Center for International Forestry Research

CIFOR Occasional Paper No. 37

Forest Carbon and Local Livelihoods:

Assessment of Opportunities and Policy Recommendations

Joyotee Smith and Sara J. Scherr

ISSN 0854-9818

Front cover photos: Mary Milne, Carol J.P. Colfer, Takeshi Toma, Haris Iskandar, Ramadhani Achdiawan, Herwasono Soedjito
Back cover photos: Carol J.P. Colfer, Edmond Dounias, Haris Iskandar, Candra Wijaya

Center for International Forestry Research
Mailing address: P.O. Box 6596 JKPWB, Jakarta 10065, Indonesia
Office address: Jl. CIFOR, Situ Gede, Sindang Barang, Bogor Barat 16680, Indonesia
Tel.: +62 (251) 622622; Fax: +62 (251) 622100
E-mail: cifor@cgiar.org
Web site: http://www.cifor.cgiar.org

Forest Trends
1050 Potomac Street, NW
Washington, D.C. 20007 USA
Tel. (202) 298 3000; Fax. (202) 298 3014
Web site: http://www.forest-trends.org

Forest Carbon and Local Livelihoods:
Assessment of Opportunities and Policy Recommendations

Joyotee Smith

Economist
Center for International Forestry Research (CIFOR)
Bogor, Indonesia

Sara J. Scherr

Senior Policy Analyst
Forest Trends, Washington, D.C., USA

Contents

Figures

Tables

Boxes

Acronyms and Abbreviations

AIJ	Activities Implemented Jointly phase of the UNFCCC
ANR	assisted natural regeneration
AR	afforestation and reforestation
ASB	Alternatives to Slash and Burn, a collaborative research led by ICRAF
CBD	Convention on Biological Diversity
CCD	Convention to Combat Desertification
CDM	Clean Development Mechanism of the Kyoto Protocol
CER	Carbon Emission Reduction
CIFOR	Center for International Forestry Research, Bogor, Indonesia
CO_2	Carbon dioxide, an important greenhouse gas
COP	Conference of the Parties (to international conventions)
CSERGE	Centre for Social and Economic Research on the Global Environment
DFID	Department for International Development, United Kingdom
ECCM	Edinburgh Centre for Carbon Management
EIT	economies in transition
Face	Forests Absorbing Carbon dioxide Emissions (Foundation)
FERN	An NGO created in 1995 by the World Rainforest Movement advocating changes in European Union activities to achieve the sustainable use of forests and respect for the rights of forest peoples
FUNDECOR	Foundation for the Development of the Central Volcanic Range, Costa Rica
GHG	Greenhouse gas
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation Agency)
ICRAF	International Centre for Research in Agroforestry (World Agroforestry Centre), Nairobi, Kenya
IFAD	International Fund for Agricultural Development:
IFF	International Forum on Forests
IIED	International Institute for Environment and Development
IISD	International Institute for Sustainable Development
ILO	International Labour Organisation
IPCC	Intergovernmental Panel on Climate Change
IPF	International Panel on Forests, now the UN Forum on Forests (formerly IFF)
IUCN	The World Conservation Union (formerly International Union for the Conservation of Nature)

JFM	Joint Forest Management, India
LULUCF	Land Use, Land Use Change and Forestry
NTFP	non-timber forest product
NTGCF	National Tree Growers' Cooperative Federation
OCIC	Oficina Costarricense de Implementación Conjunta (Costa Rican Office for Joint Implementation)
ODA	Overseas development assistance
PFP	Private Forestry Program, Costa Rica
PROCYMAF	Conservación y Manejo Sustentable de Recursos Forestales en México (Conservation and Sustainable Management of Forest Resources in Mexico)
PROFAFOR	Programa de Forestación en Ecuador (Ecuador Afforestation Program)
SBSTA	Subsidiary Body for Scientific and Technological Advice (for the international conventions, e.g. Biological Diversity, Climate Change)
SEMARNAP	Secretaría de Medio Ambiente, Recursos Naturales y Pesca (Ministry of Environment, Natural Resources and Fisheries, Mexico)
SIA	social impact assessment
tC	metric tons of carbon
TNC	The Nature Conservancy
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WCED	World Commission on Environment and Development

Acknowledgements

The authors gratefully acknowledge ideas and information contributed by participants of a workshop on this topic, organised by the Center for International Forestry Research (CIFOR) and the University of Maryland at the Bellagio International Conference Center in Como, Italy, in February 2000 (listed in Annex). We also thank Igino Emmer of the Face Foundation for access to unpublished data. Materials and thoughtful comments from Nigel Asquith, Gary Bull, Ken Chomitz, Tia Nelson, Tom Tomich and Andy White were most appreciated. The authors, CIFOR and Forest Trends are grateful to the Department for International Development (DfID), the Rockefeller Foundation, GTZ and USAID for their financial support of this work.

Preface

Resource users and managers from around the world have begun to recognise the economic, social and environmental importance of ecosystem services provided by forests. At both Forest Trends and the Center for International Forestry Research (CIFOR), we believe that new systems of payments and markets for ecosystem services are part of a fundamental restructuring of forest industry that is occurring worldwide to acknowledge this value. Emerging carbon emission trading markets are the first wave of new ecosystem service markets, together with those for environmentally certified wood, water services and biodiversity. All of these offer great promise to sustain forests and their resources, especially within working landscapes. They also present an historic opportunity for low-income forest owners and producers, who have in the past been relegated to the margins of forest product markets, to benefit economically from good husbandry of their forest resources. Whether this opportunity will be realised, however, will depend very much on how these new markets are organised.

With the Clean Development Mechanism (CDM) of the Kyoto Protocol, an international instrument has been created for trading carbon emission offsets produced in developing countries. The CDM offers an unprecedented opportunity for capital flows into economically impoverished forest regions. *Forest Carbon and Local Livelihoods*, a policy report jointly produced by CIFOR and Forest Trends, examines the potential benefits to local livelihoods from participation in forest carbon projects, as well as the possible threats. Different project options, such as multi-species, community-based reforestation and multiple-use agroforestry, are evaluated in terms of their capacity to meet CDM criteria for emissions offsets and sustainable development. The report distils lessons learned from experience in pilot carbon projects and social forestry on how carbon projects can enhance local benefits, and suggests conditions necessary for project success.

The report's authors—economists Joyotee Smith of CIFOR and Sara J. Scherr of Forest Trends—draw on this analysis to present recommendations to ensure full participation by low-income forest producers and agroforesters in CDM forest projects. Specific recommendations are made to the Subsidiary Body for Scientific and Technical Assessment (SBSTA), which is charged with developing guidelines for CDM. Strategies are also recommended for national policy-makers to create a policy environment that encourages carbon deals between industry and other carbon buyers and low-income producers that also contribute to sustainable development. Finally, the report recommends project design elements that protect local interests, while still keeping the cost of carbon sequestration competitive.

The report originated from an international workshop held at the Bellagio International Conference Center in Como, Italy, in February 2000, which was co-organised by CIFOR and the University of Maryland. Together with Forest Trends, they jointly prepared a preliminary Policy Brief, which was widely disseminated in English, Spanish and French shortly after the workshop. The present report builds on expert discussions held at the workshop, but also includes results from new research on forest carbon projects and other forest market activities by low-income producers. The analysis reflects the decisions regarding the CDM laid out at meetings in The Hague and recently in Marrakesh. The report's recommendations are also highly relevant for involving low-income forest producers in voluntary private carbon trading arrangements that are emerging outside the Kyoto framework in the United States and elsewhere.

This study points to the opportunities that are emerging to structure new ecosystem service markets so that they benefit a much wider group of people — particularly low-income forest dwellers and rural residents—than has been true for commercial forestry in the past. Forest Trends and CIFOR are focusing more attention on understanding where and how these new opportunities can be realised, and supporting innovative initiatives. This report will be a critical building block for defining programme directions in our institutions, and we hope in other private, public and civil society initiatives promoting forest carbon markets.

Michael Jenkins, *President, Forest Trends*
David Kaimowitz, *Director General, CIFOR*

Abstract

Projects implemented as part of the Clean Development Mechanism (CDM) of the Kyoto Protocol will have the dual mandate of mitigating greenhouse gas emissions and contributing to sustainable development. Basic agreement on core elements was reached in 2001, including the decision to allow afforestation and reforestation projects. However, it is not yet clear what rules will address social concerns. Many types of projects could potentially contribute to local livelihoods and ecosystem restoration, as well as to carbon emission offsets, including those using natural forest regeneration, agroforests, improved forest fallows and agroforestry. Averted deforestation projects with multiple-use forestry, though not eligible in the first CDM period, could be reconsidered in the future. Such projects can be designed to rigorously meet CDM criteria for carbon impact, additionality, leakage and duration. If suitably targeted, they can be cost-effective for investors in terms of production costs. Some, however, may have higher transaction costs.

Proactive efforts are needed to enable community-based CDM forestry projects and local land uses to compete effectively in carbon trading markets with projects managed by large-scale operators. The CDM should require mandatory social impact assessments, harmonise the CDM with social principles of other global conventions, promote measures to reduce transaction costs and explicitly include assisted natural regeneration and forest rehabilitation in the definition of afforestation and reforestation. Most developing countries will require policy action to establish the enabling conditions for forest carbon projects to contribute on a large scale to local livelihoods, integrate CDM projects within national development frameworks, attract investors, establish social criteria, secure local rights and promote support services for local people. Cost-effective project design requires attention to local participation, transparency, suitable compensation mechanisms, strategies to reduce transaction costs and risks and extend the scale of projects, and to enhance profitability of land uses.

I. Introduction

Some economists have argued that the conservation of tropical forests will be difficult unless people who use these forests are compensated for the environmental services their forests provide to the world community (Pearce 1996). Such compensation could soon become a reality with agreement being reached on the core elements of the Kyoto Protocol at Marrakesh in November 2001. In 1992, Convention on Climate Change was agreed at the United Nations Conference on Environment and Development, to stabilise greenhouse gases (GHG) in the atmosphere, at a level that would prevent dangerous changes to the climate. To operationalize the convention, a protocol was outline in Kyoto in 1997, which legally commits 39 developed countries to reduce their GHG emissions by an average of 5.2% relative to 1990 levels.

Under the Clean Development Mechanism (CDM) of the Kyoto Protocol, industrialised countries will be able to meet a part of their carbon emission reduction commitments for 2008-2012 (up to a maximum of 1% of their 1990 emissions times five) by carrying out specified afforestation and reforestation activities in developing countries (UNFCCC 2001). Other activities, such as averted deforestation and forest management, may be considered. These types of activities are considered especially relevant since deforestation and other land use changes account for at least 20% of total annual carbon emissions.

The use of forests as an emission reduction strategy has, however, long been controversial in the context of the Kyoto Protocol, and in fact is widely believed to be one of the 'crunch issues' that led to the failure to reach agreement at the earlier meeting in The Hague in November 2000 (IISD 2000). While political and technical issues have dominated the debate about forests in the CDM, awareness of social issues has been growing. Results of international workshops focusing on social issues (Bass *et al*. 2000; CIFOR and University of Maryland 2000) were disseminated at The Hague. Indigenous people and local communities,[1] supported by civil society groups such as the Amazon Alliance in Ecuador and the Amazon Working Group in Brazil, participated actively at The Hague and in Marrakesh. This has led to considerable controversy on the social impact of forest carbon trading. While some community groups have pointed out the risks of forests in the CDM (Declaration of the First International Forum of Indigenous Peoples on Climate Change 2000), others emphasise the potential benefits, provided safeguards are included (Declaration of Brazilian Civil Society on the Relation between Forests and Climate Change 2000; Resolution of Amazonian Indigenous Forum on Climate Change 2001). In recognition of this controversy, SBSTA (Subsidiary Body for Scientific and Technological Advice) has been given the responsibility for developing modalities to address social and environmental concerns. Analysis of the potential of CDM to support local livelihoods could therefore make an opportune contribution to the clarity of this debate.

This paper brings together insights from emerging forestry and conservation paradigms and investigates their relevance for the debate on the social impact of CDM forestry. Many of the groups opposed to forests in the CDM have emphasised the risks of CDM being used to establish vast mono-species plantations or protected forests from which local people are excluded. We argue that other options exist, such as multi-species community-based reforestation and multiple-use community forestry, which could provide a larger share of benefits to local communities and reduce many of the risks they face from CDM projects. Using guidelines from forestry experience and the 'ecosystem approach' endorsed by the Convention on Biological Diversity (CBD 2000), we evaluate the livelihood benefits, enabling conditions and cost-effectiveness of diverse approaches. We then suggest some proactive measures that could help to increase the attractiveness of socially beneficial projects – in the CDM guidelines themselves, through national policy action and through innovative project design.

II. Why Are Livelihood Issues Relevant for CDM Forestry?

Natural and planted forest resources are an integral part of the habitat and socio-cultural framework of rural communities (Byron and Arnold 1999). Almost all tropical forests have people living in and around them. By influencing where forests exist, which types of forests exist and who benefits from them, CDM forestry could profoundly impact livelihood strategies.

The Sustainable Development Clause of CDM

The relevance of livelihood issues has a basis in Article 12.2 of the Kyoto Protocol, which specifies that CDM projects should assist host countries in achieving sustainable development (Kyoto Protocol 1997). Although the Kyoto Protocol does not define sustainable development, a basic understanding of the concept can be derived from the work of a number of authors who have interpreted it in the context of CDM (Pearce *et al.* 1998; Bass *et al.* 2000). Sustainable development can be viewed as the creation of opportunities and capacities for raising per capita well-being (i.e., the quality of life). The sustainable livelihoods concept (Carney 1998) specifies five types of assets (or capital) that need to be expanded or made more productive to achieve this end. These include natural capital (such as land, forests and water), physical assets (such as farm tools, hospitals, roads and electricity), financial capital (such as savings, credit and liquid assets), human capital (such as health and education) and social capital (such as membership in formal or kinship groups facilitating access to other forms of capital).

The concept of sustainable development includes improved equity (World Commission on Environment and Development 1987), i.e., giving special attention to increasing the well-being of less advantaged populations. Sustainable development thus not only promotes opportunities for increasing the five forms of capital, but also facilitates empowerment, i.e., strengthening the participation of poor people in political processes and local decision-making and enhancing security, reducing their vulnerability to shocks and increasing their capacity to recover from them (World Development Report 2000/2001).

Forests and Local Livelihoods

Natural and planted forests represent more than natural capital. They contribute to human capital by providing a range of goods, such as wild game, fruit or traditional medicines, that improve health (Shanley *et al.* forthcoming). Incomes from the sale of forest products, such as latex, resins and spices (Salafsky 1993), provide financial capital that can be used as working capital for trading activities or to purchase inputs for other productive activities or to educate children (Byron and Arnold 1999). Forest foods and incomes from forest products tide households over seasonal or unforeseen shortfalls, or provide lump sums for paying off debts. Forest incomes are a vital economic buffer, particularly for women, children and the poorest households in village communities (Byron and Arnold 1999) and for the entire community during periods of stress, such as seasonal shortages or crop failures (Campbell *et al.* 1996). Forests also provide essential local environmental services (Table 1), whose loss often disproportionately afflicts the poor, who have fewer alternatives.

A New Agenda for Forestry in Ecosystem Management

Environmental conservation efforts have been evolving in recent years towards a new 'ecosystem approach' through which ecosystems are managed as a whole, with protected areas situated within

Table 1. Potential Collateral Benefits of CDM Forestry Projects

- Sustainable management of genetic, biotic and ecosystem resources
- Incorporation of genetic resources, identified through bioprospecting, into agricultural production
- Control of soil erosion and sedimentation in bodies of water
- Sustainability of hydroelectric facilities and irrigation districts
- Prevention of floods and landslides
- Permanent supply of potable water
- Reduction of pressures on natural forests
- Reduction in the expansion of extensive and steeplands farming
- Reduction in migration and displacement of rural people
- Reduction of poverty among rural producers by improving their average monthly income and capital accumulation
- Increase in social investment at municipal and regional levels
- Reduction in armed confrontation and increased political stability
- Continuous energy service, of improved quality and at lower cost
- Improved local, regional and national commercial balances
- Organisation of new businesses and diversification of rural production
- Opening of new markets and improved positioning of agricultural and forest products in internal and external markets
- Development of social organisation and citizen participation

Adapted from Villa-Lopera 2000, Figure 1.

a matrix of complementary land uses (Sayer and Iremonger 1999; CBD 2000; IUCN 2000). This approach emphasises the supplementary and buffering roles of forests within multi-use landscapes. It seeks to manage forests and other land uses for the full range of products and services, with the balance among them being determined through negotiated settlement among legitimate stakeholders.

Many of the principles of the ecosystem approach, as endorsed by the Convention on Biological Diversity (CBD 2000) address social concerns raised in relation to CDM. The approach recognises that local communities are an integral part of forest ecosystems and that their rights and interests should be respected. It enables local people to take advantage of new forest market opportunities arising from increased domestic wood and non-timber forest product (NTFP) demand in developing countries, certified wood and non-carbon environmental services (Scherr *et al.* 2002). It recognises that an appropriate balance between conserving biodiversity and using it may be more realistic and equitable than maintaining vast areas of pristine national parks. Global processes, such as the International Forum on Forests (IFF, now the UN Forum on Forests), are moving closer to consensus on adopting the ecosystem approach as a more 'environmentally and socially friendly' approach to forest conservation and management.

To be consistent with this approach, CDM projects should recognise local communities' needs to access both forest and non-forest land. Instead of compartmentalised projects promoting forest protection or plantations, CDM-supported forest projects should encompass an appropriately sized area relative to other land uses at a broader spatial scale, often integrating non-forest components in their design.

III. Can Forest Carbon Projects Deliver Livelihood Benefits?

Diverse types of forest carbon projects (Table 2) could potentially contribute to mitigate climate change through two major strategies. The first major strategy, afforestation and reforestation (AR), helps to mitigate climate change by establishing additional forest cover that sequesters carbon as trees grow, and then stores carbon for the life of the standing trees. The exact definition of AR activities in the CDM for the first commitment period is to be recommended by SBSTA. For the purpose of this paper we assume that the definition for AR agreed in industrial countries presents a plausible indication of the definition that may eventually be agreed for CDM activities. According to this definition, AR comprises human induced conversion of non-forest land uses to forest, through planting, seeding and/or human induced promotion of natural seed sources. Forests are defined as a minimum area of land of 0.05-1.0 hectares with tree crown cover greater than 10%. Several features of this definition have significant implications for local livelihoods. First, plantations established after cutting down forests will not qualify for credit. Thus there is little risk of community forests being converted to plantations. Secondly, although reforestation projects under CDM have often been assumed to involve large-scale, fast growing mono-species plantations

Table 2. Possible Types of Forest Carbon Projects

Forest Project Type	Approach	Use of Carbon Payments
Large-scale industrial pulp or timber plantations	Establish plantations of fast-growing trees for industrial use in deforested and degraded areas	To cover up-front costs of developing new industry
Agroforestry, community forest plantations	Increase tree-growing and forest cover on farms or associated non-farmed lands to supply tree products or ecosystem services (windbreaks, filter strips, fodder banks, border plantings, woodlots, streambank plantings)	To provide technical and marketing assistance; To subsidise tree establishment; To pay farmers for carbon benefits produced; To increase local organisational capacity to manage and implement carbon contracts
Agroforests (forest gardens), secondary forest fallows	Convert land under annual crops or pasture to multi-species agroforests and secondary forest fallows	To provide technical and marketing assistance; To pay farmers for carbon benefits produced; To increase local capacity
Forest rehabilitation and regeneration	Rehabilitate and regenerate severely degraded natural forests on community land or farms, to supply products and ecosystem services; Once regenerated, develop sustainable forest management system with local communities	To provide training, local organisation and planning; To pay costs of forest protection and management; To compensate users excluded from regenerating forest
Strictly protected forest areas	Remove potential threats of deforestation, and manage area so as to minimise human impacts	To compensate sources of deforestation threats; To pay costs of forest protection; To develop local income sources, outside protected forest, to reduce leakage
Multiple-use community forestry within protected forest	Remove potential threats of deforestation and develop sustainable forest management system with local communities (timber, NTFPs, hunting, ecotourism) within protected forest	To compensate sources of deforestation threat; To develop local technical, business capacity for managing protected forest

(Fearnside 1996; FERN 2000), the above definition of AR is also compatible with community-based, multi-species plantations and plantations of non-wood products, both of which provide livelihood benefits, as we show below. Thirdly, assisted natural regeneration (ANR) is included in the definition. This, as we show later, opens up possibilities for low cost options compatible with social benefits.

The second major strategy, averted deforestation, protects standing forest carbon stocks that would otherwise be lost. Such projects seek to remove a threat, such as unsustainable logging, agriculture or estate crops, that could result in deforestation or degradation. While most of the debate about averted deforestation has focused on establishment of strictly protected areas, alternative project designs incorporating multiple-use community forestry can provide greater livelihood benefits. Averted deforestation projects are not presently eligible under the CDM.

Regions undergoing rapid conversion of forest to agriculture may require both averted deforestation and reforestation components. Here, we examine each project type in terms of its livelihood benefits and risks (Table 3) and the enabling conditions for successful project implementation with livelihood benefits (Table 4).[2]

Large-Scale Industrial Pulp and Timber Plantations

Large-scale industrial plantations, using a small number of fast-growing species, could be of great interest to the private sector, because of potential profits from the pulp industry, and to host countries, because of the potential for earning export revenues.

Livelihood benefits. The main benefit to local communities from industrial plantations is employment. In very marginal agricultural areas, plantation establishment can be more labour intensive than agriculture, requiring from 70 days/ha on grassland to 400 days/ha on steep terrain. Once establishment is complete, employment requirements fall to about 9 to 15 days/ha (Morrison and Bass 1992). However, CDM plantations are likely to follow rotational harvesting systems in order to maintain carbon levels, thus employment requirements may be sustained due to the need for continuous replanting. Socially responsible industrial plantation companies may provide health, education and social services to employees and local communities. Firms have the potential to treat social sustainability as an opportunity for strategic advantage (Box 1), not just franchise protection or social obligation (Jenkins and Smith 1999).

