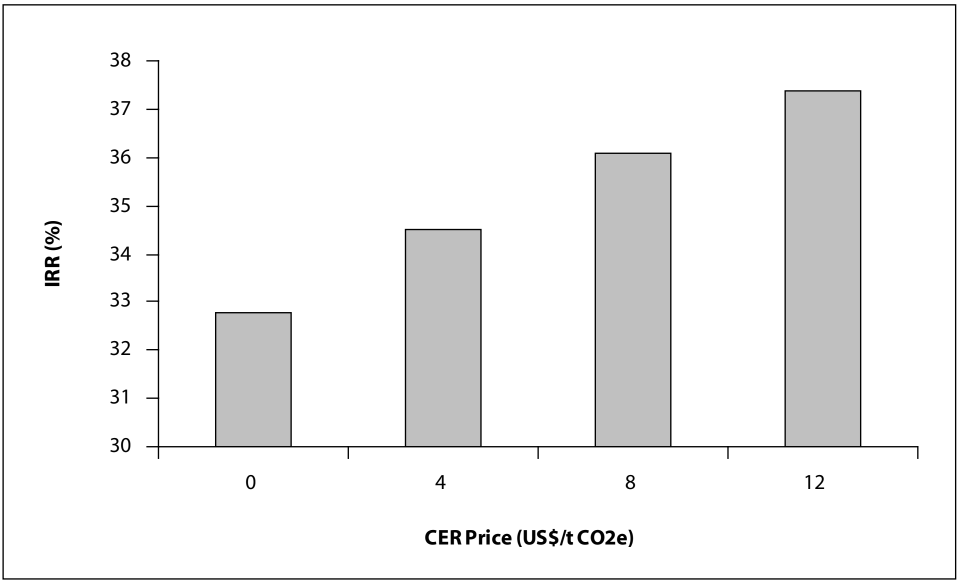

Figure 11.5. Internal rate of return at different CER prices

Under the AR CDM project scenario, agricultural expansion will occur in grasslands and involve mixed tree farming systems. This will be possible because the project activity will provide the necessary capital and technical backstopping to enable participating farmers to established viable mixed rubber systems, including the development of market linkages. Thus under the CDM, the expansion of agriculture area into protected forest is expected to decrease, which will secure the biodiversity of the protected forest. In the Loksado protected forest, there are a number of rare and endangered species of flora and fauna (District Forest Office 2005). The number of flora species is 71, consisting of 29 families including rattans, palms and bamboos. In addition, there are 34 types of medicinal plants. The number of fauna species is 64, consisting of 27 species of mammals, 6 species of reptile, and 29 species of aves. The project activity will expand the area of forest cover in the Loksado area and thus enhance the habitat for fauna—particularly those that are migratory.

From economic analysis, it was found that without considering the income from sale of CER, the project is economically attractive. The positive cash flow starts in year 5. When the sale of CER is taken into account, the benefit becomes even greater (**Figure 11.4**). Using a discount rate of 12.7% (interest rate for agriculture project long-term loan), without including the sale of CER, the NPV of the project is about US$441/ha and the IRR is 32.8%. With inclusion of CER sales, the IRR increases slightly depending on the price of the CER (**Figure 11.5**). The IRR increased by 1.7% at a CER price of US$4/t$CO_2$e, 3.3% at a CER price of US$8/t$CO_2$e and 4.6% at a CER price of US$12/t$CO_2$e. As previously mentioned, because of investment and technological barriers, the Dayak community will be unable to implement the project by themselves without financial and technical assistance. Therefore, for the implementation of the project, Amandit Cooperative expects the carbon buyer to provide part of the investment cost as upfront payment for the carbon credit. The amount of funding requested by Amandit as upfront payment is about US$380,000. The remaining cost of initial investment (US$660,000) is expected to come from various sources, particularly from government.

Conclusion

Without CDM, the Dayak community may be unable to reforest the grassland. The current practice will continue and the expansion of agriculture areas will cut into protected forest area. This means that the threat to the protected forest may increase in the future while the livelihood prospects of the Dayak community remain poor. With the CDM project, it is expected that the investment and technological barriers can be removed. The carbon buyer could provide upfront payment for covering part of the initial cost of establishing the project.

It is certain that the project will contribute positively to the incomes of poor communities through the sale of rubber and other tree products starting in the fifth year of the project and through carbon payments starting in year 10. Other benefits are that the project will reduce pressure on the protection forest in and around the project area by developing a commitment of local farmers to practice sustainable, permanent agriculture, reduce run-off, increase water storage capacity and increase water quality functions of the watershed.

Acknowledgements

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Case Study

12

Sidrap Community Reforestation of Unproductive Grassland, Indonesia

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Introduction

Sidenreng Rappang (Sidrap) district is located in South Sulawesi province, about 185 km to the north of Makassar. It covers an area of 1,883 km^2, or roughly 3% of the total area of South Sulawesi. Sidrap contains 11 subdistricts (*Kecamatans*), 38 subsubdistricts (*Kelurahans*) and 65 villages. Land use in Sidrap is dominated by 37,212 ha of irrigated rice fields, 19,162 ha of pasture, and 15,326 ha coconut plantations. Other land uses/crops include dryland rice (8,987 ha), cacao (6,765 ha), candlenut (6,398 ha), cloves (4,064 ha), cashew (2,304 ha), black pepper (210 ha), coffee (172 ha) and cotton trees (141 ha) (BPS Sidrap 2004). Sidrap is considered a major producer of agricultural commodities. The district is the biggest producer/exporter of rice and exporter of beef/cattle in South Sulawesi. It exports rice to the Middle East and beef/cattle to Jakarta and Kalimantan (BPS Sidrap 2004).

The human population of Sidrap numbers 241,555. The population density is 126 persons/km^2, and the annual growth rate is 0.25%. The people of Sidrap are diligent and hardworking, and renowned for the local principle *Resopa temmagingi mallomo pammase dewata* ('Only with hard work will blessings from God be obtained'). Most families rely on agriculture as their source of livelihood. The positive macroeconomic conditions of Sidrap overshadow the desperate economic conditions of many of its people. District data indicate that in 2003 65% of the population lived at subsistence or poverty level, and 8% lived below the poverty line (BPS Sidrap 2004).

Sidrap includes 16,000 hectares of grassland (BPS Sidrap 2004), which has become a climax land cover due to its tolerance of wildfires, which occur every 1–2 years. The grasslands are dominated by *Imperata cylindrica*. Most of these lands are found on state lands and are considered unproductive. As in many parts of Indonesia (Tomich *et al.* 1997; Roshetko *et al.* 2002), there is interest at both government and community levels to convert some of these vast grasslands to more productive tree-based systems. To date most reforestation efforts, both public and private, have fallen short of their objectives due to reoccurring fires and a lack of clear land/tree tenure. A local model of successful reforestation does exist, however.

Originally natural lowland forests, grasslands have dominated parts of Sidrap since the late 1960s. In 1967, Haji Abunawas was granted land-use rights to 382 ha of *Imperata* land in recognition of his service to the district by becoming the national Pencak Silat champion[1]. Haji Abunawas invited 100 households to share the land grant with him, providing full tenure rights to the land they convert to tree farming systems. The reforestation process is primarily supported by the resources of subsistence households, with occasional support of seedlings or other inputs from periodic government programs. This strategy has successfully reforested 300 ha, at a rate of less then 8 ha/yr. For his innovative tree farming approach and success Haji Abunawas has been honoured with national awards. The district government would like to replicate, expand and accelerate this successful farmer-led strategy as a means to rehabilitate degraded lands and establish economically viable tree production systems. It is willing to provide land/tree tenure and facilitate technical support to communities willing to rehabilitate degraded grasslands with tree-based systems. Communities are interested in this concept as a means of gaining tree and land tenure, diversifying their current farming systems, and establishing market-oriented tree-based systems to enhance their medium- to long-term income. As most households are subsistence farmers, however, they lack the start-up capital required to invest in tree-based systems.

A consortium of local organizations and government agencies is willing to assist local communities. It sees community-based carbon sequestration projects as appropriate mechanisms to accelerate the reforestation of degraded lands and achieve sustainable development by enhancing farmer incomes. In collaboration with Winrock International, the Land Management Grant College (LMGC) of Bogor Agricultural University and the Ministry of Environment and with the support of the Asian Development Bank (ADB) Carbon Sequestration through the CDM for Indonesia ADB TA No. 4137-INO project, the consortium worked with the local communities to design a small-scale afforestation and reforestation Clean Development Mechanism (SS AR CDM) project activity.

The purpose of the project activity is to reforest 650 ha of grasslands with smallholder fruit[2] and timber systems. Tree species selection was based on community preference and a market orientation. Timber species include both fast- and slow-growing varieties, with rotations of 5–7 years and 30 years, respectively; fruit species

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[1] Pencak Silat is a traditional form of martial art.

[2] 'Fruit species' indicates trees that produce fruits, nuts, spices or other traded commodities.

systems will be retained on farm for 60 or more years after establishment. Project participants (farmers, community organizations and governments) expect project activities to contribute to sustainable development by accruing the following private and public benefits:

- Increase incomes of participating families from (i) market sales of fruit and timber products starting in the fifth year after establishment and (ii) carbon payments from CERs for a 30-year period.
- Rehabilitate 650 ha of grasslands and enhance soil conservation and watershed functions in the greater project area.
- Assist in the development of Sidrap as a major producer of specific tree products.

As of this writing the PDD has been completed, a validation preview has been conducted and the host country approval is in process. This paper documents the key characteristics of and the process used to develop the proposed Sidrap SS AR CDM project activity.

Methods and Approach

Project Conceptualization

The capacity of Sidrap stakeholders to develop and implement an AR CDM project was strengthened through a series of activities summarized below (Winrock and LMGC 2006). As AR CDM projects and related issues are new concepts different from other reforestation and community development project, this series of capacity building activities was designed to be parallel and reiterative to assure stakeholders developed a sufficient minimal understanding.

