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Community forest management in Mexico: carbon mitigation and biodiversity conservation through rural development

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Abstract

Forest management is an important carbon mitigation strategy for developing countries. As demonstrated by the case of Mexico, community forest management is especially effective because it offers tangible local benefits while conserving forests and sequestering carbon. Community forestry receives minimal government support now, but the clean development mechanism (CDM) of the Kyoto Protocol could leverage additional resources to promote the approach in Mexico and elsewhere. We argue that adequately designed and implemented, community forestry management projects can avoid deforestation and restore forest cover and forest density. They comprise promising options for providing both carbon mitigation and sustainable rural development. These kinds of projects should be included in the CDM. © 2000 Elsevier Science Ltd. All rights reserved.

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1. Introduction

For developing countries like Mexico, local deforestation aggregates to global environmental change through biodiversity loss and emissions of carbon dioxide and other greenhouse gases to the atmosphere. Meanwhile, the generally poor people who inhabit forests face their own, local, environment and development problems. These often include water-borne diseases, malnutrition, inadequate healthcare, poor education, indoor air pollution, transportation difficulties, and lack of local income opportunities.

They use forests to meet these needs, sometimes under patterns of use that lead to clearing and degradation. Both deforestation and exclusionary conservation policies, therefore, imply lost opportunities to meet rural needs through wood production, non-timber forest products, tourism, water management, and compensation for environmental services. Community forest management has the potential to resolve this dilemma and capture synergies between local and global environment/development interests.

In Mexico, community forest management contrasts starkly to a generally bleak panorama of forest degradation and deforestation. Hundreds of communities with small logging and forest management businesses maintain forest cover, restore density and commercial productivity in previously mismanaged forests, and reforest abandoned agricultural areas (World Bank, 1995; Klooster, 1999; Bray and Wexler, 1996). Their experience suggests that community-based forest management has an important role to play in reversing processes of deforestation, sequestering carbon, and promoting rural development. Realizing this potential, however, requires social investment, capital, technical assistance, and training in business administration and forest management. The global benefits of carbon mitigation associated with community forest conservation could help leverage needed investments in local forest management capacity.

This article is organized as follows. In Section 1 we introduce the concept of forest management in the context of compensation strategies for environmental services, arguing that community forest management in developing countries should be included in the clean development mechanism (CDM) of the Kyoto Protocol.

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In Section 2, we present the case of community forest management in Mexico. First, we describe the forest resource, deforestation dynamics, and carbon mitigation potential of Mexican forests. Second, we outline the social context of forest protection and management in Mexico and describe the evolution, extent, and success of community forest management. Third, we assess some of the barriers to promoting it. We conclude the case study section with an analysis of current Mexican forest policies that favor plantations over natural forest management, but do contain an incipient community-support strategy. We point out how compensation for environmental services could create a correspondence between local demands for supportive forest policy and state planners' interests in foreign exchange and balance of trade issues. A mechanism to compensate for environmental services should support community-based strategies for natural forest management because this approach delivers carbon mitigation and biodiversity conservation as a byproduct of rural development.

2. Sustainable forest management: the need for inclusion in the CDM and other carbon mitigation strategies

Building on the 1992 United Nations Framework Convention on Climate Change, which encouraged emissions reductions but provided no binding commitments, the 1997 Kyoto Protocol to that convention sets greenhouse gas emissions limits for developed countries. It also established the clean development mechanism (CDM) to allow developed countries to meet a part of their commitments by supporting emissions reductions in developing countries. The protocol is not yet ratified, and remains the subject of contentious debate, especially concerning the role of land use change and forestry (LUCF) in carbon accounting, emissions reduction strategies, and the CDM. Under the current wording, the protocol limits LUCF considerations to afforestation, reforestation, and deforestation, with forest conservation and forest management projects in jeopardy of exclusion. The specific articles on the CDM, for example, do not mention carbon sinks explicitly, although forestry projects are implicitly included because they reduce emissions (Brown et al., 1998; Schlamadinger and Marland, 1998; Maclaren, 1999).

In this section we present the case that forest management is too important to be left out, at least in developing countries. Under appropriate and clear guidelines, forest management fosters sustainable development with substantial greenhouse mitigation potential. Therefore, the CDM and any other future treaty aimed at reducing greenhouse gas emissions growth rates in developing countries, should specifically include forest management, especially community forest management.

2.1. The importance of forest management within the land use sector

LUCF activities, particularly within developing countries, are important for several reasons. First, land use change, especially deforestation, plays a significant, and many times dominant, role in many countries' emissions portfolios. Globally, it accounts for 15% of current annual emissions while historic land use change contributed an estimated 30% of the anthropogenic carbon presently in the atmosphere. LUCF, therefore, has a role to play in directly reducing emissions (Brown et al., 1996; Brown, 1998). Second, LUCF holds potential for sequestering atmospheric carbon, thus decreasing net emissions. Third, forestry sector strategies have the potential to provide two important cobenefits: biodiversity conservation and sustainable rural development (Fearnside, 1997; Brown, 1998).