Box 1. Local Benefits from Industrial Forest Plantations in the Brazilian Amazon

When the Brazilian company Riocell, S.A. first operated as a pulp producer and exporter in the 1970s, conflict over pollution from the pulp mill led to public outrage and a shutdown by government. When the company changed hands in 1982, its management gave high priority to maintaining good relations with the communities surrounding its operations. In addition to operating its own forests, Riocell also leases forests and jointly owns forests with others (with whom it shares production). In 1996, it purchased 20% of its raw materials from third parties (acacia forests and jointly owned forests). Outside and joint holdings of eucalyptus are dispersed mosaic-fashion among 162 tree farms in 23 municipalities, averaging 3% of the total land area in each municipality. This structure is not only more consistent with the ecosystem approach, but also keeps the region's timber market competitive and gives farmers an incentive to plant more trees. Riocell provides direct employment for several thousand workers and also contracts out many operations and services that lower the company's costs while encouraging local entrepreneurs (Jenkins and Smith 1999: 248-56).

Livelihood risks. The risks associated with large-scale, mono-species plantations have been well publicised and disseminated. A number of authors have documented cases where governments have given concessions for industrial plantations on land traditionally held by local people (Potter and Lee 1998; Colchester 2001). Tenure conflicts are a common feature of plantations in many parts of the world where local rights have been ignored or inadequately compensated when plantations were established (Morrisson and Bass 1992; Fearnside 1996; Potter and Lee 1998; FERN 2000). A number of countries have targeted 'degraded areas' for CDM plantations. In many cases, however, these may be lands held under traditional common property systems that are used by local people for a variety of purposes (Fearnside 1996; FERN 2000; Smith *et al*. 2000), and are often of particular importance to the poor (Jodha 1986). These lands often also harbor the last remaining native plant communities in the locality. The prospect of support from CDM projects could result in unscrupulous operators claiming the lands of local people who lack legal documents, thus

Table 3. Livelihood Impacts of Forest Carbon Projects, by Project Type

	Project Types					
	Large-scale industrial timber/ pulp plantations	**Agroforestry, community forest plantations**	**Agroforests, secondary forest fallows**	**Forest rehabilitation and regeneration**	**Strictly protected areas**	**Multiple-use forestry within protected areas**
Main beneficiaries	Timber industry; governments; forest product consumers	Local communities; forest product consumers	Local communities; forest product consumers	Local communities some global biodiversity	Global conservation, large-scale operators posing threat to forest	Local communities; global conservation, large-scale operators
Influence of local people over land-management decision	+ Principal Decisions taken by industry	+++ Production of carbon benefits contingent on local benefits	+++ Production of carbon benefits contingent on local benefits	+++ Production of carbon benefits contingent on local benefits	+ Participation driven by leakage concerns	+++ Production of carbon benefits contingent on local benefits
Local livelihood co-benefits	+ Employment; social services provided by companies	+++ Tree product income, consumption; positive impacts on crop or livestock productivity	+++ Income and consumption from NTFPs, timber, soil recuperation	++ Provision of forest products for use, income	+ Development activities to control leakage	++ Maintains community access to forest resources that would otherwise be under threat of deforestation. Income and consumption from NTFPs, timber
Local environmental co-benefits	+/++ Some benefits if on degraded lands; if land-use mosaics instead of large-scale monoculture	++ Enhance water services; reduce sedimentation; improve landscape; depends on spatial configuration	++ Enhance wide range of ecosystem services	+++ Potential rehabilitation of a wide range of ecosystem services	++ Wildlife recovery; reduced sedimentation from logging	++ Maintains community access to forest resources providing ecosystem services
Local livelihood risks	+++ Loss of access to land, forest; NTFP depletion; involuntary resettlement; water, sedimentation	+ Minimal so long as tree species and configuration are compatible with other farm needs	+ Minimal, so long as sufficient land available for needed annual food crops	+ Exclusion from use of land for crops or livestock, to enable regeneration; inequitable distribution of benefits	+++ Loss of access to forest; Loss of employment	+ Inequitable distribution of local access rights, products or income

Key: **+++ High, ++ Medium, + Low**

Table 4. Enabling Conditions for Local Livelihood Benefits, by Project Type*

	Project Type					
	Large-scale industrial plantations	**Agroforestry and community forest plantations**	**Agroforests and secondary forest fallows**	**Forest regeneration or rehabilitation**	**Strictly protected areas**	**Multiple-use forestry within protected areas**
Rural population density	Low to moderate	Moderate to high	Low to moderate	Moderate to high	Very low	Very low to low
Good market infrastructure	Low to moderate	Moderate to high	Moderate to high	Low	Low	Low to moderate
Local technical & management knowledge	Minimal	Moderate to high	Moderate to high	Low to moderate	Minimal	Moderate to high
Quality of existing forest resource	Not relevant	Not relevant	Benefits higher if proximity to patches of old growth forest	May be low initially, but should have potential for high economic value after regeneration	Not relevant	Important for timber, hunting, NTFP, ecotourism benefits
Land/forest tenure security	Compensation for limits on local forest rights (formal/ informal); no coercion	Secure ownership or usufruct rights	Secure land ownership or usufruct rights	Clear community rights to protect and manage forests	Compensation for limits on local forest rights (formal/ informal); no coercion	Clear rights of access/use of forest products negotiated
Legal rights for local people to sell carbon benefits	Probably not applicable	Needed for direct farmer payment schemes, but not necessarily for development programme	Needed for direct farmer payment schemes, but not necessarily for development programme	Needed for land claimed by local communities or municipalities; plan for sharing benefits	Needed for land claimed by indigenous communities	Needed for land claimed by indigenous communities
Local organisation	Minimal, mainly to negotiate and distribute compensation claims	High, to provide technical assistance, develop contracts, manage community plantations	Moderate to high; to provide technical assistance, distribute payments, market products	High, to plan and manage community forests; low for farm forestry	Minimal, mainly to negotiate and distribute compensation claims	High, to plan and manage community forest access and use

* Full details and references in Smith and Scherr (in press).

exacerbating existing disparities in income and political power (Smith *et al.* 2000).

Other problems sometimes experienced by indigenous peoples from large-scale plantation development have included depletion of economically important wildlife, labour exploitation, increased disease and disruption of social support networks (Colchester 2001). Establishment of industrial plantations is already highly subsidised in most countries, and further financing through CDM could put alternative community forest and agroforestry production systems at a further competitive disadvantage.

Enabling Conditions. The above social risks are probably greatest where rural land tenure is unclear and land conflicts are endemic, a situation commonly found in timber-rich regions, such as the dipterocarp forests of Southeast Asia and the Amazon and Congo basins. The risk of negative social impacts is likely to be particularly high in regions with repressive governments and poor governance, and strong economic and political alliances between government and the plantation industry. Fewer social risks are likely to exist in regions with low population density and soils with intermediate productivity. Examples are the savannas of Latin America and east and southern Africa and the coastal savannas of central Africa (Smith in press).

Agroforestry and Community Forest Plantations

Historically, as population pressure increases and external pressures build up in farming systems, agroforestry[3] develops as a strategy for increasing the returns to land, meeting growing needs for forest products and producing environmental services formerly provided by forests (Arnold and Dewees 1997; Simons *et al.* 2000). From a CDM perspective, it is useful to distinguish four types of agroforestry systems, which differ by average tree density, duration and harvest intensity:

1) Blocks or strips of trees established to develop permanent forest cover for environmental or amenity services (often on degraded lands, steep hillsides or along waterways), with only low-intensity NTFP extraction, on community or household land;
2) Blocks of simple tree-crop systems planted for the intensive harvest of non-timber products, such as fruits, leafy fodder, oils, beverages, sap, etc. (usually interspersed with crop fields and pastures);
3) Blocks of trees established for timber production on farms or community-owned lands;
4) Trees or shrubs planted in lines or mixed intercrops in cropland or pastures planted for their soil fertility, conservation or microclimate effects, or to diversify product mix.

In intensively managed, forest-scarce farming systems, growing trees in small blocks and in interstitial niches in and around crop fields and pastures can significantly increase overall canopy cover. In Uganda, for example, 58% of all tree cover is on agricultural lands. Systems may include both native and exotic tree species. Wealthier farmers may favour larger-scale plantations with only one or two commercial tree species, while poorer farmers prefer a wider range of species for consumption and income diversification (Shepherd *et al.* 1999). Outgrower and cooperative schemes with local communities (long popular for high-value tree crops) are now being used by forest industries in countries such as South Africa, the Philippines and India. In a worldwide study, Mayers and Vermeulen (2002) found that 60% of forest companies producing wood pulp obtain some product from outgrowers or otherwise work with farmers.

Livelihood benefits. Agroforestry can provide a wide range of benefits to local people – for subsistence (foods, condiments, fuel, construction materials and medicines); cash income (sale of processed or unprocessed products or tree nursery stock); asset-building (for later financing of major lifecycle events, schooling or home improvement); inputs to farming (animal fodder, green manure and climbing poles); services to farming (windbreaks, fencing, erosion control, soil fertility enhancement through nitrogen-fixing or increased organic matter); and aesthetic and cultural values. Tree species may often be selected and managed so as not to compete with adjacent crops or grazing animals, and in some cases may increase yields due to microclimate, soil fertility or conservation effects, or reduce production risks.

Current *et al.* (1995) reviewed 56 agroforestry practices in eight countries and found that a majority was profitable and, in 40% of cases, financial returns were at least 25% higher than alternative farming practices. Saxena (1997) reports that eucalyptus plantations on degraded lands distributed to landless families in India became an instrument for capital accumulation, enabling them to buy small paddy fields and pay off debts. In densely populated Pakistan, over 90% of fuelwood and 60% of timber now comes from farms, with two-thirds of timber coming from trees in irrigated fields (Vergara 1997). Some pilot carbon projects using agroforestry and farm forestry have produced significant benefits (see Boxes 2 and 3).

Box 2. Local Benefits from Agroforestry: Scolel-Té Project, Mexico

In the Scolel-Té pilot carbon project in Mexico, 400 small-scale farmers in 20 communities are sequestering carbon by switching from swidden agriculture to agroforestry, either combining crops and timber trees or by enriching fallow lands (de Jong *et al*. 2000). The resulting carbon offsets (about 17,000tC at $10/tC to $12/tC) have been sold to the International Federation of Automobiles. The Scolel-Té project is notable for strong local participation in project design, management plans and distribution of carbon benefits. Considerable effort has also gone into building capacity on the basic concepts of climate change, carbon sequestration and the terms and conditions of carbon transactions. As much as 60% of carbon revenues have gone directly to farmers to cover establishment costs of new farming systems (Tipper, in press). Carbon revenues have been used by farmers to purchase food and medicines, and to improve their houses. Women have received fuel-efficient stoves to reduce fuelwood pressures (N. Asquith, unpublished data). Discounted benefits of the agroforestry systems (including carbon revenues) for most participants are estimated to range from -$110 to +$ 1700/ha (Tipper, in press). Whether or not good project design will induce farmers to maintain their agroforestry systems for an extended period, without further payments for ecosystem services, remains to be seen.

Livelihood risks. Establishing large blocks of community plantations, woodlots or conservation forests could reduce the area available for annual food crop production – a problem if food markets are unreliable or if yields do not rise. Prices for perennial products are volatile and may decline if supplies expand significantly.

Enabling conditions. Agroforestry and smallholder plantations have generally been more common and successful on household lands than in community-managed lands. Major factors contributing to successful and profitable smallholder adoption of agroforestry include market demand for forest products induced by declining forest resources, availability of planting material for diverse species, a cultural tradition of tree-planting, secure rights to harvest products of planted trees, the compatibility of tree species

Box 3. Local Benefits from Farm Forestry: PROFAFOR Project, Ecuador

The PROFAFOR pilot carbon project has established 23,000 ha of plantations of pine, eucalyptus and mixed pine and indigenous species on the farms of smallholders, in a region of low forest cover in Ecuador. Plantations have been targeted, in many cases, to areas where they contribute to controlling erosion and preventing landslides. Almost all communities have been able to cover establishment costs from project funding and have used surplus funds for food, credit schemes and livestock. Pine and eucalyptus are estimated to be profitable at discount rates of 15% to 20%, but slow-growing indigenous species give negative returns (CIFOR 2001). Project activities have provided local communities with 600,000 days of employment, 26 nurseries producing 20 million seedlings and capacity-building in nursery and plantation management. Farmers will be free to market harvested timber to the buyer of their choice (I. Emmer, unpublished data). The project assumes plantations will be maintained for 100 years. Whether or not this is realistic remains to be seen.

with crop and livestock production, and competitive market institutions (Scherr 1995, 1999). Key features of livelihood-improving outgrower schemes are: secure land tenure; choice of which species are planted; clear tree rights; financial support while trees mature; good prices; adequate returns on investment; access to technical knowledge and inputs; and diverse (rather than 'captive') product markets (Mayers and Vermeulen 2002).

Agroforests and Secondary Forest Fallows

Agroforests and forest fallows are common components of farming systems in tropical forest ecosystems. Multi-species *agroforests* (also known as complex multi-strata agroforestry or forest gardens) are found in settled farming regions in humid tropical areas all over the world, including Southeast Asia, Sri Lanka, Mesoamerica, Peru and West Africa (Salafsky 1993; Michón and de Foresta 1995). They are established in cleared land, crop land or early stages of the fallow in shifting cultivation systems by assisting the regeneration of commercially valuable native forest trees like cinnamon, planting introduced species or by establishing high productivity polycultures like coffee (Leakey 1999). Agroforests are relatively rich in forest species including plants, mammals and birds (de Foresta 1992), due to their structure and diversity, which mimic natural forests when they are in spatial or temporal proximity to natural forests. CDM projects could encourage a greater extension and permanence of agroforests by developing market opportunities, better technologies and management practices for agroforest species.

In their study of three Latin American countries, Smith *et al.* (2001) found that *secondary forest fallows* occupy around 20% of the farm area on small colonist farms in the Amazon. While some secondary forest fallows are left to regenerate spontaneously, many farmers use a variety of assisted natural regeneration techniques to increase their productivity, such as the protection of seed producer trees and the management of seedlings through transplanting, weeding and protection from pests (Pinedo-Vasquez *et al.* 2001). Data from forest inventories indicate that secondary forest fallows have considerable potential for providing a range of commercial products, such as timber, fruit and medicinal plants, if maintained for long periods, particularly in the vicinity of patches of old-growth forest. They also make a valuable contribution to sustaining agricultural productivity. Incentives for cattle ranching, however, induce many farmers to reduce fallow periods or to establish pastures instead of allowing secondary forest fallows to regenerate after cropping. As a result pastures occupy 15% to 30% of the farm area (Smith *et al.* 2001). Opportunities therefore exist for using carbon revenues to induce farmers to regenerate secondary forest fallows instead of establishing pastures, and to keep forest fallows for longer periods so that their capacity for providing useful products and recuperating soils can be enhanced.

Livelihood benefits. Agroforests are estimated to be among the most profitable of several major land uses studied in Brazil (Vosti *et al.* 2001), Cameroon (Gockowski *et al.* 2001), and Indonesia (Tomich *et al.* 2002). These systems diversify income and provide numerous supplemental foods, thus reducing livelihood risks (Box 4). They enhance the provision of a variety of ecosystem services, buffering intense rains, reducing sedimentation and maintaining pollinator populations and locally important wildlife. Using carbon revenues to establish secondary forest fallows instead of pastures would not only diversify and augment incomes of small-scale farmers, but also improve soil recuperation. Piñedo-Vasquez *et al.* (2001) document that swidden agriculturalists in the Amazonian floodplains of Amapa, Brazil, obtain average incomes of over US$6000 from timber sales after deducting direct timber management costs. Poles extracted from secondary fallow forests account for two-thirds of this income.

Box 4. Local Benefits from Agroforests in Indonesia

There are over 4 million ha of agroforests in Indonesia alone. Although most have a primary crop, such as rubber, fruit or timber species, they also contain a host of other useful species that contribute to a diverse set of livelihood strategies. In some parts of Indonesia, such as Jambi, Sumatra, agroforests are responsible for 50% to 80% of the cash incomes of farm households. The agroforests near Gunung Palung National Park (which produce seeds from *Shorea stenoptera*, durian fruits, rubber and timber) form a mosaic of rubber gardens, fruit gardens and dry rice fallows. Rubber from agroforests (a quarter of the world's natural rubber) is valued at US$1.9 billion (Salafsky 1993; Joshi *et al.* 2000).

Livelihood risks. Livelihood risks of expanding agroforests or extending the area in secondary forest fallows are similar to those for community plantations and agroforestry.

Enabling conditions. Enabling conditions for agroforests and secondary forest fallows include proximity to patches of old growth forest, an infrastructure for marketing tree crops, a traditional culture of tree and forest management and environmental conditions and policies that reduce the attractiveness of competing land uses, such as cattle ranching (de Jong *et al.* 2001). Research by Piñedo-Vasquez *et al.* (2001) shows that regional and local markets for diverse, small-diameter wood products, such as poles, contribute to the success of timber management in secondary forest fallows.

Forest Regeneration and Rehabilitation

In regions where natural forests have already been depleted, the scarcity of forest products and decline in biodiversity and ecosystem services increases the interest of communities in forest rehabilitation and protection (Byron and Arnold 1999). Local protection for communal forest regeneration is widely practised in moderately populated parts of Africa, Nepal and elsewhere, especially for dry forests that are difficult or costly to establish by seed or seedling. Techniques such as assisted regeneration and coppice management can accelerate forest recovery and improve quality (Saxena 1997). Resources from carbon deals can be used to support community organisation and capacity-building. Project design studies in central India found that teak and dry deciduous forests under community protection sequestered 1 to 3 metric tons of carbon per ha per day, and that the best opportunities were in degraded forests (crown cover under 40%); projects could include contiguous areas of 5000 ha to 10,000 ha of forest in rural communities with moderate rural population density (Poffenberger *et al.* 2001). Projects in degraded forests with crown cover over 10% will not, however, qualify for credit in the first commitment period if the definition of reforestation for the CDM is the same as the definition adopted for projects in industrialised countries.

Livelihood benefits. Forest regeneration creates an economically productive community asset (Box 5). Once regenerated, many of the management options described under multiple-use community forestry may be relevant, for both consumption and income. Forests can be enriched with species of high local use value or high commercial value. Regeneration may have important benefits in rehabilitating local ecosystem services and restoring biodiversity.

Box 5. Local Benefits from Forest Regeneration: Joint Forest Management in India

Under India's Joint Forest Management (JFM) programme, government agencies and community organisations jointly manage degraded public forests. JFM currently occupies over 7 million ha of forest land (MoEF 1999) and is credited by many for having stabilised India's forest cover (Rangachari and Mukherji 2000). Rehabilitation under JFM has included assisted natural regeneration through restricting grazing and the collection of fuelwood and leaves, management of coppices and shoots, and the planting of exotic or mixed native species (Saxena 1997). Hill and Shields (1998) show that JFM activities increased the net worth of a teak forest in Gujarat state by 60% and that of a Sal forest in West Bengal state by 35%. In the state of Orissa, gully formation was checked and stream flows were restored (Saxena 1993). In Madhya Pradesh, JFM transferred rights to the final timber harvest from the state monopoly to joint management, of which the community share is worth more than $2 billion in current prices. Meanwhile, income from NTFPs averages $280 per household per year (World Bank Task Team, Madhya Pradesh Forestry Project 2001). Local rights continue to be restricted and, in some cases, JFM projects have usurped pre-existing usufruct rights, but the principle that livelihood benefits accrue when such rights are strengthened seems clear.

Livelihood risks. The principal livelihood risks are that the benefits of an increasingly valuable community asset may be captured by local or external elites, and that inadequate arrangements may be made to accommodate forest-dependent marginal groups excluded from the forest during the regeneration process. Analysing some of the shortcomings of the Joint Forest Management programme in India, Saxena (1997) and Sundar (2000) point out that, in many cases, the poorer households and women paid the cost of protection during the regeneration period. For instance, they were forced to travel longer distances to collect firewood, while richer households were able to cope with fuelwood collection restrictions by purchasing supplies. Saxena (1997) suggests that prior to forest protection, other project components (e.g., biogas energy, fodder plots and forest gardens) should be established to take care of the needs of those who lose out during the regeneration period.

Enabling conditions. Rehabilitation is often most successful among homogeneous communities who can rely more effectively on social sanctions, and in the poorest regions where forest dependence is greater. Tenure security and clarity in rights over rehabilitated areas is critical. Forest rehabilitation has been much less problematic in situations where local people already have ownership or usufruct rights, and where trust has been built between local communities and officials.

Strict Forest Protection

In some existing pilot projects to avert deforestation, once the deforestation threat has been removed, the area is managed as a national park with human impacts within the park being minimised. Examples are the Rio Bravo project in Belize and the Noel Kempff project in Bolivia.

Livelihood benefits. Given that communities are excluded from the project area, strict forest-protection projects incur the risk of leakage of carbon emissions, i.e., that communities will cut down forests outside the project area as a result of exclusion from forests within the project boundaries. Benefits from leakage-prevention projects can be significant (see Box 6 on the Noel Kempff project). Projects may also provide collateral environmental benefits of local importance, such as the recovery of valued wildlife populations, or reduced sedimentation previously caused by logging operations. However, the share of carbon revenues captured by local communities may be low in such projects, relative to the share captured by large-scale actors such as industrial loggers, large-scale farmers or cattle ranchers, who usually pose the most serious deforestation risks.