- National Workshop on Capacity Building for Developing Project Design Document for AR CDM held 1–3 February 2005 to (i) provide an update on CDM and (ii) increase stakeholders capacity to develop AR CDM projects and their understanding of the requirements for developing projects as well as the process of getting project approval from CDM national authorities and the CDM executive board.
- National Project Identification Workshop held 28–29 April 2005 to (i) review the CDM project approval and registration processes; (ii) continue capacity building of district stakeholders regarding preparation of AR CDM projects; (iii) enhance local government capacity to facilitate AR CDM projects; and (iv) explain the district selection process for PDD development under the ADB project.
- Field visits to Sidrap held 12–18 July 2005 and 15–20 January 2006 to (i) enable the Winrock-LMGC team to become familiar with the location; (ii) confirm site data required for the PDD; (iii) hold detailed discussions with stakeholders regarding PDD development and AR CDM project implementation; and (iv) develop among stakeholders a mutual understanding and vision of the proposed AR CDM project.

- Training Workshops on AR CDM PDD Development held 20–23 October 2005 to (i) review data for the PDD and (ii) continue to enhance stakeholders' capacity to understand and develop a PDD through a learning-by-doing (writing) process.
- PDD Validation Preview held 7–12 April 2006 to pre-evaluate the Sidrap PDD in preparation of request for host country approval through the Indonesian Designated National Authority and eventual submission to the executive board for validation.

Additionally, Winrock-LMGC team members visited Sidrap or communicated with stakeholders to provide specifically requested assistance.

Stakeholder Process

Through the activities mentioned above the Winrock-LMGC team simultaneously implemented a stakeholder process intended not only to enhance capacity and commitment to the AR CDM project, but most importantly to facilitate full agreement between all stakeholders regarding the specific AR CDM project design and the roles, rights and responsibilities of each stakeholder (Winrock and LMGC 2006). The process was conducted at both the government level and the community level. This dual approach was used not to draw distinction between the government and communities, but to more directly address the concerns of stakeholders. In fact, representatives of both government and community participated in the stakeholder process at both levels. Government agencies were mainly concerned with the policies, procedures and regulations related to AR CDM project activities. The community was focused on AR CDM project design and establishment as well as management and utilization of the resultant tree-based system. Additional priorities for both levels were to identify a government agency to act as the prime mover of project support and the composition of a District CDM Steering Committee to act as a district focal point for all CDM related issues and as facilitator and promoter of CDM project activities.

At both levels initial discussions focused on answering the following questions: What is a CDM project? What are the advantages of a CDM project? How to conduct a CDM project? Where and when to conduct a CDM project? Who can undertake a CDM project? Later discussions shifted to the specifics of AR CDM project activity design and implementation. Participatory mapping to identify AR CDM eligible lands, biophysical surveys, and socioeconomic surveys were all part of the stakeholder process conducted at the community level. Discussions were conducted using a focus group discussion approach, which enables people of different social statuses from various stakeholder groups to interact as equals (Krueger 1988; Morgan 1988; Stewart and Shamdasani 1990). To promote understanding and equitability among all participants the stakeholder process was informal (but more formal at higher government level meetings), participatory, reiterative and sought to identify synergism between stakeholders' objectives and resources available to design and implement AR CDM project activities. Sometimes the local language was used to facilitate information flow and participants' sense of ownership.

Methodology

The Sidrap AR CDM project meets the criteria to use the Simplified Baseline and Monitoring Methodologies for Selected Smallscale Afforestation and Reforestation CDM Project Activity Categories (Paragraph 3, Annex II, FCCC/KP/CMP/2005/4/Add.1). Therefore, the project will consider only aboveground and belowground carbon pools in its baseline and monitoring methodologies.

Baseline: The current land cover at the project location is grasslands, with scattered shrubs covering approximately 5% of the area. Aboveground biomass was estimated from field measurements of grass and shrubs, and a weighted average for aboveground biomass of grass and shrubs was calculated, 0.95(grass biomass) + 0.05(shrub biomass). Belowground biomass was estimated by using the root–shoot ratio from the *IPCC Good Practice Guide*. Mature trees occur infrequently across the project site. Their presence, diameter and height will be recorded before the implementation of the project, so their biomass can be excluded from actual net greenhouse gas (GHG) removal calculations.

Monitoring: Lestari Foundation in collaboration with University of Hasanuddin will conduct field monitoring of the actual GHG removals by sinks. Location of the project areas, size of each area and location of permanent sampling plots will be recorded. Diameter at breast height and height of each tree in the permanent plots will be measured every five years. Permanent sampling plots will be treated in the same way as other lands within the project boundary, *e.g.*, during site preparation, fertilization, harvesting, etc. Efforts will be made to prevent permanent sampling plots from being deforested during the crediting period. The number of plots will be determined after project implementation depending on species variation, accuracy and monitoring interval. The total number of samples will be determined as recommended by Neyman (cited by Wenger 1984).

Stratification of permanent sampling plots will be based on farms with similar species composition or biophysical conditions. Each stratum will be further developed into substrata in terms of the year to be planted. Additional substrata will be developed subsequently for areas affected by fires, pests or other problems. The stratification map will be developed on a GIS platform. As mandated by paragraph 37, Annex II, FCCC/KP/CMP/2005/4/Add.1, if during the project significant underperformance is detected in some areas, changes in carbon stocks from those areas will be treated as a separate stratum. Leakage will not be monitored as it is negligible and assumed to be zero, but the amount of nitrogen fertilizer applied by farmers will be recorded.

Project Summary

Location: The project activity is designed to take place in five villages of three subdistricts in Sidrap: Lasiwala village, Pituriawa subdistrict; Rijang Panua village, Kulo subdistrict; and Bulo Wattang, Bulu Timoreng and Cipotakari villages, Panca Rijang subdistrict (**Figure 12.1**). It will be implemented in seven discrete areas, identified by field survey in collaboration with local government agencies, community leaders and other stakeholders. The specific location of each farmer's lands to be reforested will be designated at the onset of the project; those boundaries will be treated as the actual project boundaries.

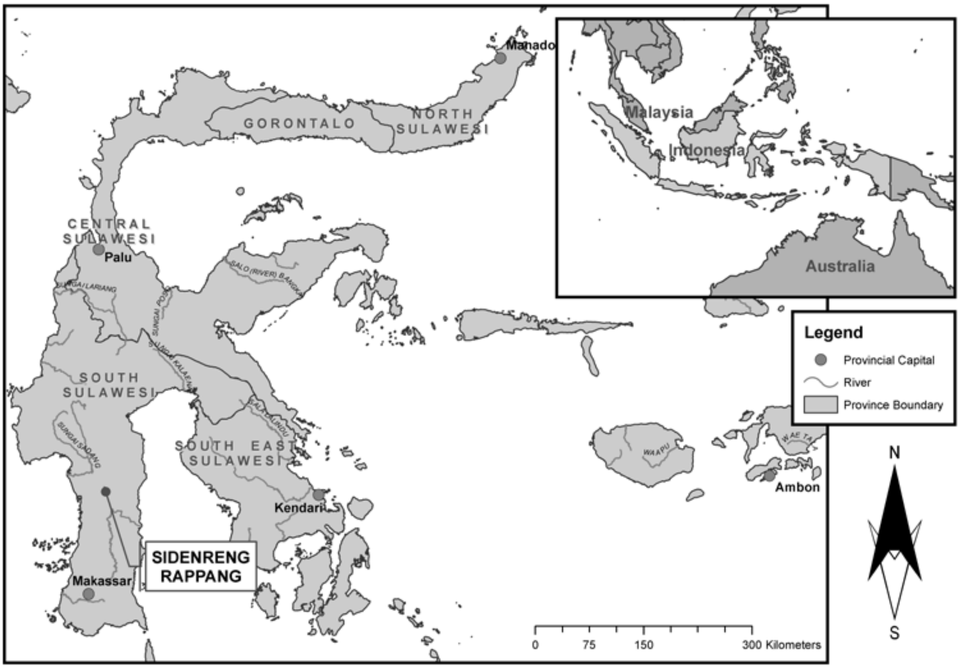

Figure 12.1. Location of the proposed Sidrap SS AR CDM project

Environmental conditions. Soil types common in Kulo and Panca Rijang subdistricts are dark grey alluvial (clays), brown podsolic (clay-loams), and complex of brown podsolic and regosol (sandy clay). Soil types of Pitu Riawa subdistrict are the same as those in Kulo and Panca Rijang, plus hydromorphic aluvial (clay), and yellowish red podsolik (loam-clay) (BPS Sidrap 2000; Bappeda Sidrap 2003a, b, c). These soils currently support the range of annual and tree crops to be established through the project activity. The topography of the project location is flat or rolling hills. The elevation of the target subdistricts is 50 m to 250 m above sea level. The temperature ranges from 32°C to 26°C. Annual precipitation is 1300–2200 mm, with bipolar distribution peaking in May and December. The dry season occurs between August and November.

Farmer profiles. Five hundred eighty-one farmers want to participate in the project activity. A socioeconomic study of 90 responding participating farmers (representing four subdistricts and four villages) specifies that most residents derive their livelihood from agriculture; few off-farm employment opportunities exist. Agriculture is an insufficient income base; 64% of the population lives at subsistence to below poverty level (Hardjanto 2006). These data correlate with government statistics (BPS Sidrap 2004). Average family size is between four and five persons, and labour availability averages three persons per family. Labour availability is insufficient for intensive annual crop production; thus families prefer tree crops over dryland annual crops. Respondents would like to expand their tree cropping systems by 1–3 ha/family, but to do so they would need financial and technical assistance, as well as secure land tenure.

Land status. The land to be reforested through project activities is non-forest state land that has never been privately owned. No people currently live on the land, although some areas are used intermittently for grass collection or cultivation. The land has been underutilized for many years. Currently there are no claims for either land use or ownership. These lands will remain state land until the central or local government grants land titles to suitable legal subjects based upon the legal process or designates the land for other activities.