A fourth issue addresses international and intertemporal justice. Climate change treaties and strategies like the CDM are predicated on the need to take action now to save future generations from harm. However, effective — and just — policies to achieve this goal should also consider the current environment and development needs of the rural poor in developing countries (Beckerman, 1992). For environmental service payments to leverage forest conservation, they need to reach the people who live in and near forests, compensating them for being forest guardians (Fearnside, 1997).

Natural forest management meets these goals better than some other LUCF activities. The greatest potential for carbon mitigation, for example, comes from avoiding deforestation through natural forest protection and management, not plantations (Watson et al., 2000). Slowing deforestation and promoting forest regeneration could sequester 12–15% of expected emissions by 2050 (Brown et al., 1996). These activities also provide more biodiversity and rural development cobenefits than plantations (Frumhoff et al., 1998) and under appropriate social arrangements address intertemporal justice issues as well. So far, however, parks and plantations have received the most attention in debates on climate mitigation strategy.

Industrial tree plantations are likely to be the most attractive project for CDM investors. Plantations are already so profitable in some areas that they displace natural forests, while sustainable natural forest conservation and management rarely generates a profit. Plantation projects are expected to have lower transaction costs as well; monitoring is thought to be less complex and there are fewer and more clearly defined actors involved (Frumhoff et al., 1998). Plantations also have strong appeal to some conservationists who believe that industrial wood demand drives deforestation, that any kind of logging is incompatible with biodiversity conservation,

and that an increased reliance on plantations would reduce pressures on natural forests (Botkin and Talbot, 1992; Sedjo and Botkin, 1997). On the other hand, plantations have been strongly criticized for negative rural development and biodiversity effects (Carrere and Lohmann, 1996).

Protected areas are an indispensable component of conservation strategies, but they have often failed to meet local needs. Their social sustainability remains an open question in many situations, and they have the potential to violently abrogate local rights and interests (Brandon and Wells, 1992; Neumann and Machlis, 1989; Peluso, 1993). Compensation for environmental services can increase the viability of protected areas, but there are limits to the area available for conservation set asides due to national and local reticence to compromise economic activities in large areas of territory (Cullet and Kameri-Mbote, 1998). Furthermore, LUCF funding from the CDM will likely be moderate (Frumhoff et al., 1998; Smith et al., 1999), which implies that massive buy-outs for conservation set-asides are probably not possible. In addition to protected areas, therefore, forest management must remain a central component of strategies to create synergies between carbon mitigation, biodiversity conservation, and rural development.

Compared to protected areas, the biodiversity conservation implications of forest management are a subject of debate, especially when management includes logging under current social and economic conditions (Botkin and Talbot, 1992; Hardner and Rice, 1999; Frumhoff and Losos, 1998). Timber production does alter forest ecology, but low-impact methods preserve much of the original biodiversity, carbon storage values, and other forest functions. Even though little forest is properly managed now, the principal problems are poor application of existing techniques and the failure to protect timber production forests from encroachment by agriculture and illegal logging (Sayer and Wegge, 1992; Palmer and Synnott, 1992; Poore et al., 1989). Under social conditions which allow for proper implementation, therefore, production forestry is an important buffer and complement to a protected area strategy (Freezailah, 1995; Blockhus, 1992).

Under adequate social arrangements, forest management slows and reverses deforestation, mitigating carbon emissions. It provides an economic alternative to converting forests to pastures and field crops. In most parts of the world, forests are inhabited and intensively used for timber, fire wood, and agriculture, often clandestinely and without coordination. Under these conditions, the choice is not between preservation and use, but rather between sustainable use, or degradation and destruction. Management, often including low-impact logging, is a *necessary* compromise for conservation: a timber production forest is better than no forest at all (Johnson and Cabarle, 1993). Expanding concepts of management beyond logging to include non-timber forest products and environmental services like carbon sequestration only strengthens this pragmatic argument in favor of forest management for conservation.

2.2. Community-based forest management

The conservation benefits of forest management require adequate social arrangements, which community-based forestry provide. This kind of approach, nearly always in common property forests and often including timber harvest, is increasingly common (Poffenberger and McGean, 1996; Messerschmidt, 1993; Utting, 1994). Previous theories presume that users of common property resources are incapable of organizing to avoid over harvesting (Hardin, 1968; Gordon, 1954). Currently, however, researchers increasingly argue that common property can also be a viable resource management system. They note that groups of people are demonstrably capable of crafting rules and following harvesting patterns that encourage sustainability in forest use under a range of conditions, especially when user groups and forest territories are stable and clearly defined. While social and economic change can destabilize these resource-management systems, a supportive policy environment, new technologies, better information, and increasing scarcity can also create invigorating new possibilities for collective action leading to viable common property management. Furthermore, many groups with long histories of forest use and forest culture have a wealth of cultural institutions upon which to draw in adapting to change (Ostrom, 1999; McKean, 1995; Ostrom et al., 1999; Berkes et al., 1998, 1989).