Box 6. Local Benefits from Forest Protection: the Noel Kempff Project, Bolivia

The Noel Kempff project includes a development component for local communities as a leakage-control measure. This provides technical and financial assistance to local communities for obtaining legal land title to, and sustainably managing, an alternative forested area. Leakage-prevention measures also include improved technologies for increasing agricultural output and diversifying income sources in areas outside the national park (Brown *et al*. 2000). A preliminary assessment in early 2000 suggests that, in the short run, some local communities have lost out as cash benefits are lower than lost income sources. Long-term impacts on local communities are likely to be positive if their claim to customary land rights is ultimately delivered and their losses from its use are compensated (Asquith *et al*. forthcoming). Around 9% of the total project investment of US$9.6 million has been allocated for development activities with local communities. While this is significant, it is only half the 18% share paid out to the timber industry, whose concession was retired to establish the national park. Also, while the timber industry received its share at the start of the project, the funds allocated for community benefits are to be disbursed over five years (Asquith *et al*. forthcoming).

Livelihood risks. Rights to natural forests are unclear and overlapping in most developing countries and subject to multiple claims by different social actors, sanctioned by different institutions (Peluso 1992). Many examples exist where local communities have been evicted from their lands when national parks are established (Stevens 1997). A major concern expressed by indigenous communities is that CDM forest-protection projects may result in local communities losing access to lands they have long used under customary rights. CDM projects may compensate the more visible and vocal stakeholders, such as the timber or estate-crop industry whose rights are recognised in national laws, while failing to compensate, or inadequately compensating, local communities whose rights are based on informal norms. Indigenous communities also fear that CDM-project forests may be managed primarily for protecting or sequestering carbon, while other products and services valued by them, such as NTFPs and cultural and spiritual values, are ignored (Declaration of the First International Forum of Indigenous Peoples on Climate Change 2000).

In some forested areas, agricultural land conversion makes much more sense for local livelihoods than keeping the land under forest, especially where soil characteristics favour agricultural production and infrastructure and market access are good (Wunder 2000a). Prevention of deforestation through CDM projects in these situations could impact negatively on local communities, unless high compensation is paid. When CDM projects retire timber concessions, local communities will lose timber harvesting and processing jobs, though alternative job opportunities may be developed (such as carbon monitoring, palmito processing and park guards, as was done in Noel Kempff; see Asquith *et al.* forthcoming).

Enabling conditions. Strict forest-protection projects will be most viable in remote areas with low population densities, where the rate of deforestation in the absence of the project is moderate or low. While this lowers carbon benefits relative to areas under high levels of threat, it also reduces protection costs and the risk of project failure. Local people will benefit mainly where they are fully compensated for the range of losses from forfeited forest access and use, and have a voice in designating the boundaries of the protected area.

Multiple-Use Community Management of Natural Forests

Nearly everywhere in the tropics, users of forest products and services face a decline in the size and/or quality of forest resources (Arnold and Dewees 1997). Strict forest protection exacerbates this trend. Instead of excluding communities from the project area, averted deforestation projects could develop various types of community forestry within the project area, after the deforestation threat has been removed. If implemented in this way, averted deforestation projects could help to reverse the decline in community access to forests and increase forest productivity. This approach would also link project success closely to the development of sustainable forest management systems appropriate for community needs. Such projects would address concerns that CDM only values forests for carbon purposes.

As already mentioned, large-scale actors will often be the main source of deforestation threats. In the past 10 to 15 years however, a number of countries have introduced legal frameworks restoring traditional community rights to forests. As a result, 14% of forests in the most forested developing countries are owned and another 8% are controlled by communities (White and Martin 2002). Some of these forests may face deforestation risks from communities who lack technical knowledge and financial capacity to manage them sustainably or prefer to convert them to other uses. Thus, new opportunities exist to make direct payments to communities to conserve and manage forests. Carbon revenues could, for example, be used to encourage swidden agriculturalists to practise multiple-use forestry on forested areas of their farms, instead of converting them to agriculture. Projects could help communities organise to prevent forest fires (Melnyk 2000).

Poorly developed, multiple-use forestry could pose a risk to conservation of the forest ecosystem – thus jeopardising protection of carbon stocks and biodiversity. New forestry paradigms suggest ways to achieve multiple objectives through land-use mosaics, and to target projects to suitable niches and contexts (Smith and Scherr in press).

Livelihood benefits. Multiple-use community forestry has been widely documented as providing livelihood benefits for both subsistence uses and cash income to forest dwellers and farmers. *Timber* harvest and processing can be a significant source of cash incomes for communities. Community forestry including timber and NTFPs in Quintana Roo, Mexico, for example, provided profits which, in good years, were high enough to cover the cost of public community services as well as to distribute around US$1000 to each household in the community (Snook 2000). Community forest concessions established in the Maya Biosphere Reserve earn significant local income from timber, while reducing only a small proportion of forest biomass (Tattanbach *et al.* 2000). Certified wood may open up new markets for communities that can use CDM payments to underwrite the high costs of certification.

Extensive harvest of plant and animal-based NTFPs may be undertaken in near-natural *extractive reserves* (Allegretti 1990). For example, an extractive reserve in Petén, Guatemala, provides employment for 7000 people (Salafsky *et al.* 2000), and reserves in Rôndonia, Brazil, provide livelihoods for 5000 rubber tappers (Brown and Rosendo 2000). NTFPs for home consumption are especially attractive to poor households, as they are usually derived from commons areas, collected using unskilled labour, help offset agricultural production risks, improve nutrition, and can fit easily into the diversified activity portfolio of the poor (Box 7).

Box 7. Local Benefits from Multiple-Use Community Forestry in Zimbabwe

A quarterly household economic survey was implemented in 29 villages in the dry woodlands area of southern Zimbabwe in 1993/94 and 1996/97. At least 100 different resource uses were identified, most notably firewood use, consumption of wild foods, livestock browse and graze, and cash income from the sale of NTFPs such as thatching grass and carpentry products. Most derived from rangelands, woodlands and rivers held under communal ownership. These NTFPs provided over a third of average total (cash plus non-cash) income per person in both years. The poorest 20% of the population earned over a third of their total income from NTFPs alone, even though the rich were the main users of resources in quantity terms (Cavendish 2000).

Hunting can improve nutrition, reduce agricultural damage and enhance cultural values. In West Africa, for example, 25% of protein requirements are met from wild meat. Advances in wildlife management show that hunting can be sustainable in tropical forests, based on the principle of linking 'sinks', i.e., areas where people hunt, with 'sources', i.e., connected areas where hunting is totally prohibited, which act as a refuge where hunted species can be replenished (Bennett and Robinson 2000).

Successful *ecotourism* can, under certain conditions, provide significant cash benefits to local communities and engage them as defenders of protected areas (IIED 1994). Ecotourism in parts of Ecuador induced communities to voluntarily restrict unsustainable hunting and empowered communities, in partnership with tour operators and environmentalists, to successfully resist oil exploration, which would have opened up the forest to squatters (Wunder 2000b).

Livelihood risks. The principal livelihood risks are from poorly designed or under-financed projects that fail to produce sustainable livelihoods and viable forest enterprises. Knowledge or skills needed for forest management and marketing may be underestimated. Where enterprises are community-owned or managed, equity problems may arise in relation to distribution of local use rights, products or income.

Enabling conditions. A number of studies have analysed the conditions under which multiple-use management by communities improves resource use and local livelihoods. Most important are low population densities, high-value forest resources, strong communal resource-management capacity, empowerment of local communities with 'sanctioned authority' to protect resources, and adequate marketing and technical support.

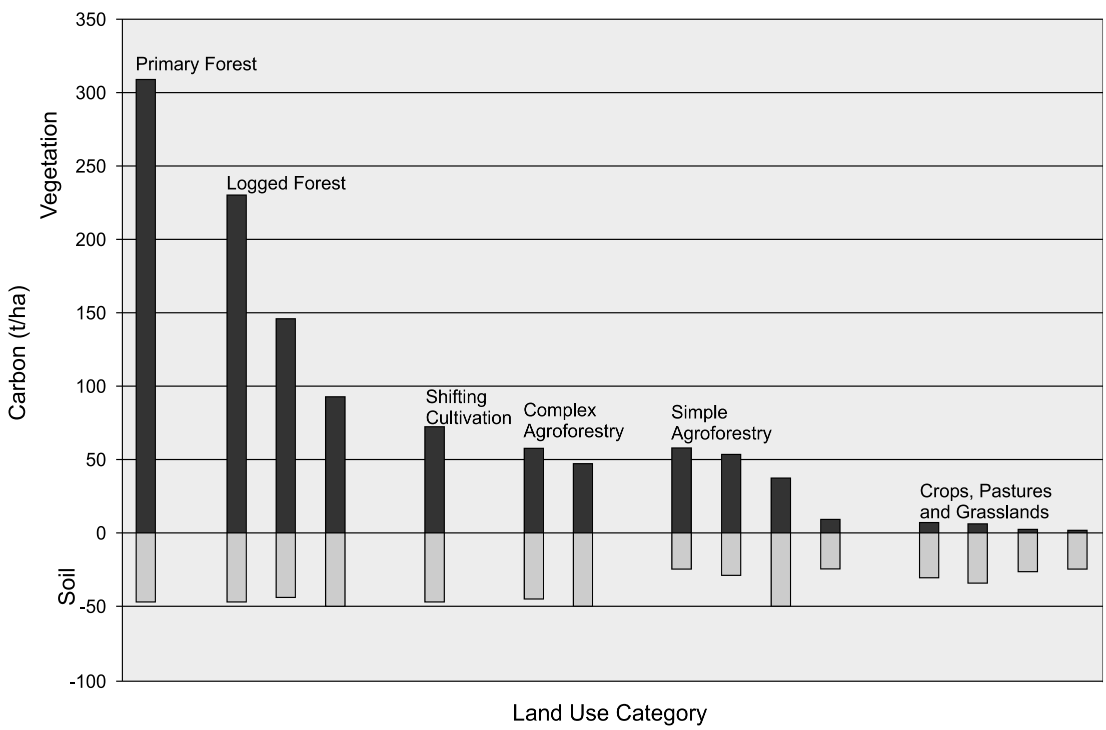
IV. Can Livelihood-Enhancing Projects Meet CDM Criteria?

In addition to contributing to sustainable development, CDM projects will have to meet certain requirements that distinguish them from conventional forestry projects. How do livelihood-enhancing forest carbon projects compare with others in meeting these criteria?

Capacity to Produce Carbon Emission Offsets

Land-use change in the tropics is a net source of carbon to the atmosphere, primarily due to deforestation.[4] Figure 1 summarises research findings on the carbon sequestered or lost from converting from one land-use system to another in the humid tropics of Brazil, Cameroon and Indonesia. Obviously, the highest level of carbon benefits results from conserving or extending primary rain forest. Annual crops and pastures store a small fraction of that amount. Logged forest, agroforests, tree crops, timber plantations and secondary forest fallows fall in between. Secondary forest fallows of 20 to 30 years, for example, store around 75tC/ha,[5] with sequestration occurring at a rate of 5tC/ha/year during the first 10 years of regrowth (Fearnside and Guimares 1996). However, any intervention that prevents the conversion of a higher to a lower carbon-storing land use, or that encourages conversion from a lower to a higher carbon-storing land use, will contribute to net carbon storage. Thus a wide range of other forestry and agroforestry systems can make a meaningful contribution. For example, Poffenberger *et al.* (2001: 33) estimated that dry forests in central

Figure 1. Above-Ground Time-Averaged and Total Soil Carbon (0-20 cm) for ASB Benchmark Sites in Brazil, Cameroon and Indonesia



Source: Tomich *et al.* 2002

India, with protection and assisted regeneration, could double per hectare rates of carbon sequestration from 27.3 to 55.2 metric tons in 10 years in secondary forests, and from 18.8 to 88.7 metric tons in old growth forest after 50 years, at a very modest cost.

Although the per hectare carbon benefits of agroforestry are low relative to averted deforestation, the area under low-productivity, annual crop land and pastures is extensive in the tropics. There is thus significant potential to increase the carbon density of existing crop and pasture-based land-use systems, in ways that also increase farm productivity and income.

Community forestry, in which products such as resins, fruit and latex are extracted from extensively managed reserves, has little or no impact on carbon stocks. However, more intensive management, particularly in cases where the mix of products includes a large wood component, would lower carbon benefits relative to those provided by strict forest protection. This would be offset however if, as would be expected, community forestry reduces the risk of leakage or project failure, relative to strict forest protection.

The definitions of land use, land-use change and forestry (LULUCF) under the Kyoto Protocol assume a single land use. In fact, sustainable development goals will typically require projects to include mosaics of diverse land uses within a landscape.

Project Duration

Project duration is relevant for carbon accounting in CDM forestry projects because carbon is sequestered or stored only while the forest or its harvested products exist. Fuel-switching projects in the energy sector, by contrast, reduce emissions permanently. Since both forestry and energy projects are eligible as emission-reduction strategies in the CDM, a number of methods for obtaining equivalence between the two project categories have been developed. Although there is as yet no agreement on methodologies to take account of project duration, it is highly likely that projects that last only for short periods will earn carbon credits at a significantly lower rate than longer-duration projects (Moura-Costa 2000b).

Under the tonne-year method of carbon accounting, for instance, a tonne of carbon sequestered for one year in a forestry project would obtain only 1/46 (or approximately 2.2%) of the credit obtained by a tonne of emission reduction in the energy sector (Moura-Costa and Wilson 2000). Simulation results for industrial plantations show that if carbon payments were made as sequestration occurs, the rate of payment under the tonne-year method would be too low to stimulate plantation establishment. If, however, carbon credits under the tonne-year method are awarded when the project starts, they would act as a considerable incentive by helping to cover establishment costs (Cacho and Hearn 2001).

Under an alternative carbon-accounting method, known as 'expiring CERs,' forestry projects would earn temporary credits, with the validity period being determined by the length of the project. After the forestry credit expires, investors would have to replace the forestry credits with credits from energy projects (which earn permanent credits) or with more temporary credits from another forestry project. Under this method, forestry credits would sell at a lower price than energy credits. The more the cost of emission reduction is expected to fall in future, as a result of technological innovations, the higher would be the willingness to pay for forestry credits (Blanco and Forner 2000). Both expiring CERs and the tonne-year method with ex ante payments would, however, require insurance to guard against the risk of project failure. This may favour industries that have easier access to insurance than communities, unless proactive measures are taken to reduce the risk of insuring community projects (see section on Project insurance).

Averted deforestation projects, associated with lower population densities and low-impact forest uses, offer projects of longest duration for storing carbon. Depending on uses and population pressures, some regenerated forests may also be protected for very long periods. Industrial forests involve harvesting of significant carbon-storing biomass, and therefore have shorter duration on a given land unit, but may be managed as a rotation to sustain target levels of carbon benefits.

Concerns about duration in agroforestry and community forest plantations have been raised, since land-use patterns in farming areas tend to change spatially over time to reflect changing product demand, demographic patterns and policies. Projects using long-duration forest systems may be less compatible with local benefits because they give communities less flexibility to change land use if market or policy conditions change.[6] Over a large project area, however, a defined level of carbon sequestration and storage could be achieved, despite such fluctuations (see 'bubble' projects below). Moreover, aggregate forest cover may remain relatively stable, even with fluctuating land uses at farm level.[7] Farmers' interests in agroforestry plantings will persist only as long as returns to forestry products and environmental services (adjusted for carbon payments) remain more profitable than alternatives. Institutional mechanisms are needed to provide self-reinforcing incentives. Forest carbon projects that provide livelihood benefits to large numbers of local people may, in fact, be more durable in the long run than strictly protected areas, due to market incentives.

Leakage

Under CDM, 'leakage' will be penalised, i.e., if project activities result in an increase in emissions outside project boundaries, these new increased emissions will be deducted from the credits earned. Leakage is likely when project operations prevent an activity that provided products or employment without offering any alternative (Watson *et al.* 2000). Livelihood-enhancing types of forest projects are likely to reduce problems of leakage. Projects that increase forest resources in forest-scarce areas (regeneration, agroforests, forest fallows or agroforestry) may provide 'negative' leakage, serving to reduce deforestation and forest degradation outside the project area. However, if these land-use types displace significant annual crop production to forested areas, projects need to simultaneously increase the productivity of agricultural land. This should be done with labour-using technologies so that the increases in agricultural productivity do not stimulate deforestation (Angelsen and Kaimowitz 2001). Multiple-use forestry can reduce the threat of leakage due to forest use or clearing by local people outside the project area.

Additionality

CDM projects will be required to demonstrate 'additionality', i.e., that the emission reductions achieved by the project would not have occurred in the absence of the project. Carbon credits will be obtained only for the difference in emissions between project activities and 'without project' or 'baseline' activities. In the case of reforestation projects, this implies that there will be need to demonstrate that barriers exist to the adoption of land uses that increase carbon sequestration. Averted deforestation projects, if allowed, would have to demonstrate an imminent threat to carbon stocks in standing forest.

Livelihood-enhancing forest carbon projects do not face a more difficult time than other projects in establishing additionality. In many parts of the world, regeneration occurs spontaneously as a result of changing land uses, such as abandonment of pastures in Latin America (Kaimowitz 1995). Often, however, regeneration requires considerable intervention, for example, through local collective action in India (Saxena 1997). In such cases it should not be difficult to establish additionality and identify activities that CDM projects could undertake to support institutional development for community forest rehabilitation. Replacing strict forest protection with a range of land uses including multiple-use community forestry should not affect the additionality of averted deforestation projects, as the change in management objective would occur after the threat (say unsustainable logging) is stopped.

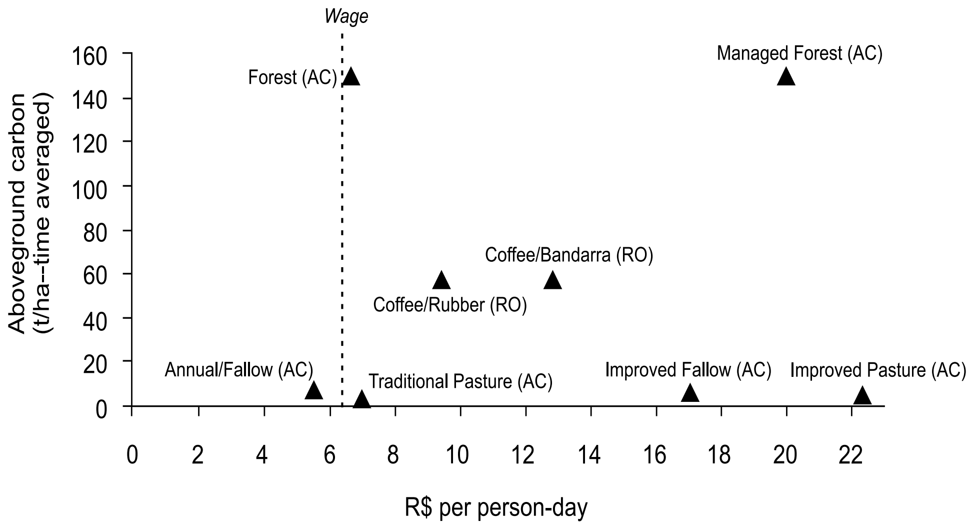
If agroforestry projects are to be successful in the long run, it will be important to locate them in sites where there is a genuine product or environmental service demand for trees. However, carbon projects would be justified only to overcome major institutional barriers that are preventing profitable or socially desirable activities from developing, such as difficulties in financing establishment costs, difficult access to planting materials, or lack of technical assistance or marketing infrastructure. For example, Vosti *et al.* (2001; Figure 2) found that financial returns to small-scale farmers from managed forests were higher than many land-use alternatives in the Brazilian Amazon. However these enterprises faced serious problems of undeveloped markets. In lowland Indonesia, the potential profitability of agroforests was much higher than alternatives, often including oil palm monoculture and commercial logging, but also required market development (Tomich *et al.* 2002).

The recent rapid growth in short-rotation industrial plantations in countries such as Brazil, Chile and South Africa was stimulated by government subsidies to give momentum to the process, particularly for establishing pulp-processing industries, which are extremely capital intensive. Additionality could therefore be established on the grounds of these up-front costs. On equity grounds, however, this is a considerably less compelling use of CDM payments than smallholder development.

Cost-Effectiveness

The potential for livelihood-enhancing forest carbon projects to compete for buyers with large-scale forest protection and industrial plantations (and non-forest CDM projects) will depend upon

Figure 2. Carbon Contribution vs Returns to Labour for Land-Use Systems in the Brazilian Amazon



Notes:

1. All prices in December 1996 R$, US$1 = R$1.04.
2. Evaluations of land-use systems use price and parameters from Pedro Peixoto, Acre (denoted 'AC') and Theobroma, Rondônia (denoted 'RO').
3. Returns do not take into account known difficulties in marketing.
4. The vertical "Wage" line represents the daily wage for hired labor during the study period.

Source: Vosti *et al.* 2001

their cost-effectiveness in producing certifiable carbon offsets. The price of carbon in a full-fledged market is still highly uncertain. In the absence of United States participation, carbon prices could be close to zero, particularly in view of surplus emissions of Economies in Transition (EIT). If, however, it is assumed that EIT restrict sales in order to maximise profits and/or if credits are banked for the second commitment period, in the hope of future US ratification of the Kyoto Protocol, then market price estimates fall mainly within the range of about $8/tC to $40/tC, with the most likely range being $15/tC to $20/tC (Grubb *et al.* 2001; Point Carbon 2001; den Elzen and de Moor 2002). The lower the cost – including both production and transaction costs – at which carbon can be supplied by a project, the greater will be the surplus that accrues to project partners.

Production costs. Production costs are the costs per metric ton of carbon (tC) of establishing and maintaining the new carbon-augmenting land use. Production costs include costs of tree establishment, management, processing and the opportunity cost of land. In the case of averted deforestation projects, they include the costs of forest protection and compensatory payments made to the sources of deforestation threats. To realistically reflect cost effectiveness, production costs should be adjusted to take account of leakage, project duration and the risk of project failure. Very few available estimates, however, take these aspects into account. Most of the figures given below and in Table 5 should therefore be regarded as underestimates of the cost of supplying carbon services.