Table 12.1. Stakeholders involved in the project

Stakeholder	Project Participant	Role and Responsibility
Farmers and farmer groups	Yes	• Establish tree-based farming systems on grasslands • Manage systems according to project agreement • Form groups or cooperatives to facilitate activities • Form CDM units to assist with project administration
Lestari Foundation and its Sidrap CDM unit (non-profit community development organization linked to MPI Reformasi)	Yes	• Project proponent and project administration • Coordinate community involvement • Facilitate development of memorandum of understanding among all stakeholders • Identify sources of start-up capital, carbon buyers and traders interested in purchasing tree products through the project • Publicize and promote the project
Sidrap CDM unit (district field unit of Lestari Foundation)	Yes	• Coordinate farmer establishment of tree-based systems • Monitor project implementation activities (seedling production, distribution, training, meetings, etc.) • Conduct field monitoring of actual GHG removals • Provide and coordinate technical training activities
District forest office	Yes	• Provide training in nursery production, tree management, fire control and other relevant topics • Provide financial support for that technical assistance • Assist other stakeholders that provide technical assistance
District government	No	• Develop supportive policy and regulatory framework • Facilitate secure land tenure during the project for participating farmers who reforest grasslands
MPI Reformasi (non-profit organization linked to forest industry)	No	• Assist identifying sources of start-up capital, carbon buyers and traders of forest products • Seek support from forest industry
District CDM steering committee	No	• Serve as district focal point for all CDM related issues • Facilitate and promote district level CDM project activities • Facilitate land tenure for farmers through the district government
Hasanuddin University	No	• Conduct field monitoring of actual GHG removals • Provide other technical assistance when requested
Private sector	No	• Purchase tree products produced through the project • Provide training regarding product market specifications • Other support to secure reliable sources of products
NGOs	No	• Provide advocacy and leadership training to farmer groups

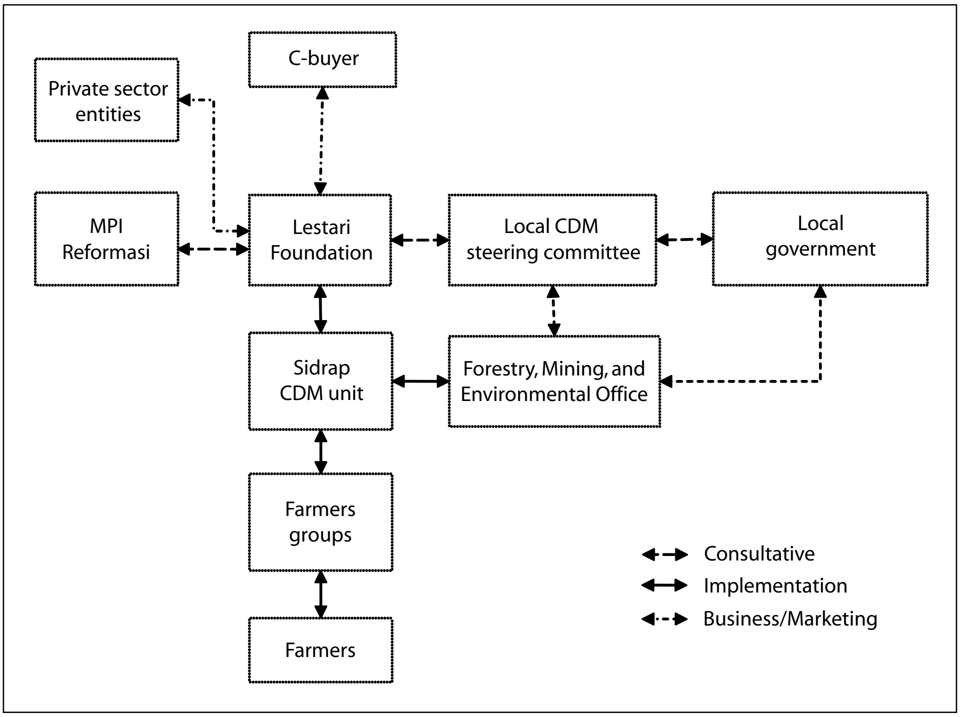

Figure 12.2. Institutional arrangement for the project activities

Project participants and linkages. Stakeholders involved in the project include communities, the district government, government technical agencies, non-profit organizations, universities, private sector organizations, and the District CDM Steering Committee, which comprises representatives from government agencies, NGOs, community leaders and farmers. However not all are project participants as defined by the UNFCCC. Project stakeholders and their roles are specified in **Table 12.1**. Linkages between stakeholders are illustrated in **Figure 12.2**.

MPI Reformasi, Lestari Foundation, the District CDM Steering Committee, the District Government and the Forestry Office will all maintain direct communicative linkages. In collaboration with Lestari Foundation, the Forestry Office will maintain direct linkages with Farmer Groups to effectively implement technical support activities. Carbon buyers and other private sector entities will interact exclusively with Lestari Foundation and MPI Reformasi. NGOs will work with Lestari Foundation and its Sidrap CDM Unit. Farmer groups and farmers will interact primarily through the Lestari Foundation and its Sidrap CDM Unit, but also have direct linkages with the Forestry Office, NGOs and other training providers. Farmer groups and farmers may contact other project parties, but are encouraged to utilize project linkages.

Project participants have agreed to share carbon payments as follows: District Government 15%, Lestari Foundation 40% and farmers 45%. All tree products produced by the tree-based systems established through the project activity will be owned by the individual farmer producer, and those products shall be sold through market linkages developed by Lestari Foundation.

Project design. Farmer participants have selected six main species to be included in the project activity: cashew (*Anacardium occidentale*), cacao (*Theobroma cacao*), cotton trees (*Ceiba pentandra*), candlenut (*Aleurites moluccana*), teak (*Tectona grandis*) and gmelina (*Gmelina arborea*). Small numbers of other species may be cultivated. The specific species to be planted will depend on the choice of individual farmers. Tree seedlings will be produced by farmers groups with technical support of other stakeholders (see **Table 12.1**). Farmers are encourage to intercrop their tree for the first 2–3 years after planting, but are forbidden from ploughing soil, which is disallowed under SS AR CDM project activities. The District Forest Office and Lestari Foundation will coordinate technical recommendations regarding tree planting and management.

Discussion and Conclusion

Stakeholder Expectations

Participating farmers expect the project to provide the following direct benefits: (i) the district government will facilitate secure land tenure through the end of the project period; (ii) farmers will be able to establish viable market-oriented tree-based systems; and (iii) other stakeholders will arrange start-up investment to initiate the project. Farmers' key expectations are enhanced incomes from the sale of tree products and carbon payments. While carbon as a product remains a bit of a mystery, the community is beginning to understand its potential. These expectations are reasonable and the community is strongly supportive of the project. Farmers state specifically that they will require assistance to participate; specifically 57% of the farmers said they require capital investment (for labour and other inputs) to establish tree-based systems. They also expect assistance with quality germplasm, technical support regarding tree management and training for awareness of market linkages and specifications. This agrees with previous analysis regarding smallholder systems for carbon sequestration and storage (Roshetko *et al.* 2006). The community also expects that additional agricultural and rural development programs will result from the success of the SS AR CDM project.

All partners expect the project to lead to sustainable socioeconomic development within the district. MPI Reformasi and its forest sector partners hope the project will result in access to additional supplies of wood and other tree products. The district government expects that the project will help develop Sidrap as a major producer of fruit, honey and timber in South Sulawesi. The district forest office, central government, and district government all expect the project to positively contribute to local and national land rehabilitation, particularly by establishing successful locally implemented models of reforestation. This includes enhanced soil conservation and watershed functions over the project area.

Baseline Scenario

Satellite imagery confirms that the project area did not have forest cover as of 31 December 1989. Field measurements and application of *IPCC Good Practice Guide* values determined that the project sites have a baseline biomass (above and below ground) of 14 tC/ha (28 t/ha). This value is higher than at other sites in Indonesia. Kiyono (2001, 2003) found in South Kalimantan that grass biomass varied from 3.0 ± 1.3 ton/ha to 1.50 ± 0.65 tC/ha. In Lampung, Indonesia, Palm *et al.* (1999) found that *Imperata*-cassava systems had an average biomass of 2.2 tC/ha, and Hairiah (1997) found that *Imperata* grasslands had an average biomass of 0.7 tC/ha. Thus we are satisfied that 14 tC/ha is a justifiable baseline scenario.

The change of carbon stock in the absence of project activities is considered negligible for a number of reasons. The grasslands have become a climax land cover in the project area due to its tolerance of the wildfires that occur every 1–2 years. There is little chance of natural tree regeneration becoming established in this fire ecosystem. There are national and local programs to reforest or rehabilitate degraded lands, but the funds available from these sources are limited. The current rate of planting under these programs is 5 to 10 ha/year/subdistrict (or 100 ha/year for the district). Assuming a best case scenario by which these programs were renewed annually and reforestation efforts were 100% successful (both assumptions doubtful), it would require 160 years to reforest the 16,000 hectares of grasslands in the district. As Haji Abunawas's success indicates, farmers can successfully reforest grasslands. But the communities do not have the capital to invest in reforestation at any reasonable scale. Most project farmers are unable to borrow funds from commercial banks, because they cultivate state lands that do not qualify as collateral under bank regulations. To support annual crop production Sidrap farmers frequently borrow funds from local moneylenders who charge high interest rates. Farmers will not borrow to establish tree crops, however, because the return on investment period is too long, a minimum of five years for the tree crops to be established under the project.

Carbon Benefit

It is anticipated that the project will sink an average of 5,922 tons of CO_2 equivalent per year. At an annual establishment rate of 325 hectares for the first 2 years and a crediting period of 30 years, the project activity will yield an estimated net anthropogenic GHG removal of 179,335 tons.