These common property systems offer an intriguing social context in which to seek forest-conserving management systems with global implications for carbon mitigation, biodiversity conservation, and rural development. Community forest management provides a setting that potentially overcomes many of the social obstacles facing conventional concession forest management. In a common property situation, forest management for timber production provides the means and incentives for communities to develop and strengthen local enforcement capabilities (Klooster 2000a, b; see Frumhoff and Losos, 1998). It provides security of operation and operational control, so that forests are not converted to other uses following logging, and so that low-impact logging techniques are correctly applied. Communities' local and territorial knowledge is also an important resource for site-specific information needed for adaptive management. This includes inventories, long-term studies on local forest dynamics based on sample plots, regeneration surveys, and the monitoring of critical conditions for pollinators and seed dispersers (Palmer and Synnott, 1992; Poore et al., 1989; Blockhus, 1992).

Table 1
Forest cover and deforestation in Mexico[a]

Land area	Area (Mha)	Range of deforestion estimates (ha/yr)	Rate (%/year)
Temperate closed-canopy forest	25.5	127,000 to 167,000	0.5 to 0.8
Tropical closed-canopy forest	25.6	189,000 to 501,000	0.8 to 2.0
Total closed-canopy forest	51.1	370,000 to 722,000	0.7 to 1.5
Open forests	66.1	54,000	0.08
Degraded forests	21.6		
Agriculture and pasture	51.7		
Other	6.1		
Total land area	196.4		

[a]Source: Masera et al. (1997).

The participation[1] of the people who inhabit forest regions helps generate effective enforcement structures and facilitates the evolution of adaptive management. Forest dwelling communities often have strong ties to the forest and highly value its future productivity. In the language of economics, they have a low discount rate (Johnson and Cabarle, 1993). Lack of these characteristics undermines current concession forestry methods (Hardner and Rice, 1999; Frumhoff and Losos, 1998). With the active participation of resident communities, forest management becomes a strategy that provides both mechanisms and incentives for communities to conserve forests, while meeting local development needs. Therefore, community forest management represents a useful tool for arresting processes of forest degradation and deforestation in developing countries. In the mid-term, it should be included in greenhouse gas emissions treaties for developing countries. More urgently, the CDM should include this valuable strategy. The case of Mexico illustrates the possibilities of this approach, and highlights the barriers to its promotion.

3. Forests, carbon mitigation, and community management: The case of Mexico

Nearly, one fourth of Mexico's territory consists of closed canopy forests, half-tropical and half-temperate,[2] and 80% of remaining forests are village-owned common properties. Mexican forests have enormous potential to sequester atmospheric carbon, but instead, deforestation is a major source of carbon emissions.

3.1. Carbon mitigation implications of Mexican forest policy

Deforestation estimates from the early 1990s range from 370,000 to 720,000 ha/year — a 0.8–2% annual rate (Table 1). Estimates of firewood collection account for nearly five times the authorized cut, contraband logging removes a volume comparable to the authorized cut, and forest fires affect between 90,000 and 500,000 ha of forests per year. Forest degradation often precedes complete deforestation as degraded forests are transformed into pastures, croplands, and eroded areas (Masera, 1996a; World Bank, 1995; Cairns et al., 1995).

Deforestation erodes Mexico's biodiversity, which is ranked among the top four or five countries in the world, with the diversity of pines, oaks, and related species in the highland forests especially outstanding (WCMC, 1988; World Bank, 1995; Dinerstein et al., 1995). It also contributes to soil erosion and hydrological changes in critical watersheds. Some 16.6% of Mexico's territory (32.5 million ha) are severely eroded. Lost soil deposits in dams, rivers, lakes, and coastal wetlands, with repercussions for navigation, energy production, fisheries, and flood control (Carabias et al., 1994; Poder Ejecutivo Federal, 1996). Nationally, forests are the second largest source of carbon emissions after energy use, contributing 30% of Mexico's estimated carbon emissions (Table 2). Nearly 80% of forest emissions come from forest conversion to pastures and agriculture (Masera et al., 1997).

Although currently a source of greenhouse gases, forests have the potential to be a carbon sink, and could substantially contribute to carbon mitigation. Estimated net carbon sequestration in Mexico's natural forests is quite dramatic, with long-term values between 100 and 180 t C/ha, and often above 200 t C/ha (De Jong et al., 1999; Masera et al., 1997).

A comprehensive analysis of six carbon mitigation options in Mexico's forest sector examined the carbon

[1] Community forestry does not guarantee a happy resolution to the participation problem, because communities are themselves usually stratified and internal exclusion occurs. It does create arenas much more conducive to participation by women and poor groups than concession policies, however (Klooster, 2000b; Andersen, 1995).

[2] In the Mexican classification of forests, "bosques templados" — translated here as temperate forests, refer to highland forests composed of pine, oak, fir, alder, sweetgum, and other genera usually associated with more northerly latitudes. Tropical, lowland forests range from very wet to dry-season deciduous.