Available estimates from China, Thailand, India and Brazil indicate that the production costs of large-scale industrial plantations could in many cases be under $5/tC, particularly if carried out in lands with few opportunity costs (Austin *et al.* 1999; Hardner *et al.* 2000). Data on economic returns to farmers from diverse tree-based land uses in the humid tropics of Sumatra, Indonesia, suggest that carbon payments would be quite competitive (Figure 3). on various kinds of agroforestry systems and community plantations indicate that the production costs of these systems may often be higher than the cost of industrial plantations, though the value of non-carbon benefits may sometimes offset this disadvantage. Available estimates are highly variable, important determinants being the opportunity cost of land to smallholders and the scarcity of tree products and services. Although the project in Scolel-Té has sold carbon for $10 to $12/tC, de Jong *et al.* (2000) estimate that, if reforestation replaces agricultural land, costs there under most conditions would range from $30/tC to $70/tC. On the other hand, the cost of establishing plantations on degraded lands in the PROFAFOR project is estimated to be

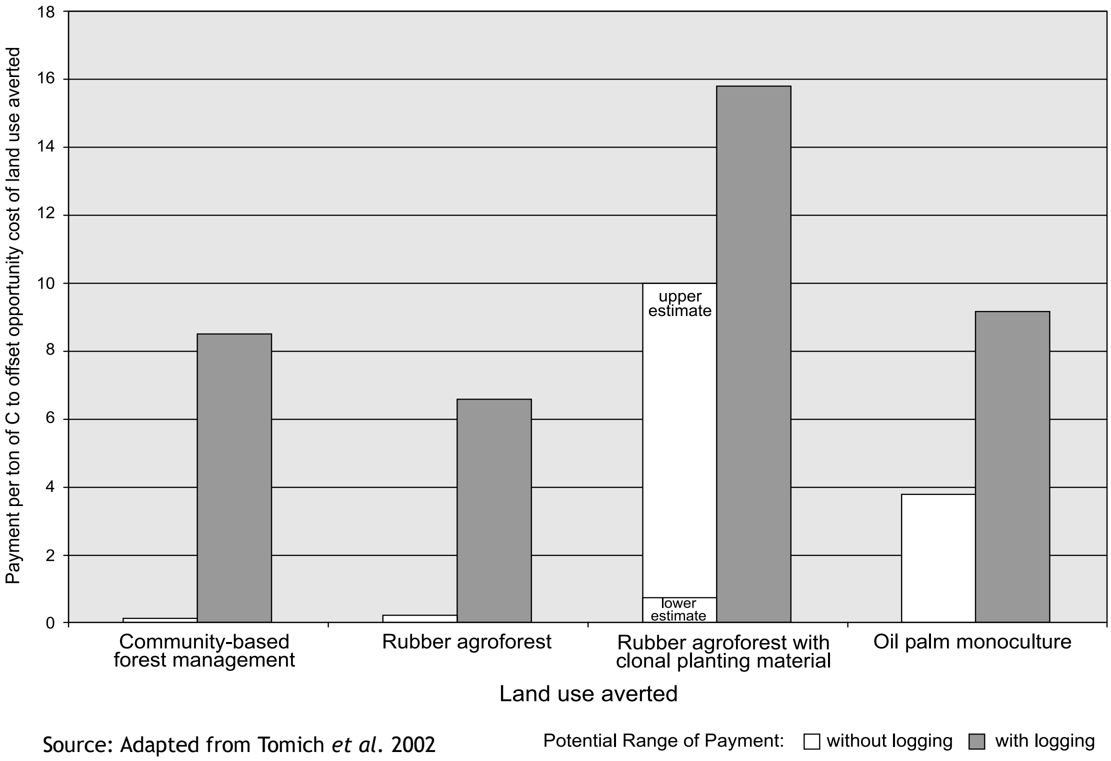
Table 5. Cost-Effectiveness of Forest Carbon Projects

Type of Project	Evidence from	Source	Findings	Comments
Large-scale industrial plantations	Ex-ante estimates from Brazil, India, China, Thailand based on existing plantations	Austin *et al*. 1999; Hardner *et al*. 2000	Could supply carbon protection at under $5/t C; especially if carried out on degraded lands with low opportunity costs	Most ignore leakage and transaction costs, and make no adjustment for project duration
Agroforestry and community forest plantations	Estimates directly elicited from swidden agriculturalists in Peru	Smith and Mourato (in press)	Compensation of $8-31/tC required to induce swidden farmers to adopt multi-strata agroforestry	Adjusts for project duration, no adjustment for leakage or transaction costs
	Ex-ante estimates from Indonesia	Tomich *et al*. 2001a	Smallholder plantations of *Acacia mangium* cost less than $20/tC	No adjustment for leakage, project duration or transaction costs
	Ex-ante estimates from Scolel-Té pilot carbon project, Mexico	I. Emmer, unpublished data 2001	Cost of establishing plantations on degraded land of smallholders: $16/tC; Costs of coordination, management of large group of smallholders estimated to equal about 56% of total costs; Monitoring and certification cost $5/ha/year	Includes most transaction costs, but excludes opportunity cost of land and assumes 100-year duration
	Scolel-Té pilot carbon project, Mexico	de Jong *et al*. 2000	Cost of establishing plantations on agricultural land of smallholders: $30-70/tC	Includes some transaction costs
Agroforests and forest fallows	Scolel-Té pilot carbon project, Mexico	de Jong *et al*. 2000	Farmers require compensation of $15-$30/tC for enriched fallows. Transaction cost of community involvement: $52-325/ha	Includes some transaction costs
	Ex ante estimates from Sumatra, Indonesia (agroforests rotated with food crops)	Tomich *et al*. 1998	Communities require carbon revenues of at least $3/tC to compensate for land-use change from cassava, and $11/tC if alternative is palm oil. Conversion to rubber agroforests costs less than $20/tC	No adjustment for leakage, duration or transaction costs. Calculations based on shadow prices, whereas communities would require compensation based on market prices
	Ex ante estimates pooled from sites in Brazil, Cameroon, Indonesia	Tomich 2000	Conversion to extensive or intensive agroforests could be induced with C price below $11/t	No adjustment for leakage, duration or transaction costs

Table 5. Continued

Type of Project	Evidence from	Source	Findings	Comments
Forest rehabilitation or regeneration	Non-carbon forest rehabilitation projects in India	Poffenberger 1996	Should be cost-effective; forest regeneration costs are only 5% of plantation costs	No adjustment for leakage, duration or transaction costs
Strict forest protection	Noel Kempff and other pilot projects	Hardner *et al*. 2000; Watson *et al*. 2000; Asquith *et al*. forthcoming	Can supply carbon protection at under $5/t C. Major transaction costs in Noel Kempff project around 23% of total cost. Monitoring and verification cost $3/ha/year	Remote areas with very low population density
Multiple use community forestry within protected areas	Estimates directly elicited from swidden agriculturalists, Peru	Smith and Mourato in press	Swidden agriculturalists require $7-24/tC to protect their forest resources	Adjusts for project duration, but not for leakage
	Simulation model for Brazilian Amazon	Carpentier, *et al*, forthcoming	One-time carbon payments of $15/tC stock would preserve half the existing stock of forest carbon on farms	No adjustments for leakage, duration or transaction costs
	Private Forestry Program (PFP) of Costa Rica	Subak 2000	Landholders were paid around $42/ha/year to protect their forests. Certain transaction costs (auditing and certification) were 23% of the value of payments landholders received for environmental services	
	Non-carbon forestry projects	Salafsky *et al*, 2000; Snook 2000; Wunder 2000b	Cost-effective at projected C prices, if large-scale actors are source of deforestation threat. Surplus available to project partners is likely to be lower than strict forest protection if wood products are extracted and transaction costs will be higher. Cost-effectiveness may be lower if deforestation risk is posed by mainly local people	

Figure 3. Carbon Price Required to Balance Returns to Conversion of Land Use to Trees in the Humid Tropics of Indonesia



Source: Adapted from Tomich *et al.* 2002

$16/tC (Igino Emmer, unpublished data). In the Peruvian Amazon, Smith and Mourato (in press) estimate that a compensation of $8/tC to $31/tC (after adjustment for project duration) would be required to induce small-scale farmers to plant complex agroforestry systems. In deforested landscapes, however, trees have high economic value (Scherr 1999) and compensatory payments may be significantly lower.

Assisted natural regeneration tends to be much cheaper than tree planting. Hence the production costs of systems that include a large assisted natural regeneration component, such as forest rehabilitation, secondary forest fallows and agroforests, tend to be lower than the cost of community plantations and agroforestry (Table 5).

Large-scale averted deforestation projects that establish strictly protected areas appear to be highly cost-effective if located in areas of low population density. The production costs of the Noel Kempff project, for instance, are estimated to be around $1/tC (Asquith *et al.* forthcoming). If community forestry is established instead of strict forest protection, costs would be incurred in assisting communities with sustainable management. However, these costs are unlikely to be significantly higher than the cost of leakage programmes for strict forest protection in more populated areas. Also, the risk of project failure under multiple-use community forestry is expected to be significantly lower than for strictly protected areas because local communities have a stake in protecting the forest. Averted deforestation projects in which direct payments are made to local communities to protect their forests may, however, be more expensive than those in which large-scale actors are the main sources of deforestation risk. This is because local communities may require a higher compensation per hectare of protected forest, given their limited access to agricultural land (Table 5).

Transaction costs. For forest carbon projects, transaction costs include the cost of providing information about carbon benefits to potential buyers (such as the cost of establishing additionality, measuring incremental carbon benefits and auditing and certifying projects); costs of obtaining information about project partners (such as costs of identifying and negotiating with project participants, developing and marketing projects, organising project participants and capacity building); and costs of ensuring parties fulfil their obligations (such as contract development and enforcement, legal costs and insurance).

Transaction costs per unit of emission reduction seem likely to be much higher for projects involving smallholders and forest communities. More varied land uses and management may increase carbon measurement costs. Monitoring and verification costs for the Noel Kempff project, for example, are estimated at under $3/ha/year (Asquith *et al.* forthcoming), compared to monitoring and certification costs of about $5/ha/year for the PROFAFOR smallholder project (Igino Emmer, unpublished data).

Projects involving communities may also cover a smaller area than large-scale forest protection or industrial plantation projects, increasing transaction costs for fixed costs such as project marketing. For instance, while the Noel Kempff project covers 634,000 ha, the PROFAFOR project established around 24,000 ha of community plantations between 1993 and 2000 (Igino Emmer, pers. comm.).

The costs of negotiating land-use decisions with large numbers of geographically dispersed local people, with different priorities, will tend to be higher for a community-managed project than in most strict forest protection or industrial forestry projects, which require simpler local consultation processes. Additional costs may be incurred in providing technical information (Emmer and Verweij 2000). In the pilot project in Scolel-Té, de Jong *et al.* (2000) estimated that costs of achieving a high level of local participation varied from $52/ha for communities with positive past experiences with projects, to as much as $325/ha for communities characterised by a high degree of conflict. Thus some transaction costs can be reduced through careful selection of participants. Also, some of the high transaction costs of pilot projects have been greatly reduced over time, as more efficient processes were developed, and standard 'off the shelf' methods became available (Noel Kempff Climate Action Project 1999; A. Moreno, W. Alpizar and I. Emmer, pers. comm. 2000).

Summary

The discussion above (summarised in Table 6) suggests that livelihood-enhancing forest carbon projects may present viable alternatives to conventionally conceived forest protection and large-scale industrial forest models, provided carbon prices are towards the higher end of the projected range and provided community projects are carefully designed and targeted to increase cost-effectiveness. The financial surplus accruing to partners in community projects, however, may be lower than in forest protection or industrial plantation projects because of higher costs. This may make some investors less interested in such projects. On the other hand, lower carbon income may be acceptable to some stakeholders if new tree-based land uses are sufficiently profitable and other co-benefits are attractive.

To be successful, careful targeting will be required for *all* types of forest carbon projects, to sites where the enabling conditions exist or can be developed. Targeting is especially needed for strictly protected areas and industrial plantation projects in order to avoid situations that pose major local livelihood risks. This means that forest carbon projects will not likely be pursued on the very large scale that some had earlier predicted (Smith *et al.* 2000).

Overall, the evidence implies that proactive interventions will be required to promote CDM forest carbon projects that promote sustainable development and the ecosystem approach, and to enlarge potential niches for such projects. The next three sections suggest policy changes for the CDM itself, for national governments and for those responsible for project design, in order to make such projects viable in an international carbon market and cost-effective in enhancing livelihoods.

V. CDM Guidelines

At Marrakesh, the SBSTA was given the responsibility of recommending modalities for implementing CDM projects, including their social implications (UNFCCC 2001). The Union of Concerned Scientists (2000) called for sound science-based rules to ensure that CDM forestry projects provide multiple benefits, including socioeconomic benefits, to local communities in developing countries. While the Marrakesh Accords clearly open the door to addressing social concerns, they also lay down specific rules for implementing the sustainable development clause of the CDM. They specify that it is the host country's prerogative to confirm whether or not a project contributes to sustainable development (UNFCCC 2001). Projects are to invite comments from local stakeholders and to report how they plan to address the issues raised. SBSTA's recommendations will clearly have to be within the bounds of these rules. In this section we suggest guidelines for CDM rules that could enhance the livelihood benefits of forest carbon projects, based on the findings above, for the consideration of SBSTA and Parties to the UNFCCC (Box 8).

The principle of host country sovereignty about the determination of sustainable development implicitly assumes that a host country will choose to participate in a project only if the

Table 6. Potential of Forest Carbon Projects to Meet CDM Criteria, by Project Type

	Project Type					
CDM Criterion	**Large-scale industrial timber /pulp plantations**	**Agroforestry, community forest plantations**	**Agroforests, secondary forest fallows**	**Forest rehabilitation and regeneration**	**Strictly protected areas**	**Multiple-use forestry within protected areas**
Carbon benefits per hectare	++	+/++	++	++	+++	++/+++ Moderate if wood products extracted
Duration of carbon storage (plot level)	+ Plantations are harvested on regular rotations[a]	+ Shifting land uses over time likely as economic incentives change[a]	++ Long-term, unless value for annual crops increases greatly[a]	++/+++ Forests may be used only for NTFPs or for some timber harvest	+++ Projects usually in perpetuity	+++ Projects usually in perpetuity
Threat of leakage	++ Plantations may reduce economic incentive for SFM elsewhere	+ Should reduce pressures on off-site forests	+/++ Some, if forest is cleared for annual crops no longer produced when land converts to agroforests/fallows	+/++ May be leakage during the protection phase; should reduce pressure on off-site forests once established	+++ Loggers, ranchers or infrastructure projects can go elsewhere	++ Loggers, ranchers or infrastructure projects can go elsewhere
Ease of proving additionality	+/++ Industrial plantations have expanded rapidly, but many required subsidies	++ Established spontaneously under some conditions. Additionality justified where barriers to adoption exist	++ Established spontaneously in many areas. Additionality justified in areas where being replaced by alternative land uses, e.g. ,cattle ranching or oil palm	+++ Spontaneous rehabilitation limited to areas of depleted forests, but even there usually requires institutional support	+++ Rates of tropical deforestation are high	+++ Rates of tropical deforestation are high
Now eligible under CDM	Yes	Yes	Yes	Depends on eventual definition of reforestation	No	No

Key: +++ High, ++ Medium, + Low

Notes: a Even in projects based on lower-duration forestry activities, long duration of carbon storage at the project level could be achieved by maintaining land uses in different stages of the production cycle in the project area. Carbon accounting and payments would have to take account of such cycles. Many, though not all, scientists consider even temporary storage in the short term to have significant climate benefits.

Box 8. Recommendations for CDM to Benefit Local Livelihoods

1. Require social impact assessments for CDM projects.
2. Establish minimum standards for stakeholder consultations
3. Harmonise the CDM with social principles of other global conventions
4. Explicitly include diverse land uses in the definition of afforestation and reforestation
5. Promote measures to reduce transaction costs
6. Establish international capacity-building and advisory services

full benefits of the project outweigh the full costs, including economic, social and environmental benefits and costs that accrue to both the inhabitants of the host country and the world community at large. Proactive measures are justified if market imperfections prevent host countries from taking into account full costs and benefits. Smith (2002) highlights several categories of imperfections relevant for social issues, that justify such efforts, including lack of host country information on full costs and benefits, host country conditions that disadvantage interests of low-income forest producers, and transaction costs that disadvantage community-based projects. The measures proposed below address these imperfections.

Require Social Impact Assessments for CDM Projects

Our analysis shows that poorly designed and implemented CDM projects can pose significant risks for local communities. This implies the need for mandatory social impact assessments (SIAs) for all CDM projects.[8] SIAs should be carried out at the project proposal stage and also at the project certification stage. Publication of the results of SIAs in the public domain would promote transparency and could be used by all stakeholders, including local communities and investors seeking socially responsible projects.

SIAs should include some minimum uniform criteria that are internationally recognised and locally sanctioned to avoid creating incentives to locate projects where requirements are least stringent.[9] SIAs should at least document any significant negative local livelihood impacts resulting from the project, and provide evidence that the communities affected approve the project. Some indigenous peoples' organisations have recommended that local people approve the social scientists contracted to undertake SIAs (Declaration of the First International Forum of Indigenous Peoples 2000).

Establish Minimum Standards for Stakeholder Consultation

Stakeholder consultation could go a long way towards addressing the social risks described earlier, provided appropriate procedures are followed and all legitimate stakeholders are consulted. Given that stakeholder consultations are mandatory under the Marrakesh Accords (UNFCCC 2001), it may be politically feasible to require minimum standards for implementing them. A useful starting point could be the principles of a number of international conventions that support local rights (see Section C following). CDM could also provide guidelines for stakeholder consultation by drawing on emerging standards of good practice, such as how to identify the most vulnerable stakeholders at the greatest risk of being excluded from the consultation processes (Colfer *et al.* 1999).

Harmonise the CDM with Social Principles of Other Global Conventions

Guidelines for the CDM should be harmonised with the social principles of other global environmental conventions, in particular the International Labor Organization Convention 169 (Rasmussen and Roy 2000), Convention on Biological Diversity (CBD 2000) and the Convention to Combat Desertification. This would be consistent with the recommendations of the Fifth Conference of Parties of the CBD and also with those made at the Second World Conservation Congress of the World Conservation Union (IUCN 2000). It would be consistent with Article 2.1(ii) of the Kyoto Protocol (UNFCCC 1997) states that activities undertaken to meet emission-reduction commitments should 'take into account commitments under relevant international environmental agreements'. Thus guidelines for the CDM should be harmonised with the social principles of other conventions. Relevant social recommendations were made at the Fifth Conference of Parties of the Convention on Biological Diversity (CBD 2000) and at the Second World Conservation Congress of the World Conservation Union (IUCN 2000). The Convention to Combat Desertification emphasizes initiatives to promote local livelihoods while regenerating natural resources. CDM forest projects may be designed explicitly to contribute to the goals of the three conventions.

Some principles the Parties may wish to consider as minimum standards for project certification are:

- Recognition of indigenous peoples and other local communities as important stakeholders whose rights and interests should be respected (Principle 1: CBD 2000). This would mean, for example, that when local uses are restricted by CDM projects, adequate compensation will have to be provided, even if local rights are informal or overlap with other rights.
- Involvement of all stakeholders in major management decisions (Principle 2: CBD 2000). This would provide safeguards against projects too narrowly focused on 'carbon farming' by giving local communities the right to negotiate with other stakeholders on management for forest goods and services valued by them.

  The International Labor Organization Convention 169 puts forward relevant principles on how stakeholder consultations should be carried out (Rasmussen and Roy 2000).

Explicitly Include Diverse Land Uses in the Definition of Afforestation and Reforestation in the CDM

Explicit inclusion of a wide range of reforestation and afforestation activities, so long as individual projects fully meet CDM performance criteria, will encourage innovation and learning by doing, and allow greater responsiveness to local concerns and preferences.

As shown above, activities that include a substantial component of assisted natural regeneration (such as forest rehabilitation, secondary forest fallows and agroforests) generally have a lower cost than systems based purely on tree planting. They also have fewer social risks than industrial plantations, while at the same time offering significant community benefits and biodiversity benefits (Tables 3 and 5). Thus, explicit inclusion of assisted natural regeneration would increase the competitiveness of projects with higher social benefits and fewer social risks. Measures that increase the scope for forest rehabilitation would also increase community and biodiversity benefits.

For reforestation activities in industrial countries, land uses with over 10% canopy cover are defined as forests and therefore ineligible for afforestation or reforestation activities. This definition, while intended to prevent forest being cut down to establish plantations, also severely and unnecessarily restricts the scope for agroforestry and forest rehabilitation in tropical environments. Similarly, it is essential to ensure that shorter-duration forestry and agroforestry land uses are eligible within CDM projects, subject to appropriate adjustment in carbon payments, as discussed in section IV above.

Foreclosing options, by excluding certain activities – particularly at this early stage – could stifle this process and result in benefits being delivered to a narrow group of stakeholders. Moreover, including only a limited set of activities will introduce economic distortions in favour of those activities. These could further disadvantage local forest and farm producers who must complete with large-scale plantations.

Promote Measures to Reduce Transaction Costs

According to the Marrakesh Accords (UNFCCC 2001), small-scale projects (i.e., those whose annual emission offsets are less than 15,000 t CO_2) will benefit from simplified modalities for determining baselines and monitoring carbon emissions. The CDM Executive Committee should be requested to include the livelihood-enhancing project categories highlighted in this paper—agroforestry, community forest plantations, agroforests, secondary forest fallows, natural forest rehabilitation and regeneration—among eligible small-scale projects.