Economic Benefit

District statistics and project surveys both show that 64% of the district population and project farmer families live at or below subsistence level (BPS Sidrap 2004; Hardjanto 2006). The project will enable these low-income communities to establish market-oriented tree-based systems. The key species to be established are cacao, cashew, candlenut, cotton tree, gmelina and teak. Cacao, cashew, candlenut and cotton tree are major commodities produced in the district for which market demand is high (BPS Sidrap 2004). Gmelina and teak are timber products with strong demand in the district forest sector (MPI Reformasi personal communications). Yields from annual crops will provide farmers household products and income year 1 through 3 of the project. By developing a diversified tree-based system farmers will be protected from the price fluctuation that may affect any of these commodities. Returns from cashew and cacao will begin in year 5; it is recommended that gmelina timber be harvested in year 10 and teak timber not before year 20 (waiting to harvest teak until year 30 is advised). Independent of carbon payments, establishment of these tree-based systems will have a positive economic impact on participating farmer families. Income from carbon payments will be an additional payment for environmental services (Roshetko *et al.* 2006).

Transaction Costs

It is important to provide farmers with the capital investment and technical training to enable them to transform their traditional low-management systems into more intensive systems that yield tree products of the quantity and quality to meet market specifications and command a higher price. Providing these financial and technical services to multiple clients (581 farmers), as well as facilitating and administering the project and monitoring activities and the actual GHG removals, is likely to result in high transaction costs for this or any SS AR CDM project. While these (high) costs are justifiable under the CDM as the extra costs required to achieve more equity and sustainable development, they are not likely to be underwritten by carbon investors who are more interested in securing carbon credits and have alternative investment opportunities such as large plantations or energy projects (Roshetko *et al.* 2006). It is anticipated that local cofunding sources will be identified to help offset high transaction costs, including the development of assistance from government, foundation or corporate sources (CIFOR 2000, 2001). Some stakeholders have agreed to use existing resources to facilitate project activities and thus leverage support. This includes the participating farmers, who will provide labour equity to cover 15% of the project establishment costs (direct project costs during the first 2 years). Lestari Foundation and the Forest Office will also support administration, facilitation and training costs unless or until other sources of funds are secured.

Environmental Impact

The proposed project areas were converted from natural lowland forest ecosystems during and prior to the 1960s. The current mosaic of land use systems includes the private holdings of small-scale farmers, government land (primarily grasslands, including areas targeted for reforestation by the project activity), areas of degraded secondary forests and small pockets of natural forests. Under the project farmers will replace grasslands with tree gardens of cashew (*Anacardium occidentale*), cacao (*Theobroma cacao*), cotton trees (*Ceiba pentandra*), candlenut (*Aleurites moluccana*), teak (*Tectona grandis*) and gmelina (*Gmelina arborea*). All six of the species are established components of the existing Sidrap landscape. The fauna of Sulawesi is one of the most distinctive in all of Indonesia. The island's indigenous species include at least 127 mammals, 332 birds, 29 amphibian and 40 lizards. Many of these species are endemic. The International Union for the Conservation of Nature considers 16 of Sulawesi's indigenous species rare or endangered (Whitten *et al.* 2002). The existing land cover at the project location, grasslands with scattered trees, is unsuitable for these indigenous species. The project will improve environmental conditions be re-establishing forest cover, with native or naturalized species. These forests areas will offer higher habitat value to native fauna, particularly migratory birds, than the existing grasslands. It is fair to forecast that these forest areas will be maintained and sustainably managed by farmers as a key component of household livelihood strategy that produces profitable crops with strong market demand for years to come.

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Case Study

13

Bombana Mixed-tree Species, Indonesia

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Introduction

The study site is located in Bombana district, Southeast Sulawesi. It covers an area of 702 ha. Most of the lands are considered to be unproductive and are dominated by *Imperata cylindrica* grassland, which is aggressively expanding in relatively poor soils. The area is occupied mostly by smallholder farmers, the major project stakeholders in addition to the local government. There is great interest of both the government and local community to convert these vast *Imperata* grasslands to more productive fruit tree and timber-based systems. Both fast- and slow-growing species, with rotations of 5–7 years and 30 years, respectively, are preferred; fruits species systems will be retained on the farms for up to 60 years (Winrock and LMGC 2006). The proposed afforestation/reforestation (AR) Clean Development Mechanism (CDM) project qualifies as a small-scale AR CDM project, as it is estimated to produce net greenhouse gas (GHG) removal by sink of not more than 8 kton of CO_2 equivalent per year. The district governments are willing to issue a Decree of *Bupati* (district head) acknowledging a special area for land rehabilitation under AR CDM projects and providing a legal base for farmers to make use of the land, as long as farmers establish and maintain tree-based systems under the project activities that meet the definition of forests.

The objectives of the study are to quantify the carbon sequestration potential of mono and mixed tree species per unit area using the CO_2Fix model and to quantify the carbon sequestration potential at landscape level using the CO_2Land model. Both model runs estimated the additionality based on the difference between project or mitigation and baseline scenarios.

Project Summary

Location

The project proposed for Bombana district will be established in five villages—Rau-Rau, Pangkuri, Lakomea, Rarowatu, and Ladumpi—of Rarowatu subdistricts on 14 discrete areas (**Figure 13.1**). These areas are found on both community and non-forest state lands. The state lands are available for private ownership, but have not yet been claimed through the legal process. The natural vegetation of the site was lowland forests (Whitten *et al.* 2002). The current land-cover is primarily underutilized grasslands with some shrubs, small areas of wetlands and some degraded secondary forests.

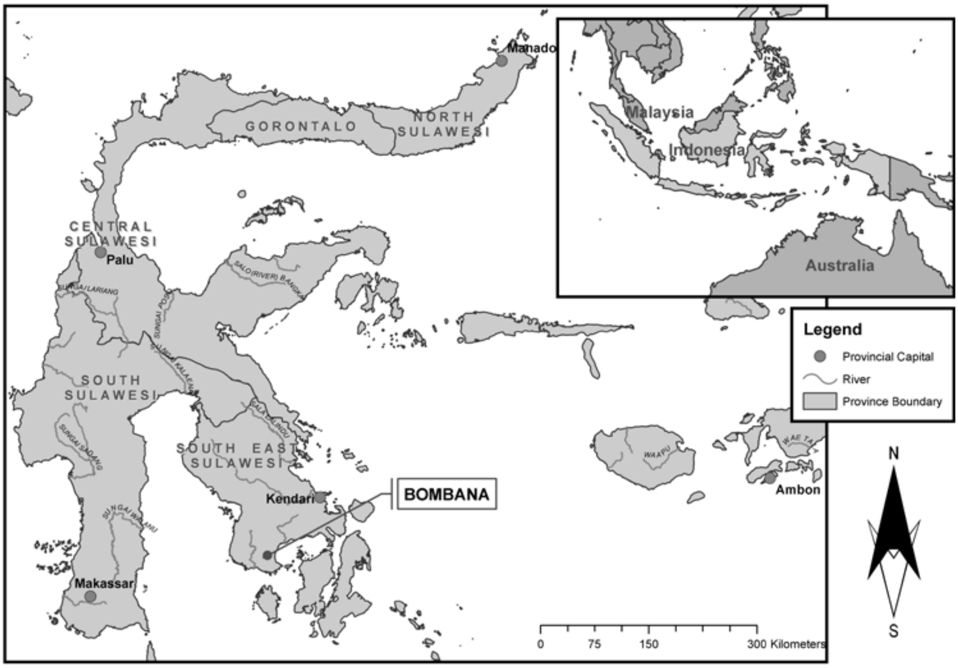

Figure 13.1. Location of AR CDM project in Bombana district, Southeast Sulawesi (Source: Winrock and LMGC 2006)

Environmental Conditions

The topography of Rarowatu subdistrict is hilly and undulating. Slopes of the land range between 3% and 25%. Common soil types are Kambisol, Podsolic, Gleisol and Aluvial, which cover about 70% of the subdistrict. Average elevation is 500 m above sea level. Annual rainfall of 1000–1500 mm, with 5–6 wet months and 3 or fewer consecutive dry months. The mean temperature is 28°C. The main climate-related problem in the area is drought. Fires are common and more severe August through October.

Farmer Profiles

Most families in the area consider themselves farming households. On average, families have access to 1–4 ha of land. Most families, however, do not have land certificates or clear land tenure to the lands they cultivate. Also, due to a lack of capital, farmers cultivate only half or less of the land to which they have access. Under this existing system farm-based income is only enough to cover basic livelihood needs. There are few or no off-farm income generating opportunities. Most farm families would like to increase their income by expanding the area under cultivation, intensifying agriculture management and diversifying their activities to include home industries, livestock production, trade etc. In order to expand or intensify agricultural activities, farm families will need adequate land tenure, financial support and training in intensive tree management and marketing (Winrock and LMGC 2006).

Project Participants

Project participants of the proposed project are farmer groups, the farmers cooperative and the district forest office and its CDM unit. Participating farmers are organised into village-based farmer groups. The farmers cooperative will be organised through facilitation of the district and be coordinated by the CDM unit. Other stakeholders include the district government, non-government organisations (NGOs) and private sector organisations. Additionally, a district CDM steering committee exists, composed of representatives from government agencies, NGOs, community leaders and farmer representatives. A key role of the committee is to facilitate land use rights for participating farmers throughout the project period and develop a mutually acceptable memorandum of understanding between all project participants. It will also monitor progress of the project activity. The local government has agreed to provide some of the initial investment required for the proposed project activity. The district forest office and CDM unit will be responsible for project administration and monitoring of actual GHG removals. Farmer groups will be responsible for the implementation of project activities. The farmer cooperative will monitor implementation of project activities. The CDM unit and NGOs will be responsible for technical and leadership training. Private sector organisations, with assistance from NGOs and the CDM unit, will provide market awareness training to farmer groups and assist with the development of market linkages for tree products. The district CDM committee will be responsible for identifying carbon buyers and markets for tree products (Winrock and LMGC 2006).