Table 2
Carbon emissions from Mexican closed-canopy forests (ca. 1990)[a]

Emissions	Temperate	Tropical	Total
Emissions from land use change (MtC/yr)	12.9	54.1	67
Carbon uptake in afforested and degraded land (MtC/yr)	1.6	12.8	14.4
Annual carbon balance forest sector (MtC/yr)	11.1	41.2	52.3

[a]Source: Masera et al., (1997).

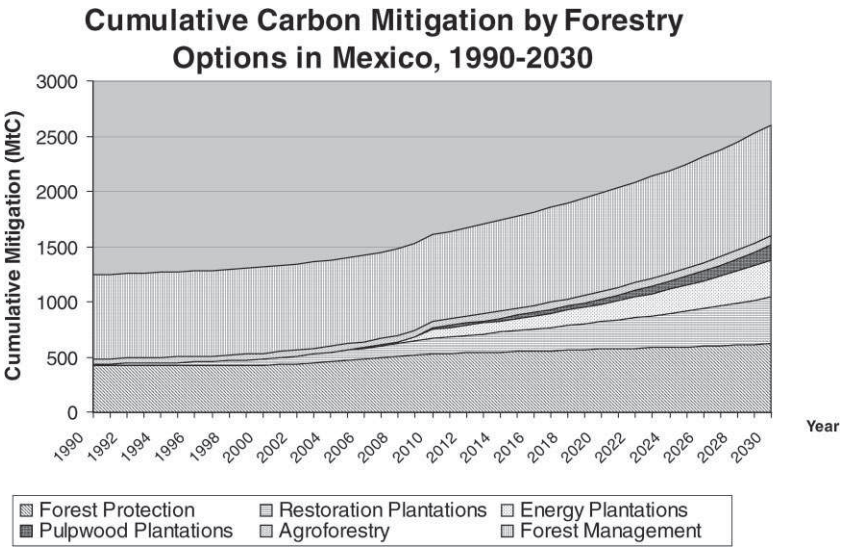

Fig. 1. Long-term carbon mitigation potential from six different forest management options. Source: (Masera et al., 1995, 1997).

mitigation potential of agroforestry systems, restoration, energy and pulpwood plantations, forest protection, and sustainable forest management. It demonstrated that forests could provide a cumulative net sequestration of between 2.3 and 3.0 Gt C by 2030. Averaged over a 40 year period, the total figures for the forest sector represent 65 Mt C/yr or approximately 81% of current emissions from energy use and industrial processes in the country. Management of natural forests has the largest mitigation potential of these options with between 1.4 and 1.6 Gt C by 2030, approximately 57% of the country's total potential in the forest sector (Fig. 1). Forest management was more than twice as effective as plantations (Masera et al., 1995, 1997).

Unfortunately, this carbon mitigation potential remains unmet. Most forests are neither protected nor managed. Protected areas comprise less than 3% of temperate forests and 7% of tropical forests, but most protected areas lack an effective enforcement structure and are inhabited by communities who use them to meet rural development needs. Formal forest management, which is almost entirely conducted on natural forests, reaches just 15% of the total closed forest area, and just a third of the area considered commercially viable. Management is concentrated in temperate closed forests, where half of the commercially viable area has a management plan. For tropical forests — which have the highest rate of deforestation — only a quarter of the area is considered commercially viable and timber management reaches only 15% of that (Table 3). Improving the quality of existing management presents additional challenges.

Table 3
Extent of commercial forest management in Mexico[a]

	Total (Mha)	Commercial (Mha)	Managed (Mha)
Temperate closed forests	25.5	12.8	6.1
Tropical closed forests	24.1	5.9	0.9

[a]Source: SARH (1992).

3.2. Community forest management in Mexico

Meeting the carbon mitigation potential of the Mexican forest sector requires management strategies that fit the social reality of forests inhabited by people who

Table 4
Distribution of forests by tenure type in Mexico[a]

Tenure type	Proportion of forests
Common properties	70% to 80%
Private properties	15% to 20%
Protected Areas	5% to 10%

[a]Source: World Bank (1995, pp. xi, 22). The range in figures is mainly due to discrepancies in definition of forest cover, survey methods, and imprecise cadastral information.

already use them to meet rural development needs. Mexican forests are home to 10 million people, many of them indigenous, and among the poorest people in the country. Most inhabitants of forested regions are residents of *ejidos* and *comunidades agrarias*, political agrarian units that hold forests and rangelands as common properties, ranging in size from 100 to 100,000 ha. The highest authority in these communities is a general assembly of community members, which can set rules for individual use of common property lands and elects a president, a presidential committee, and an oversight committee to three-year terms. Some 8400 such communities own 80% of remaining forest lands (Table 4).