The high costs of establishing and monitoring baseline estimates to document additionality in community-based projects could be greatly reduced by adopting Simplified Emission Reduction Credits. These would be calculated using standardised reference emission rates for different emission reduction/storage activities in specific locations. This would both remove uncertainty in investors' calculations and reduce costs associated with measurement and certification. An uncertainty discount could be applied, e.g., by multiplying the estimates of sequestration rates by 80%. Independent bodies would determine the reference rates and verification would involve a third party confirming that the activities had been undertaken (Sandor 2000, cited in Landell-Mills *et al.* 2002).

Establish International Capacity-Building and Advisory Services

The successful promotion of livelihood-enhancing CDM forestry projects will require investment in capacity-building and ongoing advisory services for potential investors, project designers and managers, national policy-makers and leaders of local organisations and federations. Indigenous peoples' organisations have specifically requested support to increase their familiarity with CDM instruments (Declaration of the First International Forum of Indigenous Peoples 2000). Many bilateral donors, multilateral institutions, such as the Prototype Carbon Fund of the World Bank, and international environmental NGOs have financed training courses and workshops on practical CDM issues. Such courses and services can be expanded to address the design and implementation of livelihood enhancing forest carbon projects.

The International Fund for Agricultural Development (IFAD) is supporting development of a regional centre for Asia to facilitate and provide information services for countries involved in international transfer payments for environmental services. Priorities are to build capacity among local communities to play a proactive role in identifying and negotiating CDM opportunities, and to form the hub of a network among the local bodies, allowing for interchange of experience and information (Wilson *et al.* 1999; Altarelli 2000; ICRAF 2000). Such a model could be adapted in other developing regions. A priority for such support agencies is to identify and help communities to develop mechanisms to reduce transaction costs in carbon trading.

Official and non-official sources of development assistance should be encouraged to provide funds for training and project preparation for community organisations and local NGOs collaborating with them to develop forest carbon projects.

VI. National Policy Action

The principal actors in the CDM are the specific buyers and sellers of carbon emission credits, that is, the external investors and local communities or companies undertaking commitments of carbon emission offsets. However, national governments will play a pivotal role in promoting livelihood-enhancing forest carbon projects, by creating an enabling environment for such projects to develop and providing safeguards to protect the interests of local people. Multilateral and bilateral donors can play a valuable role in financing and providing technical assistance for these national initiatives (Box 9).

Box 9. Recommendations for National Policy Action

1. Plan CDM projects within a national development framework
2. Establish national criteria for social impact assessments
3. Secure forest access and ownership rights for local people
4. Establish forest carbon rights for local people
5. Promote business support services for local forest producers
6. Reform forest market and regulatory policy

Plan CDM Projects within a National Development Framework

By proactively planning for CDM projects, national or regional governments can reduce the costs for investors to identify potential local partners, reduce the risk of locating projects in areas likely to put local livelihoods at risk, increase the likelihood that projects will contribute to sustainable development and reinforce national sovereignty. CDM plans can be integrated within the National Poverty Frameworks being developed in many countries.

Plans should recognise where enabling conditions (e.g., markets, infrastructure and population density) for successful projects exist, and clearly identify areas eligible and encouraged for forest carbon projects. For example, where policy-makers are concerned that large-scale foreign investment is cornering the forestry industry, CDM could be used to assist community forestry to compete in forest product markets (e.g., in Uganda). Situations should be avoided that 'carbonise' communities to depend solely on carbon offset payments (A. Moreno, pers. comm. 2000) To ensure the input of local people, small farmer or forest owner cooperatives, indigenous peoples' organisations and other groups should be formally represented in national planning processes.

Costa Rica has the most developed carbon programme and strategy. Other developing countries with existing or planned carbon offset programmes include Belize, Bolivia, Burkina Faso, Cameroon, Colombia, Ecuador, Guatemala, Honduras, Indonesia, Mexico, Nicaragua and Sri Lanka (Bass *et al.* 2000). Few of these have yet developed strategies specifically to promote local livelihoods, though Cameroon is in the process of developing a national strategy to participate in CDM based on a recently established community forestry framework (Tchala Abina and Ayissi Mbala

2000). Colombia is focusing on the potential for carbon payments to produce collateral environmental and other benefits (Villa-Lopera 2000).

Consideration of sustainable development benefits should become an integral part of project selection. Governments can promote community-based CDM investment and facilitate project implementation by actively attracting investors, reducing information costs, putting in place clear policies and institutions that govern CDM projects, and identifying potential sources of project support.[10] A key step would be to improve national capability to monitor forest resources, management and production in agroforestry and community forestry contexts, in order to reduce costs of project planning, baselines and monitoring and verification costs. In partnership with public and private organisations and representatives of community interests, governments can set up a 'one-stop shop' for investors. This approach would make available all the rules, regulations and recommendations for development of CDM projects (ARM and Mundy 2000), and direct investors to reputable intermediary organisations to broker deals, provide advisory services and for capacity-building (Box 10).

Box 10. Forest Carbon Planning: Costa Rica

Major changes in the Forestry Law of Costa Rica in 1996 provided the legal and regulatory basis to compensate landowners for 'environmental services'. A dedicated Costa Rican Office for Joint Implementation (OCIC) has the authority to formulate joint implementation policy, reporting to the Ministry of Environment and Energy. The office establishes project approval criteria and assists in the development of proposals. OCIC strategy has been to promote consolidation of parks, natural forest management by private landowners and renewable energy. The national proposals complement the Costa Rican land-tenure structure of traditional small- and medium-sized farm ownership, engaging and supporting such landholders (OCIC 1998).

Establish National Criteria for Social Impact Assessments

As discussed above, Article 12 of the Kyoto Protocol stipulates that CDM projects should benefit local livelihoods and lead to sustainable development. It is the responsibility of national governments to establish CDM project guidelines and criteria for 'sustainable development'. Governments can reduce uncertainties for both investors and local suppliers by making those criteria specific and transparent, and required in SIAs. In many countries, pertinent principles for such guidelines are already in use, drawn from the international criteria developed for National Forestry Programmes, in accordance with the economic, social and environmental requirements of sustainable forest management defined by the IPF/IFF process (C.-M. Falkenberg, pers. comm. 2000).

Secure Forest Access and Ownership Rights for Local People

Clearly defined rights to forests, land, trees and other forest resources are critical to the success of land-use change and forestry projects. Such rights are essential both to ensure forest protection (e.g., control fires) and to promote farm tree planting. Yet half to two-thirds of forests in developing countries are state-'owned', even though local communities may have historical claims to the land or customary use rights (White and Martin 2002). The legitimacy of local claims has been widely recognised (Lynch and Talbott 1995). National laws and practices have begun to devolve a growing proportion of forested land from state to indigenous or community control in various forms: private property (e.g., Honduras), long-term private usufruct rights (e.g., Vietnam), common property ownership (e.g., Zimbabwe) and ancestral land domain (e.g., the Philippines). Tenure reform has involved legalisation of traditional informal rights, and the mediation and negotiation of conflicts and uncertainties about resource and land rights by NGOs and government agencies. Different rights of access, withdrawal (harvest) management, exclusion and alienation, for different types of forest products and services, may be 'unbundled' and assigned to various actors (Agrawal and Ostrom 1999).

A number of pilot forest carbon projects have become involved in tenure reform. In the Noel Kempff project in Bolivia and the Los Nubes project in Guatemala, efforts are ongoing to grant legal land title to local communities in exchange for increasing the size of protected forest areas. In Ecuador, a forest CDM project was seen by indigenous groups as a way to protect their land from oil development (Amazon Alliance 2000). With such enabling conditions in place, CDM projects can provide the extra resources needed to make successful community-based forestry a reality.

However, local claims are often still subject to conflict, particularly when governments have sought to earn revenues from private commercial concessions. Landell-Mills *et al.* (2002) warn that carbon markets will increasingly generate competition for the forest resources on which the poor depend, as wealthier and more powerful stakeholders seek to control emerging benefits. It is essential that governments accelerate efforts to secure local rights to forest resources and protect them from usurpers. Legislation and regulations for the approval, verification and evaluation of CDM forest projects should establish the rights of defined types of communities to contract directly with investors, to approve project proposals and to participate in project evaluation and provide simple mechanisms for contract enforcement. As a safeguard against fraud, they should establish rules for certifying NGOs or firms undertaking intermediary roles with communities in negotiations and management.

In negotiating forest carbon deals on government forests, clear protection or compensation for traditional local uses of those forests must be made, and resident local people should be formally represented. Contract safeguards should protect vulnerable groups from potential loss of land or access rights and ensure that contracted losses of such rights, in exchange for compensation, are negotiated by legitimate community representatives and communicated openly with the entire community. Where land rights provide only weak protection for local people, CDM projects should not be approved lest they trigger 'land grabs' by more powerful constituents (private or governmental), in order to obtain carbon payments (Lopez and Ocaña 1999).[11]

Establish Forest Carbon Rights for Local People

Negotiation and implementation of forest carbon deals require that clear rights to sell carbon offsets be established. Yet few countries in the world, other than Australia, have yet provided the legislation necessary to establish such rights. Thus rights are being developed on an *ad hoc*, case-by-case basis. If ownership rights are allocated to the state, then carbon deals will be made with the government. It will be the government's responsibility in the deal to ensure that local land users produce the carbon emissions committed; their agreement to the deal would not necessarily be required, yet they could be subject to enforcement. Similarly, if carbon rights are allotted strictly to landowners with formal title, large-scale dispossession of land currently held by local people in usufruct or customary rights could result. On the other hand, if legislation is written properly, rights of local people can be safeguarded. Active lobbying by local people, their representatives and allies is urgently needed as enabling legislation is being developed (G. Bull, pers. comm. November 2001).

Promote Business Support Services for Local Producers

Successful community-based forest carbon projects will require strong community organisations. Even where active common property governance institutions exist, new commercial activities like CDM present unusual challenges for local institutions (Richards 1997; Shepherd *et al.* 1999). Federations of forest users and farmers with experience in commercial activities may already exist, but require capacity-building in relation to new demands of carbon contracts. Where local forest resource-management institutions do not already exist, they will need to be developed, building on existing organisational and social networks (Sarin 1998). Many NGOs, public agencies and forest industries with experience in community organisation for forest management may be well positioned to provide the necessary support, but will require capacity-building in relation to forest carbon offset deals.

Local organisations involved in carbon projects will also require an array of business services to provide management support, financial advice, legal services, mediation, technical assistance, marketing support and market information. While such ancillary services have rapidly emerged from the private sector to support commercial investors and governments, low-income farmers and forest communities require services tailored to meet their special requirements. The establishment of such supportive services by NGOs, public agencies or the private sector can be promoted and subsidised by national carbon offices in partnership with representative farmer and community organisations.

Reform Forest Market and Regulatory Policy

Most community-based forest carbon projects expect to achieve a large share of the benefits accruing to local people through the sale of wood or non-wood forest/tree products, in addition to any income from carbon payments. However, forest market activity in most developing countries is choked by excessive state regulation. Complex, poorly understood and contradictory regulations from various agencies make it difficult for local producers to stay in compliance, encourage the use of forest rules as social controls (through selective enforcement) and force millions of people to operate illegally. Forest communities and farmers seeking to export wood face trade barriers including export taxes and quotas, royalties and complex bureaucratic procedures. Indiscriminate regulation even penalises smallholders who produce non-native species or native pioneer species that pose no ecological concerns (ASB 2001). At the same time, most governments subsidise or provide privileged access to large-scale producers and processors, have a plethora of rules that distort markets and especially burden small-scale producers, and set excessive taxes and forest agency service fees (Scherr *et al.* 2002).

To achieve and enhance the anticipated benefits from forest carbon projects, policy reforms are needed to ease these regulatory burdens on local producers and 'level the playing field' for market participation. To achieve forest conservation objectives, strong technical assistance programmes can promote and monitor 'best practices' or encourage certification, while forest market rules and forest revenue systems are revamped (Scherr *et al.* 2002). The prospect of forest carbon income could provide an incentive to support such policy reform.

VII. CDM Project Design

If private investors and local people are to find mutual benefits in forest carbon projects, a convincing 'business case' must be made to both. Project design recommendations made here are based on lessons from past forestry experiences, pilot carbon projects implemented during the Activities Implemented Jointly (AIJ) phase of the UNFCCC, company-community forestry business partnerships and community-based conservation programmes (Box 11).

Box 11. Recommendations for Forest Carbon Project Design

1. Maximise project success through strong local participation
2. Select the most suitable compensation mechanisms
3. Enhance the profitability of new land uses
4. Increase transparency in investor-community partnerships
5. Reduce project marketing costs and investor risks
6. Increase scale and reduce costs of community-based CDM projects

Maximise Project Success through Strong Local Participation

Several decades of experience with large-scale forest protection, plantation and social forestry projects in populated rural areas demonstrates that large, centrally designed and managed projects fail far more often than they succeed. Participatory forest project planning and implementation can be both more successful and, because lower-cost local resources are used, less expensive (Campbell *et al.* 1996; Bass *et al.* 2000).

A global review of private company-community forestry business partnerships found that substantive reduction in poverty levels occurred only in cases where there was significant empowerment of local people (Mayers and Vermeulen 2002). In India, local participation in forest management through JFM significantly increased incomes and the share of forest revenues to the poor (Poffenberger and McGean 1998). Full participation, particularly of disempowered groups, to ensure that their needs and requirements are met, can help control leakage. Active community participation in project design and management serves to reduce risks of non-compliance with contractual obligations, and is treated so by insurance companies (Mundy and ARM 2000). Adequate training of officials at all levels in the concepts of participatory management is essential for success, as illustrated by experiences in Andhra Pradesh, India (Rangachari and Mukherji 2000).

In CDM projects, groups of individual or community landowners or tree-growers and outside investors negotiate business deals to produce carbon emission offsets. Deals with the greatest potential will involve communities in decisions on project design and use funds from the project to finance activities that enable local people to increase their well-being, while expanding carbon sinks in ways that would otherwise not have occurred. The definition and prioritisation of livelihood benefits from carbon business deals should be negotiated directly with the contracting communities, including the distribution of carbon revenues among project partners. Local people can identify suitable sites for forest protection or tree establishment, or principles for site selection; these will reflect local environmental management priorities and compatibility with other productive activities, as well as carbon goals. Negotiated agreements must reflect realistic goals for the pace and extent of forestry activities under local conditions and build on local practices and norms to the extent possible. Methods for community-based participatory planning, management and evaluation, at local and regional scales, are well developed and already widely used in environmental conservation and forestry programmes (e.g., Davis-Case 1989; Chung 1999; Ostrom 1999; Box 12). Larger-scale projects may include community representatives (e.g., from farmers' federations or regional indigenous peoples' organisations) on regional councils.

Box 12. Participatory Management of Community-Based CDM Forest Projects

The Plan Vivo System – piloted in Scolel-Té, Mexico – is a detailed three-phase process for implementing community-based forest carbon projects. By structuring communication between potential suppliers and purchasers of carbon services, this process allows farmers to design offset activities to suit their own needs; provides necessary confidence to buyers, sellers and the public that the offset is genuine; and provides a framework for information exchange between farmers and technical advisors. Key principles include transparency, simplicity, flexibility and documented, verifiable evidence of both carbon sequestration and livelihood effects. Simple farm plans are developed that describe the farmer's forestry objectives, where and when it will be done, what inputs are required and what the system is being managed for. Carbon offset services are purchased via a trust fund, which operates as a 'market stall' for buyers and sellers (ECCM 2000; Tipper in press).

Select the Most Suitable Compensation Mechanisms

A variety of different payment mechanisms may be used in forest carbon projects to compensate local people for losses incurred in forest protection, remunerate them for carbon services provided through protection or sequestration, cover transactions costs involved in developing alternative livelihoods, or to 'buy goodwill' by contributing charitably to the broader community (Box 13). It is important to clarify the objective, match the mechanism to the objective and make sure there is a shared understanding of how available resources will be shared. Asquith *et al.* (forthcoming) note the resentment created in the Noel Kempff project when communities learned that funds they had understood were 'theirs' disappeared into project developers' salaries and administrative costs.

In general, conversion of managed farmland back to natural forest will require direct financial payments to landowners – and possibly various other stakeholders – for lost benefits (Tomich *et al.* 2001). This link will typically need to be maintained over the life of the project. Conversion of non-forested, low-value farmland to profitable agroforestry or tree crops, which may be financed through community- or regional-level interventions in the early years of the project, may thus be less costly and administratively less burdensome. To maintain local interest and commitment, it is desirable that the link between land-use practices and benefits obtained be clearly perceived.

The way carbon payments are calculated could make a significant difference to the economic incentives for carbon sequestration. For example, Carpentier *et al.* (2000) concluded from a simulation model of small-scale farming in the Brazilian Amazon, that payments linked to carbon stocks or net carbon stocks for carbon retained in the forest or stored in all land uses would be quite effective in preserving forest and carbon. However, payments tied to carbon flows did not provide an adequate economic incentive to slow deforestation.

Poffenberger *et al.* (2001) propose a hybrid model for rewarding community forest users involved in Joint Forest Management in India. The model assumes that a forest-producer federation can negotiate a 50-year contract with a consortium of outside financing agencies (e.g., public utility

Box 13. Alternative Compensation Mechanisms for Forest Carbon Projects

- 'Pay per tree': Projects reward individual tree growers financially for carbon sequestered and capacity for future carbon sequestration.
- 'Pay for forest establishment or protection': Projects financially compensate community forest management organisations to protect or regenerate forest areas, or establish plantations. The community organisation distributes financial benefits to members.
- 'Make more profitable and sustainable land management possible': Projects invest in extension services, tree nurseries, marketing infrastructure, community-based forest enterprises, etc.; individual producers (or forest protectors) gain financially by participating in new land-use activities or sharing income from forest production.
- 'Pay communities with improved services': Projects reward community members by providing services, such as health clinics, education or enhanced rights to resources (land, forest, grass and water) that improve household and community welfare.

company or development agency) at a fixed rate per ton per year. An initial estimate of sequestration would be made to establish payment rates for the first few years, but this would be reassessed on the basis of actual sequestration. Of gross annual payments made to the federation, some 70% would be divided among participating groups as a contribution to their revolving micro-credit institution. The rest of the carbon income would be distributed among various support organisations: each group council (5%); the joint account of the Federation (5%); third-party institutions that provide support in training, monitoring, verification and reporting (10%); and the local Forest Division for operations that oversees the allocation of carbon credit resources and coordinate the overall technical assistance programme (10%).

Enhance the Profitability of New Land Uses

At least in the short term, cash revenues to farmers and communities from carbon payments are likely to be modest. Increasing either the productivity or value of new land uses will increase the surplus available to partners, including smallholders and forest communities. Through further research and technology dissemination, forest establishment and management costs can be reduced or plant growth increased, thus greatly increasing the profitability of both carbon and non-carbon components (Ciccarese 2000). The investment in planning, sustainable forest management and monitoring required for many forest carbon projects may make them eligible for forest certification at little additional cost. Communities and farmers can then sell certified timber and NTFPs for a premium or as preferred suppliers (Jenkins and Smith 1999).

Ideally, local communities and individuals involved in forest carbon projects can develop a portfolio of diverse income streams from forest resources, in order to raise incomes and reduce fluctuations in income due to climate or market variability. These can include wood and non-wood products, as well as ecosystem services like carbon or watershed protection.

Increase Transparency in Investor-Community Partnerships

Wilson *et al.* (1999) warn that even when all the necessary preconditions and facilitative structures are in place for CDM projects, mutual suspicion and distrust between communities and external private or government agencies may preclude successful CDM deals. An illustrative case is Iisaak Forest Resources an innovative partnership between Weyerhauser Corporation (a multinational forestry company), and the First Nations of Clayoquot Sound, to produce both high-value timber and environmental services in British Columbia, Canada. The negotiation process required two years to develop full trust between these previously conflicting business partners (Baird and Coady 2000). Principles for successful community-company forest partnership, drawn from a review of the experience of dozens of partnerships, are summarised in Box 14.

Box 14. Principles for Successful Community-Company Partnerships

1. *Mutual respect* for each partner's legitimate aims
2. *Fair negotiation process* where partners can make informed and free decisions
3. *Learning approach* – allowing room for disagreement and experimentation, treating deals as learning processes
4. *Realistic prospects of mutual profits* – partners being able to derive benefits commensurate with their contributions
5. *Commitment over a long period* to optimise the returns from deals
6. *Equitably shared risks*, clearly spelled out
7. *Sound business principles* – not exploitative relationships or public relations exercises
8. *Contribution to broader development strategies* and community empowerment

Source: Mayers and Vermeulen 2002.

To increase the confidence of both investors and communities in negotiating and implementing CDM contracts, it is necessary to make sure that agreements and processes are understood and widely known. Clearly drawn maps showing the boundaries of land-use and management regimes agreed upon by all stakeholders are essential, and may be done through participatory mapping exercises with local communities (Fox 1990). Professional journalists may be employed to publish the timetable of carbon payments in local newspapers and outline forest-use restrictions in public radio programmes in local languages.

Clear criteria and transparent mechanisms for the distribution of costs and benefits among multiple stakeholders have been important elements of successful community-based forestry projects (Honey 1999; Bass *et al.* 2000). Forest carbon contracts need to clearly specify the operational plan, ownership of land, carbon sequestration rights, easements, leases, project termination, project governance (defining roles of all parties), financing, apportionment of carbon credits, liabilities for failures to perform and procedures for dispute resolution. Contracts can be reviewed with risk management experts and include ways to handle liability for risks that the parties find difficult to cover with insurance; these risks should be shared equitably among investors, local communities and, if relevant, public agencies (Davis 1999).