Project Design

Farmer participants have selected two main species to be included in the project activity: cashew (*Anacardium occidentale*) and teak (*Tectona grandis*). The products of both species have strong market demand. Small numbers of other species may be cultivated as part of the project activity. These minor components are likely to be citrus (*Citrus* sp.), guava (*Psidium guajava*), clove (*Eugenia aromatica*), coffee (*Coffea robusta*), cacao (*Theobroma cacao*) and some indigenous species. The specific species to be planted on individual farms will depend on farmer's choice and the biophysical conditions of the site. Recommended tree spacing for cashew is 6 × 6 m or 3 × 12 m, and for teak 3 x 3 m, with three mid-rotation harvests. Discussion with stakeholders indicated that about 20% of the project area will be planted with cashew and 80% with teak. Approximately 100 hectares will be planted each year for 6–7 years. Intercropping trees with annual crops is uncommon in Bombana. The district forest office and other stakeholders will coordinate tree planting, maintenance and management (Winrock and LMGC 2006)

Methods

Simulation of Carbon Dynamics and Data Requirement

Good Practice Guide for Land-use, Land-use Change and Forestry (IPCC 2003) provides supplementary methods arising from the Kyoto Protocol. Among others it includes addressing carbon pools in the ecosystem, which consists of various compartments, such as living and dead biomass (both of them may reside above and below ground), and the soil organic carbon.

In this exercise CO_2Fix Ver. 3.1 (Schelhaas *et al.* 2004) was used to estimate carbon pools in the living aboveground and belowground biomass and the soil organic carbon. The model has the ability to produce multispecies and uneven-age stands in multiple cohorts, to parameterize the growth by stand density and to deal with intercohort competition. The basic input in biomass module is the stem volume growth and allocation pattern to the other tree compartments (foliage, branches and roots). Carbon stocks in the living biomass are calculated as the balance between tree growth along with turnover, mortality and harvest, whereas in the soil module the basic inputs are litter from turnover, mortality processes, and logging slash that decompose and transform into soil organic matter.

The simulation of carbon stocks and flows in the forests' living biomass are estimated using a 'cohort model' approach (Reed 1980). Cohorts are defined as groups of teak, cashew and a mix of the two. The carbon stored in living biomass of the whole stand can then be expressed as the sum of the biomass of all cohorts. For each new time step, carbon stored is calculated as the total biomass (initial and growth) minus the turnover of branches, foliage and roots as well as the tree mortality due to senescence and/or logging along with the biomass harvested.

Baseline Scenario

The AR CDM project proposed for Bombana district, Southeast Sulawesi, is to reforest 702 ha of abandoned grassland located in Rarowatu subdistricts. The lands used for the project activities is located on the slopes and tops of hills, which are covered mostly by grasslands. There is little chance for these land to regenerate into secondary forest because of frequent fires and low water content, so that significant change in the carbon stock within the project area is unlikely to occur naturally. Under the absence of the CDM project, these lands will remain grasslands, which indicates that the net GHG removals by sinks are additional to the non-project scenario. According to paragraph 10 of the simplified methodology, under this condition the project developer may assume that the change in carbon stock is equal to zero, and thus the project can apply a constant baseline. The baseline carbon stocks in the carbon pools (aboveground and belowground biomass) are constant at the level of existing carbon stock measured at the start of project activity.

Project Scenario

The species composition will be 20% cashew (*Anacardium occidentale)* and 80% teak (*Tectona grandis*). Relatively small numbers of other species may be cultivated as part of the project activities depending on farmer's choice and the biophysical conditions of the site. Approximately 100 ha will be planted annually for 6–7 years. Generally, farmers will plant teak in the lower and moister areas, whereas cashew will be planted at higher elevations on drier sites. Some farmers, however, will plant border rows of teak around their cashew plantations. Recommended tree spacing for cashew is 6 × 6 m or 3 × 12 m. The latter pattern is called hedgerow spacing and should almost double the canopy surface per area, resulting in a corresponding increase in yield, during the first 10 years (van Eijnatten 1992). Recommended tree spacing for teak is 3 × 3 m, with three mid-rotation harvests of 40%, 40% and 33% at 7, 14 and 21 years old, respectively, in a 30-year rotation (Pérez *et al.* 2003; Kanninen and Álvaro 2004).

The dynamics of carbon sequestration in teak plantations in Bombana district were simulated using data obtained by Suharlan *et al.* (1993) in a teak plantation on Java. The model for Bombana district assumed plantation density of 1,100 trees ha^{-1}, with mid-rotation harvests (thinning) of 40% at 7 and again at 14 years of age, and 33% at 21 years of age, along with clear fells at the age of 30 years. Biomass growth was estimated as a function of stands age, while relative growth rates for the other biomass tree components (foliage, branches and roots) were calculated using time-dependent allocation coefficients. Carbon content of teak wood was 0.457 Mg C/Mg DM (dry matter), with wood density of 0.5 Mg DM/m^3. The mortality rate due to senescence in this model was set at 0.02 annually, and turnover rates of tree components were set at 0.7 for foliage, 0.5 for branches and 0.05 for roots. In the CO_2Fix soil module, degree-days were assumed to be 27.7°C with potential evapotranspiration and precipitation in the growing season of 1,882 and 2,050 mm, respectively. Initial soil carbon stock was calculated based on a constant annual input of foliage and roots biomass (0.8 and 0.3 Mg C ha^{-1} yr^{-1}, respectively) from the *Imperata* grassland as the baseline.

The rate of cashew tree growth after planting, especially canopy growth, will determine how rapidly the young trees come into economic production. Only limited studies have been completed on the rate of cashew tree growth (Grundon 1999). The dynamics of carbon sequestration in a cashew (*Anacardium occidentale*) plantation in Bombana district was simulated using data obtained by Grundon (2001) through CSIRO modelling in a cashew plantation in Australia. The models for the study assumed plantation density of 400 trees ha^{-1}, with 10% thinning at year 10 and clear fells at the age of 30 years. The biomass growth was estimated as a function of stands age, and the relative growth rates of other biomass tree components were calculated using time-dependent allocation coefficients. The carbon content of cashew wood is 0.5 Mg C/Mg DM, with a wood density of 0.5 Mg DM/m^3. The mortality rate due to senescence was set gradually from 0.1 in the first year to 0.02 annually at the age of 10 years and beyond. The turnover rates of foliage, branches and roots were set to 0.5, 0.05 and 0.06, respectively. Parameters and initial soil carbon stock value similar to those used in the teak plantation case (with *Imperata* grassland baseline) were applied in the CO_2Fix soil module for cashew.

Landscape Level Scenario

Unlike CO_2Fix, which is applicable for a unit of cohort (per unit area), CO_2Land is applicable for a landscape level (total project area) scenario (Vallejo *et al.* 2004). CO_2Land is an expansion of the CO_2Fix model, intended to provide users with a tool to analyse different landscape scenarios based on CO_2Fix files describing each of the land uses present in a given landscape. The user defines the amount of areas of each land use that passes to a different one and the change rate of each transition. CO_2Land uses CO_2Fix as a server to calculate a set of CO_2Fix files representing the different land uses existing in a given landscape.

Landscape dynamics are usually represented as a transition matrix. In the simple case in Bombana, however, the exercise is using only one land-use trajectory—from grassland to plantations of timber and fruit tree species. Therefore we assume that the project baseline is the grassland without land use change, and thus the simulation for each land use/land cover class output can be calculated directly from CO_2Fix outputs. This can be done using simple spreadsheet techniques to obtain both baseline and project scenarios; hence the additionality of the project can be obtained as the difference between them.

Result and Discussions

Carbon Sequestration by Teak Plantation

The results of the CO2Fix model run for a mono-species teak plantation in Bombana district are summarized in five-year intervals in **Table 13.1** (upper part). Yearly time steps, however, demonstrate that the carbon stock in living biomass of a teak plantation would be 84 Mg C ha^{-1} before the project ends. At the same period of time the soil carbon input from the senescence of tree components (foliage, branches, stem and roots) and thinning would increase the total soil carbon by up to 77 Mg C ha^{-1}. Hence, the total carbon mitigation by teak plantation would be 161 Mg C ha^{-1} before the project ends.

The baseline scenario shows that the total carbon sequestered would range between 20 and 30 Mg C ha^{-1} within the 30-year period. These were the carbon dynamics of the *Imperata* grasslands. The same scenario and range were applied to other mono-species and mixed-species plantations. It means that the net carbon sequestration by teak plantation just before the project ends would be 131 Mg C ha^{-1} or 481 Mg CO2 eq. ha^{-1}.

The amount of carbon stored in the soil during the project period would be relatively small because of the minute portion of biomass from thinning that would be returned to the soil compartment. Over 95% of the thinned biomass would go to

Table 13.1. CO_2Fix model estimates of carbon pools and sequestration in mono-species teak and cashew plantations within a 30-year period

Year	Living aboveground	Living below-ground	Soil carbon	Total carbon	Baseline	Net C-seq.	Net C-seq.
	[Mg C/ha]	[Mg C/ha]	[Mg C/ha]	[Mg C/ha]	[Mg C/ha]	[Mg C/ha]	[Mg CO2 eq. /ha]
Teak *(Tectona grandis)*							
0	0.0	0.0	29.0	29.0	20.3	8.6	31.6
5	12.3	5.2	28.6	46.0	25.8	20.3	74.3
10	30.5	11.2	43.0	84.6	27.5	57.1	209.4
15	32.7	10.4	61.5	104.6	28.1	76.5	280.6
20	52.6	14.1	64.9	131.5	28.7	102.9	377.2
25	56.1	13.2	71.7	141.0	29.1	111.9	410.4
30	0.0	0.0	96.1	96.1	29.5	66.6	244.3
Cashew *(Anacardium occidentale)*							
0	0.0	0.0	29.0	29.0	20.3	8.6	31.6
5	5.6	2.1	26.1	33.8	25.8	8.0	29.2
10	20.2	7.8	33.3	61.3	27.5	33.8	123.8
15	26.7	9.9	37.8	74.3	28.1	46.2	169.3
20	27.0	8.5	38.0	73.5	28.7	44.9	164.5
25	27.9	7.3	38.8	74.0	29.1	44.9	164.7
30	0.0	0.0	48.1	48.1	29.5	18.5	68.0

logwood and firewood since small-diameter teakwood is merchantable in the Bombana area. This also suggests that a teak plantation project in Bombana could provide mid-rotation income to the project participant (farmer). In total, there would be 43 Mg C ha^{-1} or 95 Mg ha^{-1} of biomass to be harvested during thinning at the ages of 7, 14 and 21 years.