Where communities have taken up logging, community forest management is a form of co-management, where government regulators and local communities share resource management responsibilities (Berkes, 1997). Communities log their forests within a framework of logging permits based on management plans and the intervention of university-trained foresters, but they implement forestry within their own common property management systems and structures of community authority. Typically, the community assembly selects members to serve 1–3 year terms as business president, business manager, logging coordinator, oversight committee, and other posts. The assembly determines what proportion of forestry revenues it will re-invest, distribute to members, and spend on collective goods, including roads and public buildings. The community usually hires an outside firm to provide the required professional forestry services, or it may have these services in-house, often as a member of a union of forest communities. NGOs (non-governmental organizations) also play important technical support roles in some cases.

This relationship between federal forest regulation and community forest owners developed over time. Until the early 1980s, federal and state governments attempted to regulate forests through three main strategies: regional logging bans, regional concessions to integrated logging and processing firms, and by sanctioning short-term rental arrangements between the communities which own forests and small logging firms. All of these strategies ignored the community ownership of forests, failed to strengthen common property forest management, and minimized the economic benefits community forest owners could realize from their forests. Exacerbated by agricultural policies, cattle promotion, land reform, and colonization projects in forested areas, these forest policies failed to encourage communities to conserve forests.

In the mid-1970s, reformers within the forestry and agrarian departments responded to persistent problems of forest degradation and rural resistance against bans, concessions, and cut-and-run rental firms by promoting a community-based approach in which communities could form and manage their own logging enterprises, and thus receive greater economic benefits from their forests. In response to lobbying by unions of peasant communities, concessions were rescinded in the early 1980s and more communities could pursue this avenue. Later changes allowed communities and unions of communities to hire and oversee the required professional forestry services, providing potential avenues for community influence over logging methods and rates (Bray and Wexler, 1996; Wexler and Bray, 1996; Klooster, 1996; Cabarle et al., 1997).

By 1992, 40% of commercial timber production and 15% of milled lumber production was from the organized community forest management sector (Bray and Wexler, 1996). Short-term logging contracts between small firms and community forest owners remain common, but the number of communities with communal logging enterprises has increased since then, as more forest-owning communities make the transition from renting their forests to running their own logging businesses.[3]

Forestry communities use employment and revenues from logging to address their local environment and development needs. They sometimes distribute forestry revenues directly to community members. In other cases, funds go to reinvestment in forestry equipment like trucks, winches, sawmills, and logging roads. Forestry revenues also defray the cost of public goods like roads, public buildings, water and sewerage which state and federal governments fail to provide. The communities also spend forestry revenues on productive diversification. Revenues from forestry also fund patrols of community territories to control timber smuggling and combat forest fires (Lemus, 1995; Sanchez, 1995; Lopez, 1997).

One of the most successful forestry communities in Mexico is Nuevo San Juan Parangaricutiro in the state of Michoacán (Table 5), where community-owned logging operations, sawmills, and a furniture factory provide rural development benefits and employment for a majority of the community's 1200 male members while careful logging and reforestation activities increase the coverage

[3] Personal communication, Sergio Madrid, Consejo Civil Mexicano para la Silvicultura Sostenible, 1998.

Table 5
Socio-economic and environmental benefits during a decade of community forest management: the case of San Juan Nuevo, Michoacán (Mexico)[a]

Indicator	1988	1997
Local employment	571 permanent plus 30 part time/seasonal jobs	950 permanent plus 600 part time/seasonal
Economic infrastructure	Saw mill, carpentry, workshop	Better equipped saw mill, chip mill, infrastructure for high-quality furniture production, plant for chemical processing of resin
Social infrastructure (services to the community)	Community stores, tortillería	Same as in 1988 plus: library public transportation (4 buses), store for fertilizers, technical advice for agriculture, recreational facility
Environmental aspects		
Area afforested (ha)	0	814
Production of seedlings (No)	140,000	3,200,000
Protected areas (ha)	155	459

[a]Source: data presented by Moreno and Salinas (1998) based on a detailed analysis of the the 1988 and 1997 community forestry management plans, field visits and on-site interviews.

and commercial quality of the community's pine-oak forests (Alvarez-Icaza, 1993; Sanchez, 1995).

The state of Oaxaca also provides inspiring examples of community forest management for commercial production. Ixtlán de Juárez, the communities in the Zapotec and Chinantec Union of forestry communities (Uzachi) and the communities in the Union of Forestry Communities and Ejidos of Oaxaca (UCEFO), own their own logging businesses and sawmills, the proceeds of which have allowed diversification into transport, agricultural promotion, and ecotourism — activities which decrease community dependence on logging. These communities invest in reforestation and regeneration in areas where past logging by a parastatal concessionaire mined pine, leaving commercially degraded, oak-dominated stands (Abardia and Solano, 1995; Lopez and Gerez, 1993; Rodriguez et al., 1993).

For the four Oaxaca communities which form Uzachi, forestry provides about 1/3 of family income. In part because of the improved nutrition this income provides, and due to forestry investments in sanitation and healthcare, medical workers report a decrease in the importance of intestinal and respiratory diseases. Uzachi implements an adaptive forest management strategy, establishing 27 permanent forest monitoring plots and 15 erosion monitoring sites. They consider the habitat needs of commercial mushrooms in their management plans, and set aside conservation, woodcutting, and watershed management zones. Increasing numbers of technically skilled community personnel work in forest management and monitoring (Chapela, 1992, 1999; Chapela and Lara, 1995; Bray, 1991).