Reduce Project Marketing Costs and Investor Risks

An oft-stated concern about community-based forest carbon projects is the difficulty in marketing them to private investors seeking low-cost, simple deals, in an increasingly competitive market. But the prospect of international carbon emissions trading has already stimulated institutional innovations to address this potential constraint (e.g., Verweij and Emmer 1998).

Bundling projects. While in AIJ 'investors' negotiated individual deals directly with carbon offset producers, after CDM is established (and in non-CDM international emissions offset trading), 'investors' will increasingly be financial portfolio managers. Intermediary organisations will be able to attract investors by 'bundling' projects within a country to market a large supply of carbon offsets, and thereby spread fixed costs. For example, Costa Rica markets Certified Tradable Offsets from two large national 'umbrella' projects from forest protection, regeneration and reforestation on over a million hectares. The mean size of an individual protection contract is 80 to 100 ha; reforestation contracts are smaller, though poorer landowners are under-represented (Chomitz *et al.* 1999).

Pooled investments. A multilateral approach to CDM investments in which projects are pooled together in 'mutual fund'-type arrangements could significantly lower transaction costs and the risk of individual project failure, and offer project specialisation (Baumert *et al.* 2000). For example, the independent non-profit Face Foundation has developed a portfolio of five projects in five countries, affecting 135,000 ha that are sequestering 82 million tons of carbon (Emmer and Verweij 2000). The World Bank's Prototype Carbon Fund could help the private sector establish such forest carbon funds (Totten 1999), as will its new BioCarbon Fund and Community Development Carbon Fund. National Environment Funds already established could also pool investments. While the CDM specifies that carbon deals be negotiated between individual buyers and sellers on a project basis, a secondary market in carbon offset credits is already developing (Beil 2000).

Branding of socially responsible investments. Projects and 'bundling' organisations could use site labelling or social certification to market their projects to individual investors or specialised funds for whom livelihood benefits is a selection criterion. 'Socially responsible' investment funds in the United States alone have grown in value from only US$40 billion in 1984 to $2.16 trillion today; growth from 1997 to 1999 was twice as high as in all funds. A high proportion of these funds screen for environmental and social impacts (Berge 2000). Utility and other companies may seek to acquire credits 'stamped' as earned from livelihood-enhancing projects, to build their 'reputation capital' or 'green' image. 'Niche' investors, such as charitable trusts, development organisations and NGOs, may be especially interested and may even be willing to pay a premium.

Project insurance. A number of instruments are emerging to insure carbon-trading risk. Present mechanisms include emission credit trading insurance (for the risk that delivered credits do not meet necessary standards); credit guarantee (protecting buyers from risk that sellers will go out of business prior to credit delivery); and project risk (mitigating project performance risks including technology failure, natural hazards, financial risks and economic risks) (Cottle 2000; Landell-Mills *et al.* 2002).[12] There is a pressing need to adapt such instruments to the requirements of community-based forest carbon projects. One option would be for global financial institutions to offer Partial Risk Guarantees (Cottle and Crosthwaite-Eyre, in press) for specific risks of community projects, such as the risk of short project duration.

Increase Scale and Reduce Costs of Community-Based CDM Projects

As discussed above, while many community-based forest carbon projects can compete with large-scale protection and industrial plantation projects in terms of production costs, transaction costs are characterised by economies of scale. Project size has an important effect on unit costs. The bigger the area, the more tons of carbon involved and the lower the unit costs of items like project design, management and certification. Thus the

Table 7. Institutional Innovations to Improve Cost-Effectiveness of Community-Based CDM Projects

Institutional Innovation	Impacts on Cost-Effectiveness	Activities	Examples
Specialised services from intermediary organisations	Reduce costs (economies of scale and specialisation for intermediary); Reduce managerial complexity	Specialised firms or agencies for: marketing community-based projects to investors, providing technical expertise in project design, support contract negotiations, establish mechanisms for financial transfer, verify carbon offsets	• Numerous private companies • NGO: The Nature Conservancy role in brokering forest carbon projects in Belize, Bolivia and Brazil (TNC 1999a,b,c)
Intermediary management institutions	Economies of scale in management and administration for investors; Economies of specialisation for management institutions	Draw up and register farmers' plans for forest development, assesses plans for carbon potential, develop carbon service agreements between buyers and sellers, provide technical assistance, monitor project	• Scolel-Té, Mexico: Local Trust Fund, managed by local environmental NGO (ECCM 2000) • Costa Rica: FUNDECOR, local NGO (Chomitz *et al.* 1999) • South African Wattle Growers Union (Phenezukomkhono): contracts for 600 small-scale producer members to supply international pulp and paper companies (Mayers and Vermeulen 2002) • Papua New Guinea: 'Green Umbrella' organisation manages certification • USA: private firm manages forest for multiple small-scale owners for certification (Jenkins and Smith 1999) • Federations or regional Indigenous Peoples 'Organizations, e.g., National Tree Growers' Cooperative Federation of India (NTGCF 2000); PROCYMAF in Mexico (PROCYMAF 2000)
Build on existing community development programmes	Reduce planning and staffing costs; Increase potential scale of project	Identify communities, identify carbon opportunities, diagnose local needs and priorities, strengthen community organisation, extensionist and farmer training	• Scolel-Té: long history of researcher/ farmer partnership (ECCM 2000) • Harda Division, Madhya Pradesh, India project proposal (Poffenberger *et al.* 2001)

Table 7. Continued

Institutional Innovation	Impacts on Cost-Effectiveness	Activities	Examples
Bundling environmental service payments	Increase total payments to landowners and users	Link to CBD or CCD projects; Link to local or national water or conservation projects	• State Forests of New South Wales, Australia: seeking to bundle carbon, biodiversity and water services to reforest upland agricultural areas undergoing extreme salinisation (under development) (Brand 2000) • Colombia: combine income from sustainable land-use systems, carbon and other services and ecotourism to convert land now used for illicit crops (Villa-Lopera 2000)
Large-scale, area-wide projects	Increase scale; Reduce share of transaction costs, monitoring costs, leakage; Increase flexibility	Develop project over entire jurisdiction (e.g., a county or state), committing to defined increase in forest cover or area protected	• Chiapas, Mexico: (de Jong *et al.* 2000) • Madhya Pradesh, India: Forestry project working with 1.2 million households
Cost-sharing	Reduce project costs; Reduce costs or benefit partner	Contribution by: national or state agency; overseas development assistance; development or environmental NGO; private-sector companies; municipal utilities; local communities	• AIJ project, Burkina Faso: ODA • Noel Kempff project, Bolivia: The Nature Conservancy (NGO) • Australian forest conservation: rice farmers (to market 'green' rice at a premium)
Reduce data costs	Reduce costs	Improve data and methods for project planning, baseline development and monitoring	• FLORES: improved landscape modelling tools (Vanclay *et al.* 2000) • Improved estimates of carbon emission and sequestration from alternative land uses in diverse environments (Palm *et al.* 2000) • Standard regional baselines for representative land uses (under development) • Low-cost, participatory carbon monitoring methods (Noel Kempff project, Bolivia)

challenge is to achieve cost savings in carbon unit costs from economies of scale in project design and administration, while achieving sustainable development through effective participation by a large number of disadvantaged communities, groups or households (Tomich 2000). Various institutional strategies have been devised to reduce transaction costs and increase the scale of potential projects to keep costs per unit of carbon offset competitive (Table 7).

Specialised service contracts. Where highly specialised expertise is needed for a limited time period, specialised companies, public agencies or NGOs with experience in community-based projects can provide certain business services to lower the costs of negotiating deals between investors and local communities in CDM projects. Important services that could be undertaken more cost effectively by specialised agencies (including non-profit organisations established to support community-based projects) include project design, legal services, establishment of transaction systems and design of monitoring systems.

Intermediary management organisations. Groups with expertise in community organisation can take responsibility for project management and mediating between investors and local people (Box 15). Wilson *et al.* (1999) recommend criteria for selecting such institutions: that they be perceived as representing the grassroots; have been involved in providing technical support to local communities; and have the capacity to interact with government authorities or other potential support agencies. Obviously, they also require excellent management and technical forestry skills, and a thorough understanding of forest carbon rules. Chomitz *et al.* (1999) note that such organisations often have lower monitoring and administrative costs than distant government agencies, and can realise economies of scale in dealing with neighbouring clients. Concerns about reputation can sometimes help ensure the integrity of the monitoring process.

Sites with established community organisations. Transaction costs can be greatly reduced by developing carbon projects in communities where there are already active local organisations and participatory development programmes in place, with community representatives already selected and authorised to negotiate with outsiders, and diagnoses of local needs and priorities already completed. For example, the proposed forest carbon project in Harda, India, would rely on existing hamlet and federation institutions established for community forestry programmes (Poffenberger *et al.* 2001).

Where such institutions are not already well established, actors other than CDM investors or their community partners – such as NGOs or public agencies – may be willing to cover selected transaction costs associated with community organisation without expecting to share carbon credits or carbon payments. Their motivation would be an expectation of desirable collateral benefits from the projects, such as biodiversity or watershed conservation or economic development for poverty reduction.

Bundling environmental service payments. Another way to make forest carbon projects more cost-effective is to bundle diverse types of environmental service payments, so that total payments provided to land users suffice to finance the desired changes in land use (Box 16). For example, forest carbon may be linked to initiatives under the biodiversity or desertification conventions. A review of 10 forest carbon projects in developing countries using this mechanism found that carbon services were generally linked with biodiversity services. In most cases, the two were merged and sold together. A few examples used the 'shopping basket' approach that is more efficient but more difficult to achieve under conditions of incomplete markets (Landell-Mills *et al.* 2002).

Bubble projects. 'Bubble project' is a term used to describe an area-based project, in which an entire jurisdiction (e.g., a county or state), rather than individual farmers or communities, commits to a defined increase in forest cover or area of forest protected. Bubble projects offer several advantages. Leakage is much less of a

Box 15. Multi-Project Bundling by an Intermediary NGO in Costa Rica

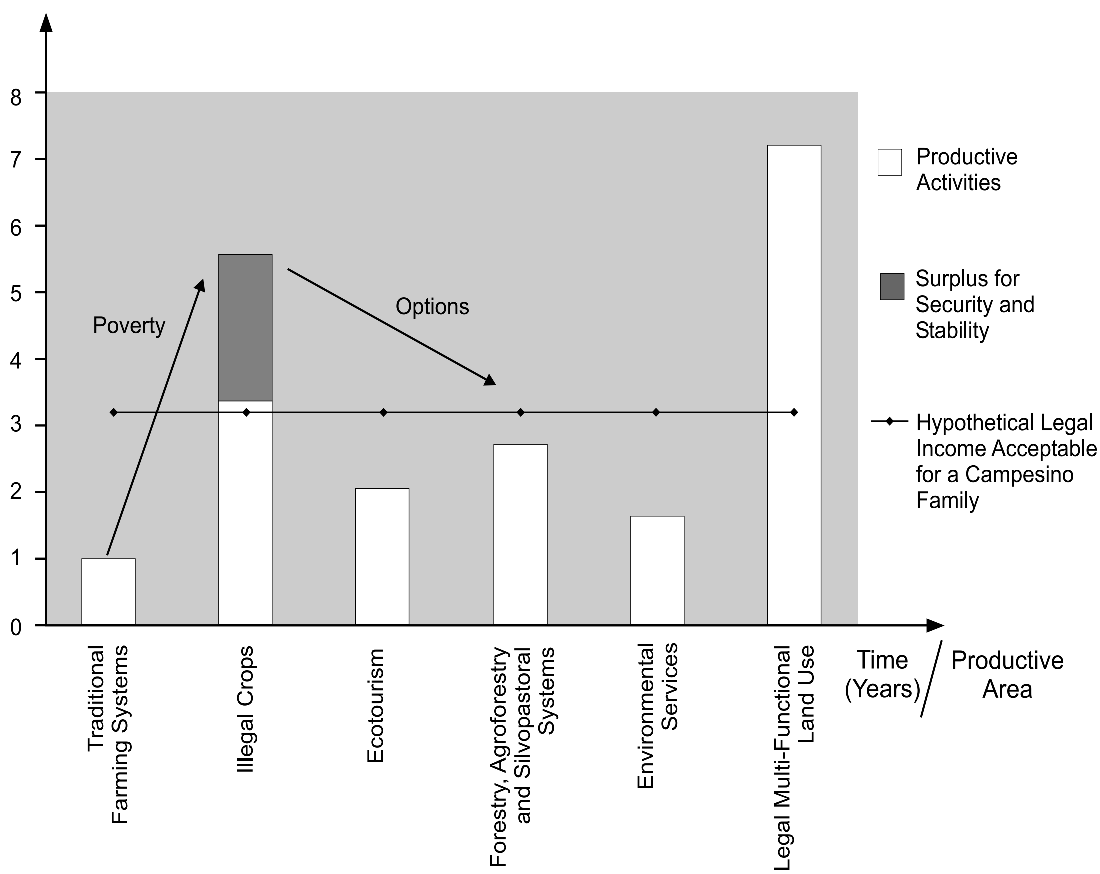
FUNDECOR (the Foundation for the Development of the Central Volcanic Range) is the most prominent of a number of NGOs that have spontaneously adopted the role of intermediary management institution for forest carbon projects in Costa Rica. In 1999, FUNDECOR had enrolled 371 clients with 22,000 ha in incentive programmes. While many clients are large, reforestation clients often have 5 ha or less under plantation. FUNDECOR handles all the paperwork related to application for forest environmental service payments, which is especially important for poorer, less-educated clients. FUNDECOR serves as supervising forester for the projects, drawing up management plans, monitoring client performance and providing technical assistance (Chomitz *et al.* 1999).

problem because much larger areas are defined in the project. More flexibility can be allowed for land-use change within the region in response to new economic conditions, so long as the overall quantitative goals for the region's carbon emission offsets are met. Thus projects in more populated areas would be feasible. Systems of transferable development rights, for example, can be used within the project area (Chomitz 1999). This model overcomes problems and costs of enforcing and monitoring long-term carbon storage at the plot level by allowing large-scale assessments. The bubble concept might be especially useful where poor growing conditions or land degradation result in low carbon offsets per hectare, but large areas of low-value land could be incorporated into the project (within a mosaic of other land uses). For example, some leading foresters of India believe there is promising potential to develop forest carbon projects at the provincial-scale by adapting successful models of JFM for regeneration of degraded forests. Though sequestering only 3-5t/ha/year of carbon, the project could be implemented on 2 million ha per year, providing significant carbon sequestration, livelihood and environmental benefits (Bahuguna 2000).

Box 16. Bundling Environmental Service Payments in Forest Projects

State Forests of New South Wales, a quasi-public agency in Australia responsible for managing over 250,000 ha of forest, is seeking to reforest upland agricultural areas experiencing severe salinisation. Carbon credits are being sought to finance supplemental costs of reforestation, along with contributions from farmers, downstream water users and biodiversity conservation programmes (Brand 2000). A similar strategy is being explored in Colombia, where studies suggest that farmer incomes from combining more sustainable land-use systems, environmental services and ecotourism would not only be several-fold higher than those from traditional farming systems, but even significantly higher than production of crops for illicit drugs (Villa-Lopera 2000; Figure 4).

Figure 4. Bundling payments for environmental services in Colombia



Source: Adapted from Villa Lopera, A. (2000). Figure 2. Hypothetical behavior of rural producer facing different rural productive activities and average income potential from CDM forest projects. In Análisis preliminar de beneficios colaterales.

VIII. Conclusions

CDM projects could profoundly affect livelihood strategies. Almost all tropical forests have people living in and around them, and forest resources are an integral part of the socioeconomic and cultural milieu in rural areas. The above analysis identifies where the real opportunities and risks of CDM projects lie for rural livelihoods, and the proactive efforts needed at various levels to raise the likelihood of positive impacts.

CDM Forest Projects: Potential Contributions to Local Livelihoods

Much of the controversy over the social impacts of CDM forestry has centred around large-scale industrial plantations and forest-protection projects, which may indeed pose significant risks for local communities. However, our results show that CDM projects for reforesting degraded and deforested areas, and for averting deforestation, *can* be fashioned to provide significant benefits to communities and reduce many of these risks. The ecosystem approach recently endorsed by the Convention on Biological Diversity recognises that large untouched national parks may not be required for carbon stock protection or biodiversity conservation. Instead, negotiated settlement among legitimate stakeholders of a combination of land uses, including protected areas but also a range of sustainable farming and community-based, multiple-use forestry activities, may be more realistic and more compatible with local benefits. Likewise, carbon sequestration can provide greater social and environmental co-benefits if based on multi-species reforestation in agroforests, farms and community forest rehabilitation. There appears to be potential for carbon projects to provide livelihood benefits on a significant scale in some of the poorest parts of the world, often in areas where there are few alternative strategies for economic development or sources of investment capital.

Our analysis highlights, however, that proactive interventions are likely to be required to support implementation of these approaches, to secure land rights and to reduce the high transaction costs of meaningfully involving large numbers of smallholders. We suggest a number of ways in which CDM rules could be crafted to encourage such approaches. We recommend Social Impact Assessments be required and that CDM be harmonised with the CBD, incorporating some of its guiding principles as minimum standards for stakeholder consultations and project certification, particularly those supporting local communities and indigenous populations. Assisted natural regeneration and forest rehabilitation should be explicitly included in the definition of afforestation and reforestation. Reducing transaction costs, such as the costs of establishing baselines and monitoring carbon flows, would have both efficiency and equity benefits. Proactive national policy action will be essential to attract investors to livelihood-enhancing forest carbon projects, ensure they are consistent with development goals and provide enabling conditions for them to succeed, particularly in relation to tenure security and regulatory policy. Experience suggests a variety of institutional mechanisms by which livelihood-enhancing forest carbon projects can be made more cost-effective, lower risk and more attractive to investors.

Over the longer term, in countries that commit to supporting them, community-based forest carbon projects could contribute towards increasing and diversifying rural incomes, while opening up areas that would otherwise not be available for carbon emission offsets. In the short term, however, projects are likely to be successful only in well-targeted sites. Most developing countries will require considerable efforts to establish the enabling conditions for forest carbon projects to contribute on a large scale to local livelihoods.

Moving Forward: An Agenda for Action

The past five years have seen an explosion of research and institutional experimentation related to forest carbon. Most of these efforts, however, have paid little attention to social issues. The analysis above suggests important gaps that will need to be filled if investors, governments, communities and other interested groups are to aggressively pursue the real opportunities that exist to mitigate climate change while also reducing poverty.

Parties to the Convention. The Parties to the Convention on Climate Change, through the SBSTA and the IPCC, can specify definitions, regulations and criteria for CDM forest carbon projects that encourage projects that respond to local needs and can be cost-effective in producing carbon benefits. They can also strengthen capacity-building and advisory services for investors, community carbon service providers and intermediaries in the design and implementation of community-based projects.

National Governments. Developing countries that wish to take advantage of the potential opportunities of the CDM to support sustainable development will need to be very proactive in establishing enabling conditions. By putting in place suitable legislation and institutions to attract investors and reduce transaction costs, and safeguarding local rights and protections, they can create competitive advantage in community-based projects.

Private Investors. Community-based forest carbon projects can offer good financial deals to private investors where they are well targeted and well designed. In some cases additional financial and reputation benefits result from positive social co-benefits. Collaboration with intermediaries experienced in participatory rural development will be essential, and investors are advised to seek sites where community organisation is already fairly well developed and potential risks to local livelihoods are low. Interested investors will need to acquire expertise, or at least trusted advisors, for adapting project planning, contracts and monitoring for community-based projects. A niche exists for specialist fund managers, as well as business service providers, with this expertise.

Farmer and indigenous organisations. Community-based organisations could benefit significantly from CDM forest carbon projects, but also face significant risks. Before embarking on deals, they will want to be well informed about the process and have access to professional advice. Strong national lobbying efforts are called for to establish local and community rights to trade forest carbon, claim customary land rights and related compensation, set criteria for Social Impact Assessments and to claim a fair share of carbon benefits.

Conservation and development assistance organisations. Conservation and development assistance organisations can play a strategic and pivotal role as brokers, intermediaries and service providers for community-based forest carbon projects. They can be important allies for farmer and indigenous organisations in development of enabling legislation and regulation that safeguard local livelihoods and reduce the transaction costs of livelihood-enhancing forest carbon projects.

Research organisations. Research organisations can help to improve the cost-effectiveness of community-based CDM forest projects by developing low-cost methods for assessing dynamic baselines and projected carbon performance in heterogeneous landscapes (Tomich 2000); by improving the productivity of forest management and agroforestry systems; and by examining the effectiveness and costs of alternative institutional arrangements to reduce transaction costs. Researchers can undertake more rigorous assessment of the livelihood benefits and risks of diverse types of forest carbon projects in different socioeconomic conditions. They can develop networks to support adaptive learning and sharing of experiences in implementing livelihood-enhancing forest carbon projects.

IX. Endnotes

[1] In this paper, we use the term 'community' to include farmers, forest dwellers and individual local actors, as well as local social organisations such as indigenous organisations, farmers' groups, forest user groups and cooperatives.

[2] More detail may be found in Smith and Scherr (in press).

[3] Agroforestry is the practice of growing trees, shrubs and other perennials in spatial, temporal or economic interaction with crops, livestock or other farm components.

[4] The net CO_2 flux is a result of land-use change and depends on how quickly land uses are converted, the biomass of the vegetation that is cleared, the fate of the carbon cleared, the biomass of new vegetation, the time course of the subsequent land-use systems, and the regrowth rates of vegetation (Palm *et al.* 1999).

[5] Our analyses in this paper refer to metric tons of carbon (tC). Carbon debates commonly also refer to the metric of tons of carbon dioxide (t CO_2). To make the conversion, 1 ton of carbon is equivalent to 3.67 tons of carbon dioxide; 1 ton of carbon dioxide is equivalent to 0.273 tons of carbon (Watson *et al.* 2000).

[6] Financial accounting arrangements for projects need not be the same as environmental accounting of carbon (Moura-Costa 2000a).