Carbon Sequestration by Cashew Plantation

The lower part of **Table 13.1** shows five-year time steps of carbon stock changes in cashew plantation. Annual time steps, however, demonstrate that the carbon stock in the living biomass would be 35 Mg C ha^{-1} before project end. In the same period the inputs to soil carbon from the senescence of tree components (foliage, branches, stem and roots) and 10% thinning at year 10 were expected to increase the total soil carbon by up to 40 Mg C ha^{-1} before project end. It means that the cashew stand would mitigate atmospheric carbon by as much as 75 Mg C ha^{-1} during the 30-year period, a much lower value than that for teak plantation. With the same baseline scenario as teak plantation, the net carbon sequestration of cashew stand would be 45 Mg C ha^{-1} or 167 Mg CO_2 e ha^{-1}.

Cashew is a species well known to smallholder farmers, and it grows in soils with low fertility and few inputs. Regardless of the fact that the amount of carbon sequestered by cashew plantation is relatively low due to small increments of tree growth, cashew starts bearing fruit after three or four years and produces nuts at a weight of up to 4.5 kg/tree with a yield of 1.9 Mg ha^{-1} annually under intensive management practices (O'Farrell *et al.* 2000). The average cashew nut yield in Indonesia, however, is much lower (less than 1.0 Mg ha^{-1}) than in other major producing countries, which achieve nut yields between 2.5 and 4.0 Mg ha^{-1} annually (Hadad *et al.* 2003; Tolla 2004). With better management practices such as weeding and thinning, the cashew plantation project in Bombana could provide higher benefits from the nuts to the project participants.

Carbon Sequestration by Mixed-Tree Species Plantation

The dynamics of carbon sequestration in a mixed-species teak and cashew plantation in Bombana district was simulated using data from both species (Suharlan *et al.* 1993; Grundon 2001). The models assumed that the mixed-species plantation had a density of 935 trees ha^{-1} in total. Of those, 55 trees ha^{-1} (20% of total) of cashew will be planted as commodities trees along with 880 trees ha^{-1} (80%) of teak. It was also assumed that the teak stand would be thinned by 40% at the age of 7 years and again at 14 years, and by 33% at the age of 21 years, with the final harvest at the age of 30 years. Growth was estimated as a function of stand age, and the relative growth rates of other biomass tree components were calculated using time-dependent allocation coefficients. The same constants for carbon content, wood density, mortality rates, turnover rates of each tree component, as well as soil module parameters and initial soil carbon for each species as used in the mono-species plantation cases were applied.

The CO_2Fix simulated result of mixed-species plantation is shown in **Figure 13.2**. The upper graph indicates carbon sequestration in the living biomass of mixed-species plantation of 74 Mg C ha^{-1} before project end. During the project period the amount of carbon removed from the teak stand following the thinning schedule would be 3.5 Mg C ha^{-1} at the age of 7 years, 16.0 Mg C ha^{-1} at the age of 14 years, and 13.7 Mg C ha^{-1} at the age of 21 years. These could potentially provide carbon inputs to the soil compartment from the senescence of tree components (foliage, branches, stem and roots) of up to 71 Mg C ha^{-1} before project end.

The lower graph of **Figure 13.2** shows that the mixed-species plantation on abandoned grassland could mitigate carbon by up to 145 Mg C ha^{-1} before project end. Without the project activities, it was assumed that the amount of carbon sequestered would range between 20 and 30 Mg C ha^{-1} within 30 years. It means that the mixed-species option for grassland reforestation would yield a net carbon sequestration of 115 Mg C ha^{-1} (423.9 Mg CO_2 e ha^{-1}) before project end.

Although this option supplies slightly lower carbon mitigation than a pure teak plantation, it also provides additional income from the highly marketable nuts to participating farmers. The rotation ages for plantations and trees in mixed-species systems, as well as pruning and thinning activities, play an important role in the amount of carbon they sequester in the system. In such a mixed system it is unlikely that the landscape would be clear felt, meaning that the standing stocks would remain to sustain the sequestered carbon. A combination of land management practice and knowledge of the market for non-timber products, like nuts, would offer other options to optimize economic benefits. Soil carbon may be increased when pruning and thinning techniques are improved. Likewise the proportions of the species may be altered too.

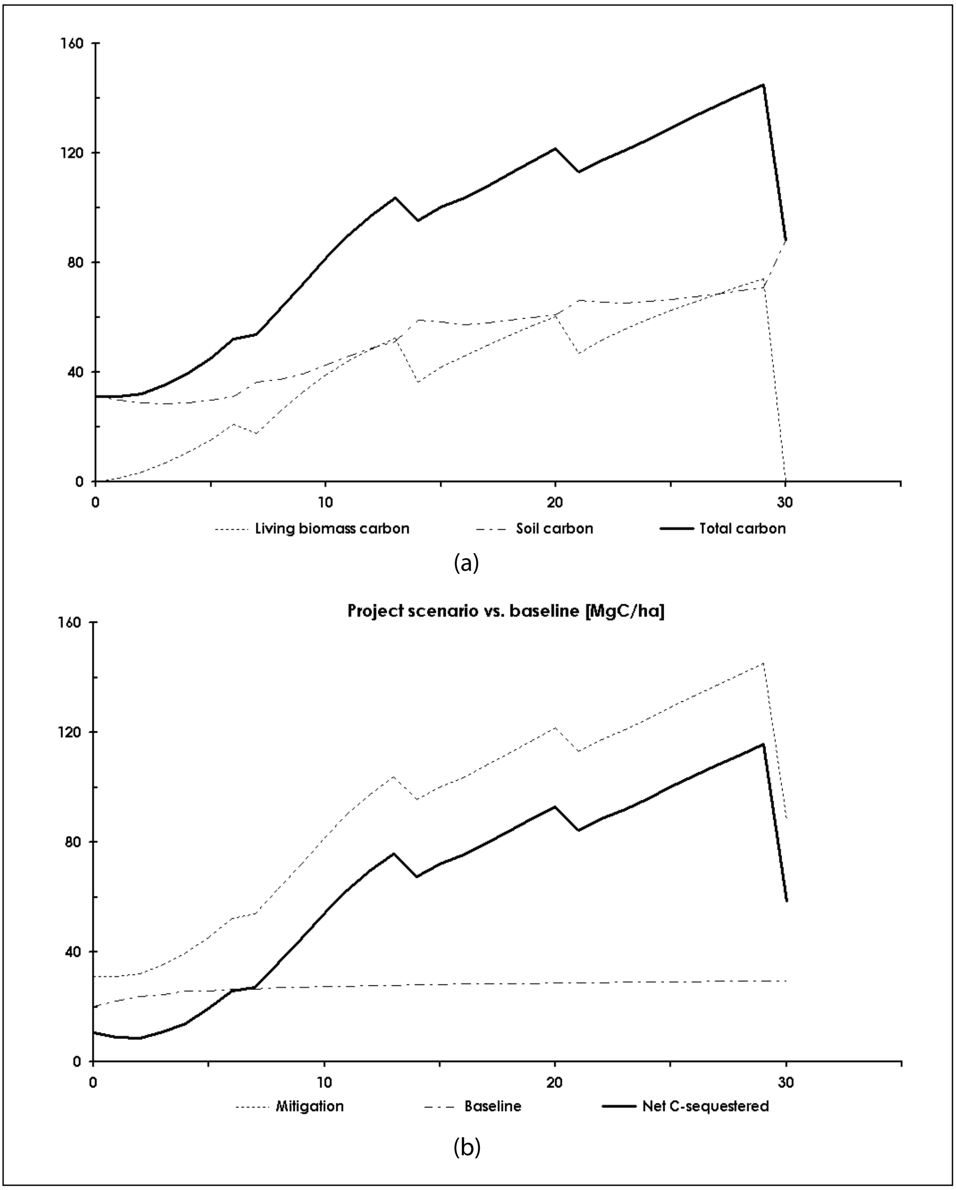

Figure 13.2. CO_2Fix model estimates of carbon sequestration of mixed-species plantation (80% teak as timber species and 20% cashew for fruit species) in 30-year period

Total Carbon Sequestration at Landscape Level

The CO_2Fix model outputs of mixed-species plantation (teak and cashew) that indicate the potential carbon sequestration per unit area are used to simulate the carbon benefits for the entire project area of 702 ha using the CO_2Land model, with the assumption that between 100 and 102 ha of the area will be planted annually for 7 years. As shown in **Figure 13.3**, the total carbon sequestered in a 30-year period would be 39,925 Mg C, 81% of which would be carbon in aboveground and 19%