Community control of forestry in Mexico's tropical forests also leads to stable or increasing forest cover, the designation of permanent forest areas where agricultural clearing does not occur, and greater interest in reforestation and forest regeneration than the previous concession model. The Maya of Quintana Roo are beginning to systematically tackle the difficult questions of managing diverse forests for more than just a few species of valuable timber. In an explicit recognition of the limited scientific knowledge base for tropical forest management, they too established permanent monitoring plots and periodically re-evaluate forest inventories. In contrast with the concession period, community members are now interested and involved in mahogany enrichment reforestation (Santos et al., 1998; Lanz et al., 1995; Merino, 1995; Bray et al., 1993).

In late 1999, 10 communities, managing 118,790 ha of forests, had already earned certification for their good forest management from SmartWood, a certifying organization accredited by the Forest Stewardship Council. Another seven communities, managing 51,823 ha of forests, were at the point of signing their certification contracts (Ward and Bihun, 2000). By mid-2000, thirteen communities were fully certified, five were certified conditional to specified improvements in forest management, and 19 were somewhere in the certification process.[4]

Forest management in communities like these reverses deforestation trends and enhances forest density: it transforms forests from carbon sources to carbon sinks. The total net carbon sequestration potential in a sample of five communities managing 375,500 ha reaches 64.1 million t C (Table 6). A preliminary economic analysis shows unit costs below $10/t C for most projects (Masera and Ordóñez, 1997, Sheinbaum and Masera, in press). In all cases, however, communities receive no financial compensation for the global benefits derived from the local carbon sequestration.

[4] Personal communications, Sergio Madrid, Consejo Civil Mexicano para la Silvicultura Sostenible, June 16, 1999 and June 20, 2000.

Table 6
Estimated net carbon sequestration potential of selected community-based forestry projects in Mexico[a]

Project	Area (ha)	Average long-term carbon sequestration potential (MtC)
Temperate forests		
San Juan Nuevo, Michoacan	11,000	1.8
San Pedro el Alto, Oaxaca	27,400	4.4
UZACHI, Oaxaca	23,100	4.1
Tropical forests		
Ejidos Mayas, Quintana Roo	197,700	33.8
Sociedad de Productores Forestales Ejidales de Q. Roo	117,000	20.0

[a]Source: Adapted from Masera and Sheinbaum (in press). Net carbon sequestered includes above and below ground biomass, soils, and wood products.

Table 7
A typology of forest communities in Mexico[a]

Characteristics	Number	Percentage
Competitive, entrepreneurial, with traditional social structures adapted to promote agile business functions.	10–20	< 1%
Potentially competitive, but need better infrastructure and business skills. Half are indigenous, with different social parameters for decision-making.	280–360	< 4%
Good forest resources, but history of bossism and external exploitation, insecure boundaries, and lack business skills	2000	30%
Poor forest resources, need better training and access to capital. Forestry could provide a small part of community income.	1980	20%
Poor resources, poor internal organization, lack of education, social marginalization, lack of market knowledge.	2000	30%
Potential tourism and non-timber values higher than timber.	800	10%
Traditional agro-forestry systems, including swidden/fallow.	100–150	2%

[a]Source: World Bank (1995, pp. 24–26).

3.3. Barriers to community forest management

Some of the barriers to the spread of community forest management are technical, related to inappropriate methods and past mismanagement. Where management does exist, harvest rates are low, averaging about $1\,m^3$/ha/yr. This decreases the economic viability of forest management. Several new silvicultural systems, based on a better knowledge of the biology and dynamics of temperate pine and pine/oak forests exist, but they have been implemented on only 2.6 million ha, just 43% of Mexico's managed temperate forest area. These new systems have the potential to significantly increase productivity, generate greater benefits, and thus enhance forest conservation incentives (SARH, 1992; Comite Intersectarial para el Cambio Climatico, 1999). The cost of management plans represents an additional barrier, especially for communities with relatively small forest areas.

In tropical forests, one of the main complexities for the implementation of an economically viable sustainable management system is the high diversity of tree species, most of which lack developed markets. The most common commercial species are mahogany, Honduras mahogany and chicle. Areas with low or depleted volumes of these few commercial species barely compete with alternative uses of the land, such as conversion to pasture or field crops (SARH, 1992; Merino, 1996). In both tropical and temperate forests, communities must often engage in restoration forestry to correct the effects of high grading from past concessionaire mismanagement and clandestine cutting.

The thousands of communities that own commercial quality forests also face a variety of social and economic obstacles to establishing conservative community-based forestry. These include a lack of capital and technical assistance, increased competition from cheap foreign imports, continued competition with clandestine logging within Mexico, and lack of skills in administration and forest management.