[7] For example, a representative study of 40 rural villages (*aldeas*) in central Honduras found that although aggregate forest cover change from the mid-1970s to the mid-1990s declined by only 2.3%, this masked a gross decline of 15%, offset by forest regeneration of 12.6% on other lands (Scherr 2000).

[8] It should be noted that similar risks characterise some types of energy projects proposed under CDM, and may thus also merit mandatory SIAs, if not required social impact criteria.

[9] Although this will not be possible for environmental impact assessment, given the guidelines in the Marrakesh Accords, it has not been explicitly ruled out in the case of SIAs.

[10] Costa Rica follows the 'unilateral' model for CDM, with the government making project investments and marketing carbon offsets produced. The Costa Rican government believes that this structure makes it easier to attract investment to priority projects than in the bilateral model. However, in both bilateral and multilateral models, the government can play a proactive role (Baumert *et al.* 2000).

[11] R. Lopez (pers. comm. 1999) warns that developing countries eventually opting for open global trading of carbon offsets, involving more numerous projects established through private deals, will face a daunting challenge to establish institutional protections, particularly to protect tenure rights.

[12] Costa Rica, for example, permanently reserves approximately 21% of the offsets produced in the initial year of the project as insurance against the baseline, and 25% of the offsets from pasture regeneration in the dry, heavily grazed Guanacaste and Palo Verde region, as insurance against failure of regeneration (Chomitz *et al.* 1999).

X. References

Agrawal, A. and Ostrom, E. 1999 Collective action, property rights and devolution of forest and protected area management. *In:* Meinzen-Dick, R., Knox, A. and Di Gregorio, M. (eds.) Collective action, property rights and devolution of natural resource management – Exchange of knowledge and implications for policy, 41-74. Proceedings of the International Conference held from 21-25 June 1999, Puerto Azul, the Philippines. German Foundation for International Development, International Food Policy Research Institute and International Centre for Living Aquatic Resource Management, Feldafing, Germany.

Allegretti, M. 1990 Extractive reserves: An alternative for reconciling development and conservation in Amazonia. *In*: Anderson, A. (ed.) Alternatives to deforestation: steps toward sustainable use of the Amazon rain forest, 252-65. Columbia University Press, New York.

Altarelli, V. 2000 Rural livelihoods and the CDM. Paper presented at the CIFOR-University of Maryland international workshop on 'Capturing the Value of Forest Carbon for Local Livelihoods', Bellagio, Italy, 14-18 February 2000.

Amazon Alliance 2000 Report from the Quito Workshop, 4-6 May 2000, and Update on Indigenous and Other Local Peoples Participation in the Climate Negotiations. Amazon Alliance, Washington, D.C.

Amazonian Indigenous Forum 2001 Resolution of Amazonian Indigenous Forum on Climate Change, Manaus, Brazil, 11 October 2001.

Angelsen, A. and Kaimowitz, D. 2001 Introduction: The role of agricultural technologies in tropical deforestation. In: Angelsen, A. and Kaimowitz, D. (eds.) Agricultural technologies and tropical deforestation, 1-17. CIFOR and CABI Publishing, Wallingford, UK.

ARM and Mundy, E. 2000 Policy risks for the forest sector associated with the implementation of the Kyoto Protocol. Report to Forest Trends, Washington, D.C. May 2000.

Arnold, J.E.M. and Dewees, P. 1997 Farms, trees, and farmers. Responses to agricultural intensification. Earthscan, London.

ASB. 2001 Deregulating agroforestry timber to fight poverty and protect the environment. ASB Policy brief 03. Alternatives to Slash and Burn Programme. World Agroforestry Centre (ICRAF), Nairobi.

Asquith, N.M., Vargas Rios, M.T. and Smith, J. In press. Can forest-protection carbon projects improve rural livelihoods? Analysis of the Noel Kempff Mercado Climate Action Project, Bolivia. Mitigation and Adapation Strategies.

Austin, D, Faeth, P., Da Motta, R.S., Ferraz, C., Young, C.E.F., Ji, Z., Junfeng, L. Pathak, M., Srivastava, L. and Sharma, S. 1999 How much sustainable development can we expect from the Clean Development Mechanism? World Resources Institute, Climate Notes, November 1999. WRI, Washington, DC.

Bahuguna, V. 2000 Community-based carbon projects – Indian perspective. Paper presented at the CIFOR-University of Maryland international workshop on 'Capturing the Value of Forest Carbon for Local Livelihoods', Bellagio, Italy, 14-18 February 2000.

Baird, L. and Coady, L. 2000 A new economic model for conservation-based forestry in temperate old growth forests – White Paper by Iisaak Forest Resources, Clayoquot Sound, British Columbia. Paper presented to Conference on 'Developing Commercial Markets for Environmental Services of Forests', Vancouver, Canada, 4-6 October 2000.

Bass, S., Dubois, O., Moura-Costa, P., Pinard, M., Tipper, R. and Wilson, C. 2000 Rural livelihoods and carbon management. IIED Natural Resource Issues Paper No. 1. International Institute for Environment and Development, London.

Baumert, K.A., Kete, N. and Fueres, C. 2000 Designing the Clean Development Mechanism to meet the needs of a broad range of interests. World Resources Institute, Climate Energy & Pollution Program, August 2000. Washington, DC.

Beil, S. 2000 The commercial market for carbon credits. Paper presented to Conference on 'Developing Commercial Markets for Environmental Services of Forests', Vancouver, Canada, 4-6 October 2000.

Bennett, E.L. and Robinson, J.G. 2000 Hunting of wildlife in tropical forests, Implications for biodiversity and forest peoples. Environment Department, The World Bank, Washington, D.C.

Berge, D. 2000 Attracting private capital to the new forest economy – A social investment perspective. Paper presented to Conference on 'Developing Commercial Markets for Environmental Services of Forests', Vancouver, Canada, 4-6 October 2000.

Blanco, J. and Forner, C. 2000 Special considerations regarding the 'expiring CERs' proposal. Economic and Financial Analysis Group, The Ministry of the Environment, Colombia, and CIFOR, Bogor, Indonesia.

Brand, D. 2000 Emerging markets for forest services and implications for rural development, forest industry and government. Paper presented to Conference on 'Developing Commercial Markets for Environmental Services of Forests', Vancouver, Canada, 4-6 October 2000.

Brown, K. and Rosendo, S. 2000 Environmentalists, rubber tappers and empowerment: the politics and economics of extractive reserves. Development and Change 31: 201-27.

Brown, S., Burnham, M., Delaney, M., Powell, M., Vaca, R. and Moreno, A. 2000 Issues and challenges for forest-based carbon-offset projects: a case study of the Noel Kempff Climate Action project in Bolivia. Mitigation and Adaptation Strategies for Global Change 5(1): 99-121.

Byron, N. and Arnold, M. 1999 What futures for the people of the tropical forests? World Development 27: 789-805.

Cacho, O. and Hearn, R. 2001 The economic implications of carbon accounting methods for the profitability of agroforestry systems. University of New England and New South Wales Department of Agriculture, Armidale, Australia.

Campbell, B., Frost, P. and Byron, N. 1996 Miombo woodlands and rural livelihoods: options and opportunities. *In:* The Miombo in transition: woodlands and welfare in Africa, 221-30. CIFOR, Bogor, Indonesia.

Carney, D. 1998 Implementing the sustainable rural livelihoods approach. *In:* Carney, D. (ed.) Sustainable rural livelihoods: what contribution can we make?, 3-23. DFID, London.

Carpentier, C.L., Vosti, S.A., Witcover, J. 2000 Small-scale farms in the Western Brazilian Amazon: Can they benefit from carbon trade?. Technical Report. International Food Policy Research Institute. EPTD Discussion Paper No. 67, pp. 42. Washington, DC.

Cavendish, W. 2000. Rural livelihoods and non-timber forest products. Centre for the Study of African Economies, Oxford, and Imperial College, London.

CBD (Convention on Biological Diversity) Ecosystem Approach 2000 Decisions Adopted by the Conference of The Parties to the Convention on Biological Diversity at its Fifth Meeting. Nairobi, 15-26 May 2000. http://www.biodiv.org/Decisions/COP5/html/COP-5-Dec-06-e.htm

Chomitz, K.M. 1999 Forest carbon: A discussion brief on issues, project types, and implications for the World Bank's Forest Policy Strategy. DECRG, The World Bank: Washington, D.C. Working Draft 8 May 1999.

Chomitz, K.M. 2000 Evaluating carbon offsets from forestry and energy projects: how do they compare? Development Research Group, The World Bank, Washington, D.C., March 2000.

Chomitz, K.M., Brenes, E. and Constantino, L. 1999 Financing environmental services: the Costa Rican experience and its implications. The Science of the Total Environment 240: 157-69.

Chung, B.R. 1999 Community-based land use planning in conservation areas: Lessons from local participatory processes that seek to balance economic uses with ecosystem protection. America Verde, Training Manual No. 3, International Program. The Nature Conservancy, Arlington, Virginia.

Ciccarese, L. 2000 The Plan Vivo system: A system for planning, managing and monitoring the supply of carbon offsets from small farmers. Paper presented at the international workshop on 'Capturing the Value of Forest Carbon for Local Livelihoods,' Bellagio, Italy, 14-18 February 2000.

CIFOR (Center for International Forestry Research) 2001 Forest carbon, livelihoods and biodiversity. A report to the European Commission. CIFOR and EU, Bogor, Indonesia.

CIFOR & University of Maryland 2000 Forest carbon for local livelihoods. CIFOR, Bogor, Indonesia.

Colchester, M. 2001 Forest industries, indigenous peoples and human rights. Thematic paper prepared for a workshop on 'Indigenous peoples, private sector natural resource, energy and mining companies and human rights'. Sub-Commission on the Promotion and Protection of Human Rights, UNCTAD, ILO and WTO, Room IX, Palais des Nations, Geneva.

Colfer, C. J.P., Prabhu, R., Gunter, M., McDougall, C., Porro, N.M. and Porro, R. 1999 Who counts most? Assessing human well-being in sustainable forest management. The Criteria and Indicators toolbox series 8. CIFOR, EU, GTZ and USAID, Bogor, Indonesia.

Cottle, P. 2000. Making the link: Sustainable forest management and forestry finance. Paper presented to Conference on 'Developing Commercial Markets for Environmental Services of Forests', Vancouver, Canada, 4-6 October 2000.

Cottle, P. and Crosthwaite-Eyre, C. Forthcoming. Insuring forest sinks. *In*: Pagiola, S., Bishop, J. and Landell-Mills, N. (eds). Selling forest environmental services: market-based mechanisms for conservation. Earthscan, London.

Current, D., Lutz, E. and Scherr, S. (eds.) 1995 Costs, benefits, and farmer adoption of agroforestry: Project experience in Central America and the Caribbean. Environment Paper Number 14. The World Bank, Washington, DC.

Davis, P. 1999 Carbon forestry projects in developing countries: Legal issues and tools. Forest Trends, Washington, D.C. Draft.

Davis-Case, D. 1989 Community forestry: participatory assessment, monitoring and evaluation. Food and Agriculture Organization of the United Nations, Rome.

Declaration of Brazilian Civil Society on the Relations between Forests and Climate Change and Expectation for COP-6, 2000 Belém, Brazil, 24 October 2000.

Declaration of the First International Forum of Indigenous Peoples on Climate Change, 2000. Lyon, France, 4-6 September 2000.

de Foresta, H. 1992 Complex agroforestry systems and conservation of biological diversity. *In:* Kheong, Y.S. and Win, L.S. (eds.) Harmony with nature: an international conference on the conservation of biological diversity, 488-500. The Malayan Nature Journal. Golden Jubilee Issue, Kuala Lumpur, Malaysia.

de Jong, B.H.J., Tipper, R. and Montoya-Gómez, G. 2000 An economic analysis of the potential for carbon sequestration by forests: evidence from southern Mexico. Ecological Economics 33: 313-27.

de Jong, W., van Noordwijk, M., Sirait, M., Liswanti, N. and Suyanto 2001 Farming secondary forests in Indonesia. Journal of Tropical Forest Science 13: 705-26.

den Elzen, M.G.J. and de Moor, A.P.G. 2002 The Bonn Agreement and Marrakesh Accords: an Updated Analysis. RIVM National Institute of Public Health and the Environment Report 728001017. Bilthoven, The Netherlands.

ECCM (Edinburgh Centre for Carbon Management) 2000 The Plan Vivo. Edinburgh, www.eccm.uk.com/planvivo.

Emmer, I.M. and Verweij, J.A. 2000 Carbon offsets and transaction costs in Face projects. Presented at the international workshop on 'Capturing the Value of Forest Carbon for Local Livelihoods', Bellagio, Italy, 14-18 February 2000.

Fearnside, P.M. 1996 Socioeconomic factors in the management of tropical forests for carbon. *In:* Apps, M. and Price, D. (eds.) Forest ecosystems, forest management and the global carbon cycle, 349-61. NATO ASI Series 1, Vol. 40. Springer-Verlag, Berlin.

Fearnside, P.M. and Guimares, W.M. 1996 Carbon uptake by secondary forests in Brazilian Amazonia. Forest Ecology and Management 80: 35-46.

FERN 2000 Sinking the Kyoto Protocol: the links between forests, plantations and carbon sinks. FERN Briefing Note in cooperation with Both Ends. FERN, Moreton-in-Marsh, UK, October 2000.

Fox, J. 1990 Diagnostic tools for social forestry. *In:* Poffenberger, M. (ed.) Keepers of the forest: Land management alternatives in Southeast Asia, 119-33. Kumarian Press, West Hartford, CT.

Gockowski, J., Nkamleu, B. and Wendt, J. 2001 Implications of resource use intensification for the environment and sustainable technology systems in the central African rainforest. *In:* Lee, D. and Barrett, C. (eds.) Tradeoffs or synergies? Agricultural intensification, economic development and the environment, 197-219. CAB International, Wallingford, UK.

Grubb, M., Hourcade, J.-C. and Oberthur, S. 2001 Keeping Kyoto. A study of approaches to maintaining the Kyoto Protocol on Climate Change. Climate Strategies International Network for Climate Policy Analysis. Imperial College, London.

Hardner, J., Frumhof, P.C. and Goetze, D.C. 2000 Prospects for mitigating carbon, conserving biodiversity, and promoting socioeconomic development objectives through the Clean Development Mechanism. *In*: Bloomfield, J., Ratchford, M. and Browm S. Mitigation and Adaptation Strategies for Global Change 5(1) :61-80. Special issue on Land-Use Change and Forestry in the Kyoto Protocol.

Hill, I. and Shields, D. 1998 Incentives for joint forest management in India. Analytical methods and case studies. Technical Paper 394. The World Bank, Washington, D.C.

Honey, M. 1999 Ecotourism and sustainable development: Who owns paradise? Island Press, Washington, D.C.

ICRAF (International Centre for Research in Agroforestry) 2000 Developing a regional environmental services unit for the benefit of the upland poor in Asia. A concept proposal to provide technical assistance to the International Fund for Agricultural Development. ICRAF, Bogor. January 2000.

IIED (International Institute for Environment and Development) 1994 Whose Eden? An overview of community approaches to wildlife management. IIED & ODA, London.

IISD (International Institute for Sustainable Development) 2000 Summary of the Sixth Conference of the Parties to the Framework convention on Climate Change, 13-25 November 2000. Earth Negotiations Bulletin 12(163).

IUCN 2000 The role of an ecosystem approach in balancing climate change, biodiversity, and social objectives. Discussion Paper on 'Carbon sequestration, biodiversity and sustainable livelihoods'. IUCN, Washington, D.C.

Jenkins, M.B. and Smith, E.T. 1999 The business of sustainable forestry: Strategies for an industry in transition. Island Press, Washington, D.C.

Jodha, N.S. 1986 Common property resources and rural poor in dry regions of India. Economic and Political Weekly 21(27): 1169-81.

Joshi, L., van Noordwijk, M. Wibawa, G., Vincent, G. Hardiwinoto, S. and Sukandi, T. 2000). Gap replanting – an emerging trend in rejuvenation of jungle rubber agroforests in Jambi, Indonesia. Paper presented at a workshop on 'Evolution and Sustainability of Intermediate Systems of Forest Management', 28 June-1 July 2000, Lofoten, Norway.

Kaimowitz, D. 1995 Livestock and deforestation in Central America. EPTD Discussion Paper. International Food Policy Research Institute, Washington, D.C.

Kyoto Protocol to the Convention on Climate Change 1997. The Climate Change Secretariat. Bonn.

Landell-Mills, N., Bishop, J. and Porras, I. 2002 Silver bullet or fools' gold? Markets for forest environmental services and the poor: Emerging issues. International Institute for Environment and Development (IIED), London.

Leakey, R.R.B. 1999 Agroforestry for biodiversity in farming systems. *In*: Collins, W.W. and Qualset, C.O. (eds). Biodiversity in Agro-ecosystems. CRC Press, New York, pp. 127-145.

Lopez, R. and Ocaña, C. 1999 Why Latin America should participate in global trade in carbon emissions: Carbon trade as a source of funding for sustainable development. Department of Agricultural and Resource Economics, University of Maryland, College Park, Maryland.

Lynch, O. and Talbott, K. 1995 Balancing acts: Community-based forest management and national law in Asia and the Pacific for Indonesia, India, Nepal, Philippines, Sri Lanka and Thailand. World Resources Institute (WRI), Washington, DC.

Mayers, J. and Vermeulen, S. 2002 Company-community forestry partnerships: From raw deals to mutual benefits? International Institute for Environment and Development, London.

Melnyk, M. 2000 Resource management: conditions for effective community-based fire management. Presentation for workshop on Community-Based Fire Management. Kasetsart University, Bangkok, Thailand, 6-8 December. RECOFTC and Project Firefights Southeast Asia.

Michón, G. and de Foresta, H. 1995 The Indonesian agroforest model. Forest resource management and biodiversity conservation. *In:* Halladay, P. and Gilmour, D.A. (eds.) Conserving biodiversity outside protected areas: The role of traditional agro-ecosystems, 90-106. IUCN, Gland, Switzerland.

MoEF (Ministry of Environment and Forest) 1999 National Forestry Action Programme in India. Government of India, New Delhi.

Morrison, E. and Bass, S. 1992 What about the people? *In:* Sergeant, C. and Bass, S. (eds.) Plantations in politics. Forest plantations in development, 92-120. Earthscan, London.

Moura-Costa, P. 2000a. Carbon accounting methods. Brief. Forest Trends, Washington, D.C.

Moura-Costa, P. 2000b. Project duration. Brief. Forest Trends, Washington, D.C.

Moura-Costa, P. and Wilson, C. 2000 An equivalence factor between CO_2 avoided emissions and sequestration – description and applications in forestry. Mitigation and Adaptation Strategies for Global Change 5: 51-60.

Mundy, E. and ARM 2000 Risk mitigation in forestry-linkages with Kyoto and sustainable forestry management. Forest Trends, Washington, D.C.

Noel Kempff Climate Action Project. 1999 Technical operating protocols: Carbon monitoring, leakage monitoring, accounting and reporting, verification and certification. Bolivia, November 1999.

NTGCF 2000 National Tree Growers' Cooperative Federation. www.ntgcf.org/projects.html

OCIC (Oficina Costarricense de Implementacion Conjunta) 1998 The Costa Rican experience with market instruments to mitigate climate change and conserve biodiversity. San Jose, Costa Rica.

Ostrom, E. 1999 Self-governance and forest resources. Occasional Paper No. 20. CIFOR, Bogor, Indonesia. February.

Palm, C.A., Woomer, P.L., Alegre, J., Arevalo, L., Castilla, C., Cordeiro, D.G., Feigl, B., Hairiah, K., Kotto-Same, J., Mendes, A., Moukam, A., Murdiyardo, D., Njomgang, R., Parton, W.J., Ricse, A., Rodrigues, V., Sitompul, S.M. and van Noordjik, M. 1999 Carbon sequestration and trace gas emission in slash and burn and alternative land-uses in the humid tropics. ASB Climate Change Working Group, Final Report, Phase II. International Centre for Research in Agroforestry (ICRAF), Nairobi, Kenya.

Pearce, D. 1996 Global environmental value and the tropical forests: demonstration and capture. *In:* Adamowicz, W., Boxall, P., Luckert, M., Phillips, W. and White, W. (eds.) Forestry, economics and the environment, 11-49. CAB International, Wallingford, UK.

Pearce, D., Day, B., Newcombe, J., Brunello, T. and Bello, T. 1998 The Clean Development Mechanism: benefits of the CDM for developing countries. Unpublished report. CSERGE, University College, London.

Peluso, N.L. 1992 Rich Forests, poor people: resource control and resistance in Java. University of California Press, Berkeley, California.

Piñedo-Vasquez, M., Zarin, D.J., Coffey, K., Padoch, C. and Rabelo, F. 2001. Post-boom logging in Amazonia. Human Ecology 29: 219-39.

Poffenberger, M. (ed.) 1996 Communities and forest management: A report of the IUCN Working Group on Community Involvement in Forest Management, with recommendations to the Intergovernmental Panel on Forests. The World Conservation Union, Cambridge, UK.

Poffenberger, M. and McGean, B. (eds.) 1998 Village voices, forest choices: Joint Forest Management in India. Oxford University Press, Delhi.

Poffenberger, M. (ed.), Ravindranath, N.H., Pandey, D.N., Murthy, I.K., Bist, R. and Jain, D. 2001 Communities and climate change: The Clean Development Mechanism and village-based forest restoration in Central India. A case study from Harda Forest Division, Madhya Pradesh, India. Community Forestry International, Inc. and the Indian Institute of Forest Management: Santa Barbara, California.

Point Carbon 2001 The carbon market: Status and prospects. Presentation at COP-7, Marrakesh, 8 November 2001.