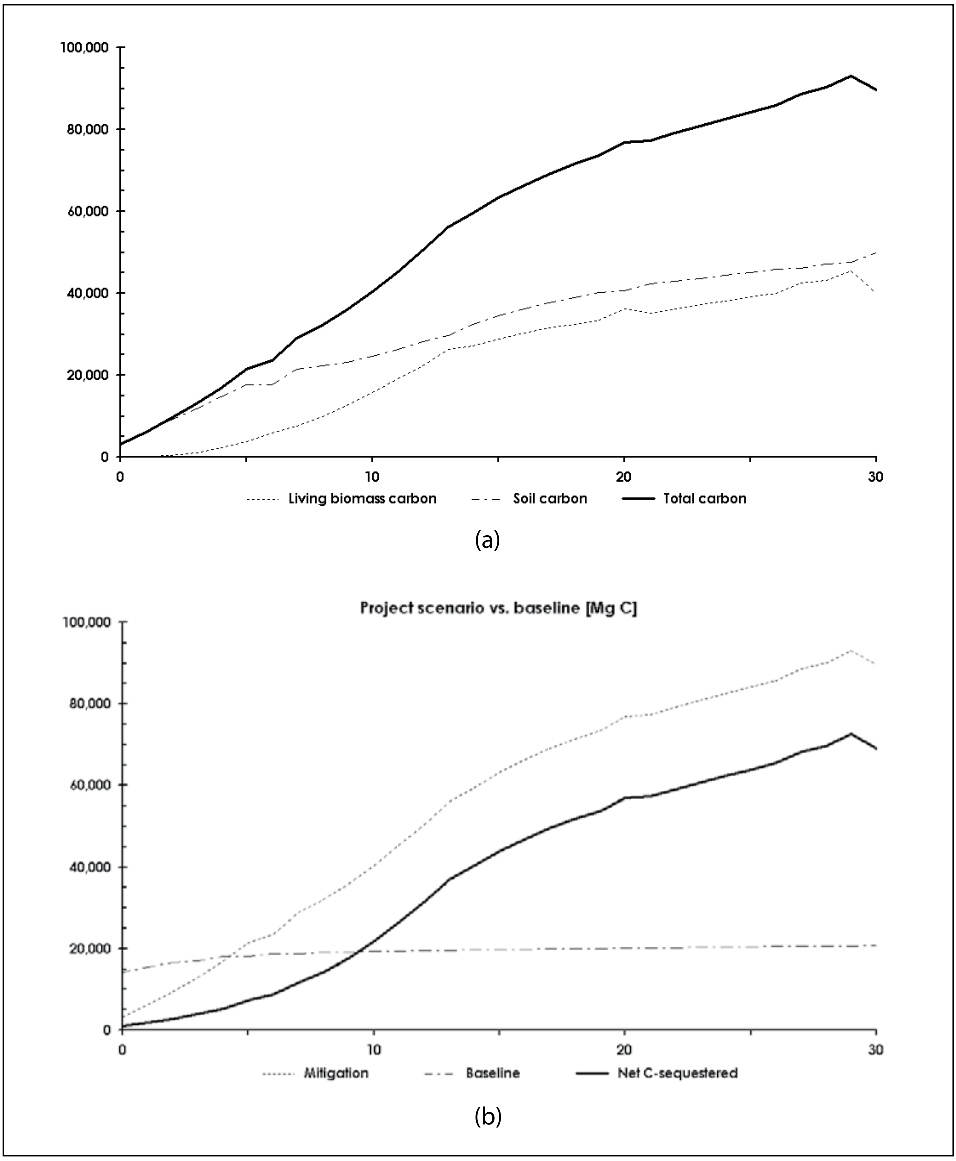

Figure 13.3. CO_2Land model estimates of landscape level carbon sequestration of mixed-species plantation (teak as timber species and cashew as fruit species) in each pool (a); and comparison of carbon mitigation and baseline to show net carbon sequestration (b)

in belowground living biomass. Furthermore, in the period the project would store as much as 46,711 Mg carbon in soil pools, giving a total carbon mitigation of 86,635 Mg C.

In addition to tree species composition in the plantations, teak (planted at 80% tree density) had a greater percentage of carbon sequestered, following several thinning activities, than cashew trees during the project period. Considering the above stated tree species combination for Bombana, it was demonstrated that the maximum carbon sequestered would be 69,201 Mg C. Assuming the baseline estimated from carbon stock in *Imperata* grassland just before the end of project period to be 20,667 Mg C, net carbon sequestration would be 253,759 Mg CO_2 e within the 702 ha project area. This amount is far below the 8 kt CO_2 yr^{-1} threshold of small-scale AR CDM decided in COP 10 (Decision 14/CP.10).

Conclusions

The proposed small-scale AR CDM projects are designed for a period of 30 years without renewal. Based on the CO_2Fix run for the project period the peaks of net CO_2 sequestration use a static baseline developed from the field survey of the biomass of the *Imperata cylindrica* grass. The peaks of net sequestration of teak and cashew in Bombana are 410 Mg ha^{-1} and 169 Mg ha^{-1}, respectively.

Mixed-tree species plantations are generally better than monoculture for biomass productivity. For an area with poor quality soils like the one used in this study a mixed plantation can give an average annual productivity of about 2.4 Mg C ha^{-1} over 30 years. The CO_2Fix outputs, which indicate the potential sequestration per unit area, are used to simulate the carbon benefits for the entire project area using CO_2Land. Considering the above stated combinations in Bombana, with the project area of 702 ha and proportion of 80% teak and 20% cashew, the maximum sequestration during the project was demonstrated to be 253,759 Mg CO_2 e. Furthermore it was shown that in terms of carbon gain the Bombana site will benefit more and it would be a lot simpler in terms of farm management. Carbon fixation through forestry-based activities is a function of biomass accumulation and storage. Therefore, any activity or management practice that changes the biomass in an area has an effect on its capacity to store or sequester carbon.

Carbon sequestration is often discussed in the context of the establishment of new forests, but this fixation can also be achieved by improving the growth rates of existing forests through silvicultural treatments such as thinning, pruning, weeding or fertilization. Generally, long-lived trees with high-density wood (*i.e.*, *Tectona grandis*) store more carbon per volume than short-lived, low-wood-density, fast-growing trees (*i.e.*, *Ceiba pentandra* and *Gmelina arborea*). In terms of total carbon offsets from plantations, however, this does not mean that involving large, slow-growing trees is necessarily better than involving fast-growing trees and vice versa.

Acknowledgements

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Lessons Learned

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Introduction

The 13 case studies presented in the previous chapters have demonstrated that small-scale, low-key forest activities by local communities may be an effective way of reducing rates of degradation and increasing the rate at which natural forest is able to sequester carbon, as well as a means of sequestering carbon in new plantations. Under the current Kyoto Protocol arrangements (*i.e.* under CDM), only the latter activity is eligible for carbon crediting, but the case studies illustrate the fact that local communities are easily capable of mitigating carbon in a variety of ways through better management of existing forest, provided that they will benefit financially through the sale of the resulting carbon credits. Because 25% of all global carbon emissions derive from loss of tropical forest, it would seem sensible to adopt all means of combating this loss.

The advantages of involving local communities are both environmental and social. The environmental advantages are that large areas of tropical forest may be better protected as a result of such activities, and may start to function in a sink capacity rather than as a source, while at the same time preserving other important forest values such as water catchment and biodiversity. The social advantages are that poor people living in forest areas and on the fringes of forests—those who are often forced by poverty to degrade the forest—may find a new livelihood function in 'carbon forestry', which may help to lift them out of poverty, whether this involves forest management or the setting up of new plantations. The justice of this idea is appealing and the case studies demonstrate clearly the support of local communities in seven different countries for the principle.

In What Situations Can Forest Management for Carbon Compete with Other Land Uses?

The sites selected for this study were of two types. The first six cases, which concern sustainable management of existing natural forest, are all in places where historically degradation was the main process by which forest carbon was lost. These are zones of rather low land value, where there is no obvious competition for alternative land use such as agriculture, because of the terrain, lack of infrastructure such as irrigation or distance from markets. In such areas, the opportunity costs are low, and a small reward for carbon stock increase or for reduced carbon emissions may represent an attractive financial opportunity. Our case studies indicate that the annual increase in levels of carbon in such forests was sufficient to generate such an incentive even if low rates are paid for the carbon credits.

Case studies 7–13 deal primarily with cases of communities involved in afforestation or reforestation activities, on land cleared long ago that now has grass as its climax vegetation. In these cases the question is whether payments for carbon would be sufficient to persuade farmers to plant trees. Interestingly in many cases it seems that tree-based agricultural systems (many of which involve fruit trees or other multiple-benefit species) may in the long run be more profitable than the subsistence crop agriculture now being carried out, but start-up money would be needed for farmers to make the shift. Up-front payments for the carbon credits to be generated may provide just the stimulus farmers need to make this change.

Calculating the Carbon Gains

In estimating the potential for rural communities to become profitably involved in carbon mitigation through forestry activities, it is essential to be able to make realistic and reliable estimates of the biomass increases that will result from their efforts. A variety of methods for doing this are illustrated by the case studies. The first five case studies, under the *Kyoto: Think Global, Act Local* project have piloted a field methodology in which villagers with low levels of education (4–7 years of primary school) use hand-held computers to map the forest areas and store data gathered by standard forest inventory methods. These data provide the basis for projection of growth rates for individual areas of forest. The case from Ikalahan (Philippines) also shows that local people are well able to make such measurements themselves. In most of the remaining cases, carbon estimates were made by professionals, on the basis of some inputs from local people, often using remote sensing techniques as well as forest inventory. In two cases, sophisticated modelling methods were used (the FALLOW model in Case Study 10 and CO_2Fix in Case Study 13).

A number of issues need to be considered as regards the methodology used. Remote sensing technology, though perhaps useful for assessing changes in forest area, cannot yet easily pick up degradation (loss of biomass under the canopy). Since it is in many cases precisely degradation, rather than deforestation, that is responsible for the emissions, and better management of the natural forest that is being proposed to mitigate the emissions, it is without question that accurate, ground-level measurements are required, both in construction of the baseline and in later monitoring of stock changes. Our case studies show that local communities can do this job themselves, reliably and accurately.

For the case of tree plantations and tree-based agriculture (afforestation/reforestation projects), a different methodology is clearly needed to establish the baseline and to estimate probable growth rates (*i.e.* modelling or reference to standard growth rates tables). Several methodologies have already been adopted by the UNFCCC in this regard and some of the case studies have made use of these. For monitoring growth rates after the project starts, however, local people in the communities, once trained, may be able to provide accurate data at a much lower cost than professionals.