Only a minority of these communities have successfully integrated traditional social structures with the business demands and technical requirements of commercial forestry (Table 7). Many of them have been unable to consolidate their organizations or maintain the

quality of their forests, and most have major internal problems including mismanagement, corruption and lack of internal accountability; their forests often suffer from illicit cutting, clearing and deterioration (World Bank, 1995; Merino, 1996).

Despite their problems, though, many of these communities participate in reforestation efforts, fight fires, and take precautionary measures to avoid damage from grazing animals in areas of forest regeneration. They do a better job of forest management than either the previous concessionaires, or many of the communities where no formal forest management exists but where cutting and clearing continue anyway. Even unsuccessful community forest management, therefore, is an improvement on the regional logging bans in places that entrenched clandestine logging economies[5] which federal authorities are now unable to control (Klooster, 1999; Wexler, 1996).

These less-successful communities will benefit from efforts to extend improved forest management techniques, but they also require technical and financial assistance of various kinds. In the successful communities, community-based management followed historic processes of social learning as concessionaire clients, local and regional struggles to re-appropriate forests, the evolution of communal institutions under progressively greater responsibility for forest management, the growth of a corps of community members with technical and administrative skills, a successively greater collective capability to technically manage common property forest resources, and a growing internal consensus to control clandestine cutting and clearing through common property management systems. Community members with professional training and experience outside the community were often instrumental in the processes of consolidating community-based forestry.

More than an historical process of social learning was involved, however. The experience of successful communities suggest that there are extendable techniques that can foster participation, including appropriate accounting methods, administration skills, and forest management expertise. Many of these were the result of explicit NGO and government extension services, starting in the mid-1970s in some cases (Merino, 1996; Klooster, 1999). The variety of experiences in Mexico also suggests the possibility of a community-to-community transfer process, in which advanced communities share their knowledge and learning with less-experienced communities via study tours and workshops.

Many communities capitalized when timber and lumber prices were higher, before the current free trade period flooded Mexican markets with cheap lumber from the United States, Canada and elsewhere. Under the current, highly competitive market, incentive and subsidy programs for improving management plans, acquiring logging equipment, improving sawmils, and maintaining logging roads are also needed.

Capturing the potential benefits of a highly competitive market for carbon credits involves additional challenges, including technical and business management training for the preparation, implementation and monitoring of carbon sequestration projects. Some of these issues have been successfully resolved in other regions of Mexico, through participatory collaborative schemes between research institutions, local NGOs and community organizations (Climafor, 1999; Chapela, 1999).

3.4. Current directions of Mexican forest policy

Without the availability of incentives from the CDM or a similar instrument, Mexican forest policy is unlikely to embrace this integrated extension strategy for community forest management. Funding is one barrier. The federal budget fails to reflect the importance of Mexican forests for local development and the global environment. In 1998, forestry activities in the federal environmental agency received just 641.872 million pesos,[6] less than 1% of the federal budget[7] (Garnica and Flores, 1998). Mexico's 1998 budget for 116 protected areas, many of them forested, was only 48.1 million pesos.[8] Meanwhile, despite a scaling back from past policies of direct subsidies to forest clearing, credit policies, agricultural subsidies, and land titling programs continue to favor forest conversion (Poder Ejecutivo Federal, 1996).

Not only is forestry still a minor priority in national development strategy generally, but even within the sector, natural forest management and protection receives less attention than industrial plantation promotion. Forest development policy in Mexico during the 1990s retreated from support for community forest management and moved towards an effort to develop an internationally competitive industrial plantation sector (Bray and Wexler, 1996; Wexler and Bray, 1996). New fiscal policies coupled with recent reforms to agrarian and forestry laws are designed to open up the forestry sector to transnational investment in plantations. Investors can compete in auctions for these subsidies of up to 65%, but the communities which own land appropriate for small-scale

[5] The states of Puebla, Michoacan, and Chiapas are especially notable in this regard.

[6] The average inter-bank rate for 1998 was 9.14 Mexican Pesos per US Dollar.

[7] Neither does the national economy reflect forestry's importance. Forest harvesting and the wood products industry comprise less than 1% of the gross national product (INEGI and SEMARNAP, 1998).

[8] This figure reported in a circulated draft proposal to reorganize the forestry department prepared by the office of Senator Adolfo Aguilar Zinser. "Iniciativa de Reformas al Marco Normativo Forestal", April 1999.