Potter, L., and Lee, J. 1998 Tree planting in Indonesia: trends, impacts and directions. Occasional Paper No. 18. CIFOR and USAID, Bogor, Indonesia.

PROCYMAF 2000 Proyecto de conservación y manejo sustentable de recursos forestales en México. Informe y avance 1998-2000. Misión de evaluación de medio término, SEMARNAP, Mexico.

Rangachari, C.S. and Mukherji, S.D. 2000 Old roots new shoots, A study of joint forest management in Andhra Pradesh, India. Winrock International and Ford Foundation, New Delhi.

Rasmussen, H. and Roy, C. 2000 ILO Convention on Indigenous and Tribal Peoples, 1989, No. 169: a manual. International Labour Organisation, Geneva.

Richards, M. 1997 Common property resource institutions and forest management in Latin America. Development and Change 28: 95-117.

Ruis-Pérez, M. and Byron, N. 1999 A methodology to analyze divergent case studies of non-timber forest products and their development potential. Forest Science 45: 1-14.

Salafsky, N. 1993 The Forest Garden Project. An ecological and economic study of a locally developed land-use system in West Kalimantan, Indonesia. Ph.D. Thesis. Duke University. Durham, N.C.

Salafsky, N., Degelby, B.L. and Terborgh, J.W. 2000 Can extractive reserves save the rain forest? An ecological and socioeconomic comparison of non-timber forest product extraction systems in Petén, Guatemala, and West Kalimantan, Indonesia. Conservation Biology 7: 39-52.

Sarin, M. 1998 From conflict to collaboration: Institutional issues in community management. *In:* Poffenberger, M. and McGean, B. (eds.) Village voices, forest choices: Joint Forest Management in India, 176-209. Oxford University Press: Delhi.

Saxena, N.C. 1997 The saga of participatory forest management in India. Special Publication. CIFOR, Bogor, Indonesia.

Sayer, J.A. and Iremonger, S. 1999 The state of the world's forest biodiversity. *In:* Palo, M and Usivuori, J. (eds.) World forests, society and environment, 129-34. Kluwer Academic Press, Amsterdam.

Scherr, S.J. 1995 Economic factors in farmer adoption of agroforestry: Patterns observed in western Kenya. World Development 23: 787-804.

Scherr, S.J. 1999 The economic context for agroforestry development: evidence from Central America and the Caribbean. Outlook on Agriculture 28(3): 163-70.

Scherr, S.J. 2000 The evolving role of forestry with agricultural intensification in the Central Hillsides of Honduras, 1970s-1990s. Paper presented to the International Union of Forestry Research Organizations World Congress, Kuala Lumpur, Malaysia, August 2000.

Scherr, S.J., White, A. and Kaimowitz, D. 2002 Making forest markets work for low-income producers. Forest Trends and CIFOR, Washington, D.C.

Shanley, P., Pierce, A., Laird, S. and Guillen, A. (Eds.) Forthcoming. Tapping the green market: Management and certification of non-timber forest products. Earthscan: London.

Shepherd, G., Arnold, M. and Bass, S. 1999 Current understandings, emerging issues and their implications for World Bank Forest Policy and funding priorities: A contribution to the world Bank Forest Policy Review Process. Forests and sustainable livelihoods. An Issues Paper. The World Bank, Washington, D.C.

Simons, A.J., Jaenicke, H., Tchoundjeu, Z., Dawson, I., Kindt, R., Oginosako, Z., Lengkeek, A. and de Grande, A. 2000 The future of trees is on farms: Tree domestication in Africa. *In:* Krishnapillay, B., Soepadmo, E., Arshad, N.L., Wong, A., Appanah, S., Chik, S.W., Manokaran, N., Tong, H.L and Choon, K.K. (eds.) Forests and society: The role of research. Sub-plenary sessions. Volume 1, 752-60. Malaysian XXI IUFRO World Congress Organizing Committee, Kuala Lumpur.

Smith, J. In press Afforestation and reforestation in the Clean Development Mechanism of the Kyoto Protocol: implications for forests and forest peoples. International Journal of Global Environmental Issues.

Smith, J. and Mourato, S. In press Can carbon trading reduce deforestation by slash-and-burn farmers? Evidence from the Peruvian Amazon. *In:* Pearce, D. and Pearce, C. (eds.) Valuing environmental benefits: Case studies from the Developing World. Edward Elgar, Cheltenham, UK

Smith, J. and Scherr, S.J. In press Capturing the value of forest carbon for local livelihoods. World Development.

Smith, J., Finegan, B., Sabogal, C., Goncalves-Ferreira, M., Siles Gonzalez, G., van de Kop, P. and Diaz-Barba, A. 2001 Management of secondary forests in colonist swidden agriculture in Peru, Brazil and Nicaragua. *In:* Palo, M., Uusivuori, J. and Mery, G. (eds.) World forests, markets and policies. World forests Vol. III, 263-78. Kluwer Academic Publishers, Dordrecht.

Smith, J., Mulongoy, K., Persson, R. and Sayer, J. 2000 Harnessing carbon markets for tropical forest conservation: towards a more realistic assessment. Environmental Conservation 27: 300-11.

Snook, L.K. 2000 Utilization and management of timber and non-timber forest resources in the forest ejidos of Quintana Roo, Mexico. FAO case studies on combined timber-non-timber management, FAO 6-15 May 2000.

Stevens, S. (ed.) 1997 Conservation through cultural survival: Indigenous peoples and protected areas. Island Press, Washington, D.C.

Subak, S. 2000 Forest protection and reforestation in Costa Rica: Evaluation of a Clean Development Mechanism prototype. Environmental Management 26: 283-97.

Sundar, N. 2000 Unpacking the 'Joint' in Joint Forest Management. Development and Change 31: 255-79.

Tattenbach, F., Kleysen, B., Alpizar, W., Manso, P., Corrales, L., Galvez, J., Leiva, M., Imbach, P. and Mora, G. 2000 A GHG emissions reductions project proposal for five community forest concessions in the Mayan Biosphere Reserve, Petén, Guatemala. Prepared by the OCIC Consulting Group for USAID Contract 596-0-00-00-00056-00. September 2000.

Tchala Abina, F. and Ayissi Mbala, J.P. 2000 Forest carbon trading: Potentials, problems and prospects in Cameroon. Paper presented at the international workshop on 'Capturing the Value of Forest Carbon for Local Livelihoods,' Bellagio, Italy, 14-18 February 2000.

Tipper, R. In press Helping indigenous farmers participate in the international market for carbon services: the case of Scolel-Té, Chapter 13 *In:* Pagiola, S., Bishop, J. and Landell-Mills, N. (eds.) Selling forest environmental services: Market based mechanisms for conservation. Earthscan, London.

Tipper, R. and de Jong, B.H. 1998 Quantification and regulation of carbon offsets from forestry: comparison of alternative methodologies, with special reference to Chiapas, Mexico. Commonwealth Forestry Review 77: 219-27.

TNC (The Nature Conservancy) 1999a Climate Action: The Atlantic Forest, Brazil. The Nature Conservancy, Arlington, Virginia.

TNC 1999b Climate Action: Noel Kempff Mercado National Park, Bolivia. The Nature Conservancy, Arlington, Virginia.

TNC 1999c Climate Action: Rio Bravo Conservation and Management Area, Belize. The Nature Conservancy, Arlington, Virginia

Tomich, T.P. 2000 Notes on 'Project-level action', CIFOR-University of Maryland international workshop on 'Capturing the Value of Forest Carbon for Local Livelihoods,' Bellagio, Italy, 4-6 February 2000.

Tomich, T.P., de Foresta, H., Dennis, R., Murdiyarso, D., Ketterings, Q.M., Palm, C. Stolle, F., Suyanto and van Noordwijk, M. 2002 Carbon offsets for conservation and development in Indonesia? American Journal of Alternative Agriculture 17(3): 125-137.

Tomich, T.P., van Noordwijk, M., Budidarsono, S., Gillison, Kusumanto, K., Murdiyarso, D., Stolle, F. and Fagi, A.M. 2001 Agricultural intensification, deforestation and the environment: Assessing tradeoffs in Sumatra, Indonesia. *In:* Lee, D.R. and. Barrett, C.B. (eds.) Tradeoffs or synergies? Agricultural intensification, economic development and the environment, 221-44. CABI Publishing, Wallingford, UK.

Tomich, T.P., van Noordwijk, M., Budidarsono, S., Gillison, Kusumanto, K., Murdiyarso, D., Stolle, F. and Fagi, A.M. 1998 Alternatives to slash-and-burn in Indonesia. Summary report & synthesis of Phase II. ASB-Indonesia Report number 8, 1998. ICRAF, Bogor, Indonesia.

Totten, M. 1999 Getting it right: Emerging markets for storing carbon in forests. Forest Trends and World Resources Institute, Washington, D.C.

Union of Concerned Scientists 2000 Scientists call for action on forest conservation in the Kyoto Protocol's Clean Development Mechanism. Union of Concerned Scientists, Cambridge, Mass.

UNFCCC (United Nations Framework Convention on Climate Change) 1997 Http://unfccc.int/resource/convkp.html

UNFCCC (United Nations Framework Convention on Climate Change) 2001 The Marrakesh Accords & The Marrakesh Declaration. http://www.unfccc.int/

Vanclay, J., Muetzelfeldt, R., Haggith, M. and Bousquet, F. 2000 FLORES: Helping people realise sustainable futures. *In:* Krishnapillay, B., Soepadmo, E., Arshad, N.L., Wong, A., Appanah, S., Chik, S.W., Manokaran, M., Tong, H.L. and Choon, K.K. (eds.) Forests and society: The role of research. Sub-Plenary Sessions, Volume 1. Malaysian XXI IUFRO World Congress Organising Committee. IUFRO and Forest Research Institute Malaysia: Kuala Lumpur, Malaysia, pp. 723-729.

Vergara, N. 1997 Wood materials from non-forest areas. Asia-Pacific Forestry Sector Outlook Study Working Paper No. APFSOS/WP/19. Forestry Policy and Planning division, Rome and Regional Office for Asia and the Pacific. Food and Agriculture Organization, Bangkok.

Verweij, H. and Emmer, I.M. 1998 Implementing carbon sequestration projects in two contrasting areas: the Czech Republic and Uganda. Commonwealth Forestry Review 77: 203-8.

Villa-Lopera, A. 2000 Analisis preliminar de beneficios colaterales. Paper presented at the CIFOR-University of Maryland international workshop on 'Capturing the Value of Forest Carbon for Local Livelihoods,' Bellagio, Italy,14-18 February 2000.

Vosti, S.A., Witcover, J., Carpentier, C.L., Magalhaes de Oliveria, S.J. and Carvalho dos Santos, J. 2001 Intensifying small-scale agriculture in the western Brazilian Amazon: Issues, implications and implementation. *In:* Lee, D.R. and Barrett, C.B. (eds.) Tradeoffs or synergies? Agricultural intensification, economic development and the environment, 245-66. CABI Publishing, Wallingford, UK.

Watson, R.T., Noble, I.R., Bolin, B., Ravindranath, N.H., Verardo, D.J. and Doken, D.J. (eds.) 2000 Land use, land-use change, and forestry. Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK.

White, T.A. and Martin, A. 2002 Who owns the world's forests? Forest Trends, Washington, D.C.

Wilson, C., Moura-Costa, P. and Stuart M. 1999 Transfer payments for environmental services to local communities: A local-regional approach. IFAD Proposed Special Programme for Asia. International Fund for Agricultural Development, Rome. Draft.

World Bank Task Team 2001 Madhya Pradesh Forestry Project. The World Bank, Washington, D.C.

World Commission on Environment and Development 1987 Our common future. Oxford University Press, Oxford, UK.

World Development Report 2000/2001. Attacking poverty overview. The World Bank, Washington, D.C.

Wunder, S. 2000a The economics of deforestation, the example of Ecuador. Anthony's Series, Macmillan Press, Houndmills, UK.

Wunder, S. 2000b Ecotourism and economic incentives – an empirical approach. Ecological Economics 32: 465-79.

Annex.

Participants in the Workshop on 'Capturing the Value of Forest Carbon for Sustainable Local Livelihoods', Bellagio International Conference Center, Como, Italy, February 2000

Mary Helena Allegretti
Ministry of the Environment, Secretary for Coordination of the Amazon, Brazil

William Alpizar
Costa Rican Office of Joint Implementation (OCIC), San Jose, Costa Rica

Vanda Altarelli
Rural Sociologist, TCII, Food and Agriculture Organization, Rome, Italy

Nigel Asquith
Conservation International, Washington, D.C.

Joseph Patrick Ayissi Mbala
University of Dschang, Faculty of Agronomy and Agricultural Sciences, Dschang, West Province, Cameroon

Vinod Bahuguna
Deputy Inspector General of Forests, Ministry of Environment and Forests, New Delhi, India

Lorenzo Ciccarese
ANPA, Italian Environment Protection Agency, Dept. Natural and Protected Areas, Rome, Italy

Igino Emmer
Monitoring and Research, Face Foundation, Arnhem, The Netherlands

Claus-Michael Falkenberg
GTZ, Hamburg, Germany

James Gockowski
IITA Humid Forest Ecoregional Center, Yaoundé, Cameroon

Ken MacDicken [Co-organiser]
Director of Research, Center for International Forestry Research, Bogor, Indonesia

Adolfo Moreno
Executive Director, Fundacion Amigos de la Naturaliza (FAN), Santa Cruz de la Sierra, Bolivia

Daniel Murdiyarso
Programme Head, BIOTROP-GCTE, Global Change Impacts Centre for Southeast Asia, Bogor, Indonesia

Tia Nelson
Deputy Director, Climate Change Program, The Nature Conservancy, Arlington, Virginia USA

Mark Poffenberger
Asian Forest Network, Santa Barbara, California, USA

Jeffrey A. Sayer [Co-organiser]
WWF, Switzerland
(Former Director-General, Center for International Forestry Research, Bogor, Indonesia)

Sara J. Scherr [Co- organiser]
Senior Policy Analyst, Forest Trends, Washington, D.C. and Adjunct Professor, Agricultural and Resource Economics Department, University of Maryland, College Park, Maryland, USA

Joyotee Smith [Co-organiser]
Economist, Center for International Forestry Research, Bogor, Indonesia

Aca Sugandhy
Assistant Minister for Environment, Division of Policy Formulation for Environmental Management, Jakarta, Indonesia

Francois Tchala Abina
Permanent Secretary of the Environment, Ministry of the Environment and Forests, Yaoundé, Cameroon

Thomas Tomich
Coordinator, Alternatives to Slash and Burn Program, International Centre for Research in Agroforestry, Nairobi, Kenya

Eveline Trines
Programme Officer, Science and Technology Programme, United Nations Climate Change Secretariat, Bonn, Germany

Jose Antonio Villa-Lopera
Private Consultant, Santa Fe de Bogotá, D.C., Colombia

Katherine Warner
Director, Natural Resources, Winrock International, Rosslyn, Virginia, USA (formerly Senior Community Forestry Officer, Community Forestry, FAO, Rome, Italy)

CIFOR Occasional Paper Series

1. Forestry Research within the Consultative Group on International Agricultural Research
Jeffrey A. Sayer

2. Social and Economical Aspects of Miombo Woodland Management in Southern Africa: Options and Opportunities for Research
Peter A. Dewees

3. Environment, development and poverty: A Report of the International Workshop on India's Forest Management and Ecological Revival
Uma Lele, Kinsuk Mitra and O.N. Kaul

4. Science and International Nature Conservation
Jeffrey A.Sayer

5. Report on the Workshop on Barriers to the Application of Forestry Research Results
C.T.S. Nair, Thomas Enters and B. Payne

6. Production and Standards for Chemical Non-Wood Forest Products in China
Shen Zhaobang

7. • Cattle, Broadleaf Forests and the Agricultural Modernization Law of Honduras: The Case of Olancho
• (Spanish edition) Ganadería, bosques latifoliaods y Ley de Modernizatción en Honduras: El caso de Olancho
William D.Sunderlin and Juan A.Rodriguez

8. High quality printing stock - has research made a difference?
Francis S.P. Ng

9. • Rates Causes of Deforestation in Indonesia: Towards a Resolution of the Ambiguities
• (Indonesian edition) Laju dan Penyebab Deforestasi di Indonesia: Penelaahan Kerancuan dan Penyelesaiannya
William D. Sunderlin and Ida Aju Pradnja Resosudarmo

10. Report on Discussion Forum on Irformation Services in the Asia-Pacific and AGRIS/CARIS in the 21st Century and Asia-Pacific Regional Consultation
Michael O. Ibach and Yvonne Byron

11. Capacity for Forestry Research in the Southern African Development Community
Godwin S. Kowero and Michael J. Spilsbury

12. Technologies for sustainable forest management: Challenges for the 21st century
Jeffrey A. Sayer, Jerome K. Vanclay and R. Neil Byron

13. Bosques secundarios como recurso para el desarrollo rural y la conservación ambiental en los trópicos de América Latina
Joyotee Smith, César Sabogal, Wil de Jong and David Kaimowitz

14. Cameroon's Logging Industry: Structure, Economic Importance and Effects of Devaluation
Richard Eba'a Atyi

15. • Reduced-Impact Logging Guidelines for Lowland and Hill Dipterocarp Forests in Indonesia
• (Indonesian edition) Pedoman Pembalakan Berdampak Rendah untuk Hutan Dipterocarpa Lahan Rendah dan Bukit di Indonesia
Plinio Sist, Dennis P. Dykstra and Robert Fimbel

16. Site Management and Productivity in Tropical Forest Plantations
A. Tiarks, E.K.S. Nambiar and Christian Cossalter

17. Rational Exploitations: Economic Criteria and Indicators for Sustainable Management of Tropical Forests
Jack Ruitenbeek and Cynthia Cartier

18. Tree Planting in Indonesia: Trends, Impacts and Directions
Lesley Potter and Justin Lee

19. Le Marche des Produits Forestiers Non Ligneux de l'Afrique Centrale en France et en Belgique: Produits, Acteurs, Circuits de Distribution et Debouches Actuels
Honoré Tabuna

20. Self-Governance and Forest Resources
Elinor Ostrom

21. Promoting Forest Conservation through Ecotourism Income? A case study from the Ecuadorian Amazon region
Sven Wunder

22. Una de Gato: Fate and Future of a Peruvian Forest Resource
Wil de Jong, Mary Melnyk, Luis Alfaro Lozano, Marina Rosales and Myriam García

23. Les Approches Participatives dans la Gestion des Ecosystemes Forestiers d'Afrique Centrale: Revue des Initiatives Existantes
Jean-Claude Nguinguiri

24. Capacity for Forestry Research in Selected Countries of West and Central Africa
Michael J. Spilsbury, Godwin S. Kowero and F. Tchala-Abina

25. L'Ímpact de la Crise Economique sur les Populations, les Migration et le Couvert Forestier du Sud-Cameroun
Jacques Pokam Wadja Kemajou and William D.Sunderlin

26. • The Impact of Sectoral Development on Natural Forest Conservation and Degradation: The Case of Timber and Tree Crop Plantations in Indonesia
• (Indonesian edition) Dampak Pembangunan Sektoral terhadap Konversi dan Degradasi Hutan Alam: Kasus Pembangunan HTI dan Perkebunan di Indonesia
Hariadi Kartodihardjo and Agus Supriono

27. L'Impact de la Crise Économique sur les Systèmes Agricoles et le Changement du Couvert Forestier dans la Zone Forestière Humide du Cameroun
Henriette Bikié, Ousseynou Ndoye and William D.Sunderlin

28. • The Effect of Indonesia's Economic Crisis on Small Farmers and Natural Forest Coverin the Outer Islands
• (Indonesian Edition) Dampak Krisis Ekonomi Indonesia terhadap Petani Kecil dan Tutupan Hutan Alam di Luar Jawa
William D. Sunderlin, Ida Aju Pradnja Resosudarmo, Edy Rianto, Arild Angelsen

29. The Hesitant Boom: Indonesia's Oil Palm Sub-Sector in an Era of Economic Crisis and Political Change
Anne Casson

30. The Underlying Causes of Forest Decline
Arnoldo Contreras-Hermosilla

31. 'Wild logging': The rise and fall of logging networks and biodiversity conservation projects on Sumatra's rainforest frontier
John F. McCarthy

32. Situating Zimbabwe's Natural Resource Governance Systems in History
Alois Mandondo

33. Forestry, Poverty and Aid
J.E. Michael Arnold

34. The Invisible Wand: Adaptive Co-management as an Emergent Strategy in Complex Bio-economic systems.
Jack Ruitenbeek and Cynthia Cartier

35. Modelling Methods for Policy Analysis in Miombo Woodlands
   A. A Goal Programming Model for Planning Management of Miombo Woodlands
   I. Nhantumbo and Godwin S. Kowero
   B. A System Dynamics Model for Management of Miombo Woodlands
   Ussif Rashid Sumaila, Arild Angelsen and Godwin S. Kowero

36. How to Know More about Forests? Supply and Use of Information for Forest Policy
K. Janz and R. Persson

Center for International Forestry Research

CIFOR Occasional Paper publishes the results of research that is particularly significant to tropical forestry. The content of each paper is peer reviewed internally and externally, and published simultaneously on the web in downloadable format (www.cifor.cgiar.org/publications/papers).

Contact publications at *cifor@cgiar.org* to request a copy.

The Center for International Forestry Research (CIFOR) was established in 1993 as part of the Consultative Group on International Agricultural Research (CGIAR) in response to global concerns about the social, environmental and economic consequences of forest loss and degradation. CIFOR research produces knowledge and methods needed to improve the well-being of forest-dependent people and to help tropical countries manage their forests wisely for sustained benefits. This research is done in more than two dozen countries, in partnership with numerous partners. Since it was founded, CIFOR has also played a central role in influencing global and national forestry policies.

CIFOR is one of the 16 Future Harvest centres
of the Consultative Group on International Agricultural Research (CGIAR)