The Importance of Local Organisations

In all the cases observed, the importance of strong local control over the process was evident. In the cases of management of existing forest, the forest areas studied were all managed by communities, rather than individual landowners or land users, as a result of legal decentralisation of control of the state forest. The details of the institutional arrangements vary from country to country, but in all cases the village forest organisation has clear rights and responsibilities as regards use of the forest, and there are democratic procedures in place within most of the local communities to ensure that management of the forest, and distribution of the products, is carried out in a transparent manner. Village-level organisations in these places have demonstrated themselves to be strong enough to enforce sets of forest by-laws and to ensure that the forest is guarded against fire and against intruders. The *Kyoto: Think Global, Act Local* project demonstrated that they were also quite capable of monitoring changes in carbon stock over time, using standard forest inventory methods and simple electronic instruments for mapping.

The RUPES projects in the Philippines (case studies 7 and 8) and most of the case studies from Indonesia, particularly 9, 11 and 12, also indicate the necessity of getting the local institutional structure right. Though the process may be slow, and therefore involve quite heavy overhead costs, the importance of involving appropriate local institutions, such as the *nagari,* which has the support and confidence of local people, is evident. Obviously, by involving the farmers at the beginning, choices regarding the areas to be planted and the types of trees selected can be made in accordance with local requirements and constraints.

But beyond this there are other, possibly more pressing reasons behind the selection of local institutions. The motivation of villagers involved in forest management and farmers involved in tree plantations is that they stand to gain, and they expect to be rewarded financially for their efforts. The local institution will have to oversee the distribution of these rewards, and as such it needs to have the trust of the participants. Case study 6 for example shows that equitable distribution of benefits cannot be assumed; there is always a danger of elite capture of profits. The local institutions will have to justify themselves and work in acceptably transparent ways if any of these schemes are to succeed at all, for otherwise people will simply not cooperate. Two of the case studies (11 and 12) show how the local people have already been involved in discussion about how the financial benefits are to be shared among the various institutions involved.

Reducing Transaction Costs

All of the cases described involve transaction costs; clearly reduction of these to the minimum is of great importance, so that as much as possible of the carbon market value can be returned to the villagers and farmers. As noted in cases 11 and 12, however, there will be other claimants as well. Selling carbon credits on the international market means that quite complicated procedures have to be followed, as has been experienced by those case studies for which PINs and PDDs have been completed. Of course, these are pioneering efforts (in Indonesia, no forestry CDMs have yet been approved by the DNA, although five energy projects have been accepted), and in time, the procedures will become more routine. But in addition to the difficulties associated with such procedures, small-scale projects inherently suffer from the principle of economies of scale; and setting up participatory projects always involves a lot of overhead.

In an attempt to drive down at least part of the transaction costs, local people have been involved in the data gathering exercises (case studies 1–5). These cases studies demonstrate the value of this approach, in which villagers use hand-held computers with GIS/GPS equipment, which make possible accurate mapping of the forest areas and which facilitate the storage of data on carbon stock. This seemingly high-tech approach was found to be well suited to the local conditions. Some technical support is of course required (maintenance of computers), but after a few days' training, the villagers showed themselves well able to operate the system without supervision. That this results in considerably lowered local transaction costs is demonstrated in Case Study 3 (Kitalangulo, Tanzania). Although this method has so far only been used in cases concerned with forest management, we believe that it can be used in a wide variety of situations, including in planning and monitoring of tree plantation and tree-based agriculture projects etc.

Financing the Carbon

As noted at the outset, at present the only financing available for mitigation of carbon emissions from tropical forestry is through AR CDM projects. There is, however, ongoing discussion by the Parties to the Convention concerning a new policy, REDD, which may take a much broader view. This is likely to be applied at national, sectoral level, such that average reduction in deforestation and degradation over the country as a whole may be compensated in proportion to the carbon thus saved.

The seven case studies concerned with AR CDM development (7–13) all aim for financing for tCERs, through the Bio-carbon Fund or bilateral CDM financing schemes; but many recognise that alternative buyers are available, and express the desire to tap into this market. The problem is to identify potential carbon purchasers and make contact. None have yet succeeded in bridging this difficult gap.

The case studies concerning forest management (1–6) are all non-Kyoto compliant. They have been developed with a view to tapping into future finance streams under a REDD type of policy. They pioneer the idea that within a national program of reduction of deforestation, individuals and groups of stakeholders who take action to mitigate forest carbon will need to be recognized and rewarded. This implies that a national system of Payments for Environmental Services (PES) is in place. PES systems explicitly recognise the need to bridge the interests of landowners (sellers) and outside beneficiaries of the services (buyers) through compensation payments and other forms of rewards, like recognition of land ownership, and are voluntary in nature. PES works on the business-like principle that payments are made only if the service is actually delivered. Within a national deforestation strategy, discrete efforts, such as the ones described in the case studies, could function as individual projects. As such, it is important that each project is able to clearly measure its own contribution, so that it can claim its fair share of the rewards.

Several of the case studies noted that carbon forestry produces more benefits than only carbon: other forest values such as biodiversity and water catchment are also preserved. Some of the case studies deal directly with the possibility of bundling such environmental services and selling these as a total package (Case Study 9 in particular, where the future of a HEP plant hangs in the balance). This is clearly a highly positive direction to move in; the main difficulty is that while a worldwide carbon market is beginning to develop, there is no international market yet for other forest services except forest certification under Forest Stewardship Council. Possibly GEF funds could be supportive, and new international funds (multilateral or bilateral) may in the future become so, but in general it makes most sense for such projects to look, and lobby, for local (national) sources of finance, particularly as regards water protection, the benefits of which are indeed national rather than international.

An unknown factor in the whole question of finance is the market price of forest-based carbon. At present AR CDM projects are rewarded with temporary credits, but so few have been approved so far that no market value can be established. It is certain, however, that they will be worth considerably less than regular CERs since they have to be renewed at the end of their lifetimes. There is a strong argument, however, that deforestation credits should be rewarded with regular CERs since conceptually the credits are for reduced emissions rather than for creation of temporary sinks. Measures that reduce deforestation slow the rate at which carbon is emitted, just as renewable energy slows the rate at which stored fossil fuels are used and converted to atmospheric carbon. This principle is, however, one that policy makers still have to decided on.

An alternative to the whole idea of financing forestry activities through crediting of carbon and market mechanisms would be a separate global agreement that deals only with forestry matters. Instead of mixing forestry interventions with energy interventions, quite different targets might be agreed upon for the former, and a totally new set of institutional arrangements could be drawn up to arrange finance.

Conclusions

This book has attempted to demonstrate, though the use of 13 real cases, that local communities in remote parts of the developing world are more than able to comprehend the potential of maintaining forest or planting trees for the purposes of carbon mitigation, and that they recognize that they themselves can benefit from this mitigation, if a suitable reward system is constructed using the market value of carbon to create incentives.

We have tried to show that the involvement of local people in (i) organising such projects, (ii) the management of the trees and (iii) measuring and monitoring of growth of carbon stocks is not only possible but also highly beneficial. Although there are many unknown factors, local transaction costs can be considerably lowered if local people themselves perform a large share of all these activities.

The contours of international policy on tropical forestry as regards climate change are in a process of change at the present time. Policy makers would be wise to consider seriously the potential assistance local communities and stakeholders could lend to achieving global objectives in the reduction of atmospheric carbon.

Center for International Forestry Research (CIFOR)
CIFOR is a leading international forestry research organisation established in 1993 in response to global concerns about the social, environmental, and economic consequences of forest loss and degradation. CIFOR is dedicated to developing policies and technologies for sustainable use and management of forests, and for enhancing the well-being of people in developing countries who rely on tropical forests for their livelihoods. CIFOR is one of the 15 centres supported by the Consultative Group on International Agricultural Research (CGIAR). With headquarters in Bogor, Indonesia, CIFOR has regional offices in Brazil, Burkina Faso, Cameroon and Zimbabwe, and it works in over 30 other countries around the world.

The Technology and Sustainable Development (TSD), the University of Twente
TSD group forms part of the Centre for Clean Technology and Environmental Policy at the University of Twente, Netherlands. It is concerned with North-South aspects of sustainable development and in particular with the management of natural resources. It provides education to technology students and is involved in research on social, economic and political aspects of energy, water, forest, and climate policy in developing countries. Since 2003, the TSD has been carrying out research on community forest management in the context of the international climate policy regime, under a project called "Kyoto: Think Global, Act Local", which is financed by Netherlands Development Cooperation. The aim of this research is to investigate the possibility for financing community management of forests by poor, forest dependent people, through carbon market mechanisms.

The World Agroforestry Centre (ICRAF)
ICRAF is an autonomous, not-for-profit, international agroforestry research institution established in 1978 with its headquarters in Nairobi, Kenya. ICRAF is one of a network of 15 Future Harvest Centres of the Consultative Group on International Agricultural Research (CGIAR), supported by an international consortium of nearly 60 different governments, private foundations, regional development banks, and the World Bank. For millennia, farmers have nurtured trees on their farms and across their landscapes. ICRAF and partners transform this ancient practice into a youthful science. We are an international research centre working with farmers and other partners. We use science to understand the complex role of trees in livelihoods and the environment, and promote use of this knowledge to improve decisions and practices impacting on the poor. The Southeast Asia program established in 1993 is based in Indonesia, but also reaches out to farmers in Thailand, Vietnam, the Philippines and southern China. We support the thoughtful inclusion of 'trees of change' in farms and farming landscapes to provide various environmental and livelihood benefits.

A new era is dawning for community-based forest management. The carbon market, both under the Kyoto Protocol and the emerging voluntary markets open the potential for participation of the rural poor in the global endeavor to mitigate global climate change through atmospheric carbon sequestration. Such activities could enhance livelihoods and reduce poverty while supporting environmental conservation at global and local level.

Some of the thirteen case studies presented here could be linked to the United Nations Framework Convention on Climate Change (UNFCCC) Conference of Parties Decision 19/CP.9 on afforestation and reforestation under the Clean Development Mechanism (AR CDM) of the Kyoto Protocol; and Decision 14/CP.10 on Small-scale AR CDM. Others could be linked to the proposed new policy of reduced emissions from deforestation which is currently under discussion by the Parties to the UNFCCC.

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