Table 8
The global environmental and other benefits of Mexican forest policies

	Planned Government investment (millions of pesos)[a]	Carbon sequestration Potential (million tons of carbon)	Other benefits	Beneficiary of government funds
Plantations (PRODEPLAN)	894.0	2.2	Foreign exchange, balance of trade	Transnational plantation companies
Forest management (PRODEFOR)	448.6	245.0	Biodiversity protection, rural development	Community forest owners

[a]The 1998 inter-bank exchange rate was 9.14 Mexican Pesos per US Dollar. Figures for government investment and carbon sequestration potential are from the National Climate Action Plan (Comite Intersectarial para el Cambio Climatico, 1999). The PRODEPLAN projection is 1997–2000 and the PRODEFOR projection is 1995–2000. In practice, actual expenditures have fallen well below projections. Sources for benefits include (Pare and Madrid, 1996; de Ita, 1996; Tellez, 1994).

plantations are greatly disadvantaged by the terms of the auction; the policy disproportionately benefits transnational forestry companies. In contrast, a network of forestry communities proposed a program of subsidies for natural forest management to increase their competitiveness with US and Canadian producers, but this plan was rejected (Tellez, 1994; de Ita, 1996; Pare and Madrid, 1996; Red Mocaf, 1996).

In terms of global environmental change implications, however, favoring plantations over forestry is not the efficient choice. While they do have an important role in Mexican carbon mitigation strategies (Masera, 1996b, Masera et al., in press), large scale plantations deliver negligible biodiversity and rural development benefits while mitigating much less carbon than forestry projects. They do promise improvements in the balance of trade and in foreign exchange earnings, however. Goals of 875,000 ha of plantations in 25 years correspond to the area needed to generate foreign currency revenues equivalent to current petroleum revenues, for example. Policy motivations are not so much environmental, as they are macroeconomic (Table 8).

The pro-plantation emphasis of Mexican forest policy generated a great deal of opposition from environmental groups and community forest management organizations demanding greater participation in policy making and greater funding for the Forestry Development Program (PRODEFOR, Programa de Desarrollo Forestal). The initial 10–1 funding disparity between plantation promotion and natural forest management has decreased somewhat[9] (de Ita, 1996; Garnica and Flores, 1998; Pare and Madrid, 1996).

In 1998, more than half of PRODEFOR expenditures subsidized the costs of management plans, but the program also funded training workshops, especially for communities not currently involved in timber production or who sell stumpage rights to outside contractors because they lack equipment and training to form community logging businesses.[10] A World Bank-financed pilot program in Oaxaca also provides support for forest management plans while developing an innovative approach to building communities' managerial capacity for forestry. Capacity-building activities include direct training in administration and forest management, support for participatory rural appraisals, and community-to-community training programs to catalyze the social learning process (SEMARNAP and PROCYMAF, 1998; Allieri et al., 2000). A community forest management policy might evolve from current programs, but this will require both greater funding and a sharper emphasis on making productive capital more available, improving community organization, strengthening administrative skills, and enhancing local forestry knowledge.

There are two main implications of this discussion of Mexican forest policy directions. First, the CDM should *not* cover plantations in the absence of natural forest management activities. Incentives already exist for plantation projects, and there is already a strong constituency for such projects. Additional subsidies could create perverse incentives to convert natural forests or cause the displacement of plantation-zone inhabitants into forested areas. Second, the CDM *should* cover community forest management, because this would enable Mexico to convert carbon offsets into foreign exchange earnings and improved balance of trade ratios. Such a CDM would make policies and projects that generate biodiversity and rural development cobenefits more palatable to donors, investors, and national governments. It could

[9] In 1997, the federal budget allocated 250 million pesos for plantation promotion (PRODEPLAN, Programa de Desarrollo de Plantaciones) and only 23 million pesos for natural forest management. In 1998, these programs were budgeted at 180 million pesos and 100 million pesos, respectively. Actual allocation and spending on programs in the forestry sector tend to be less than budget.

[10] The community forest management sector calls for more funding, a greater emphasis on enhancing community managerial capacity and technical forestry skills, and a lesser role for professional foresters in the program.

encourage synergy between macroeconomic development goals and a forest policy that includes extension, lending, and other activities to remove barriers to the spread of community forest management.[11]

4. Conclusions

Developing countries' forests can not solve the climate change problem alone. Strong actions in the energy sector are necessary to eventually reduce greenhouse gas emissions enough to stabilize atmospheric concentrations at safe levels. In the meantime, however, forestry mitigation options can play an important role in bridging the gap to a non-fossil fuel energy economy. To achieve this objective, international financing mechanisms like the CDM should target a broad range of forestry options, especially ones like community forestry that deliver substantial biodiversity and rural development cobenefits. If forest management is excluded, financing mechanisms could provide perverse incentives for expanding options such as industrial tree plantations at the expense of native forests, eroding carbon mitigation, biodiversity, and rural development benefits.

The case of Mexico illustrates the argument. Deforestation is a major contributor to greenhouse gas emissions even in this oil rich, moderately industrialized country. Forest management has the greatest potential for carbon mitigation in the land use sector and it also delivers rural development and biodiversity cobenefits. In the social context of developing nations like Mexico, natural forest management for timber and other products represents a necessary compromise for forest conservation. Forestry jobs and revenues provide incentives for forest-dwelling communities to conserve local forests, and at the same time, communities are often best positioned to effectively implement forestry.

Community-based forestry has made impressive gains in Mexico, and offers hopeful examples of forest conservation and restoration that contrast with general patterns of deforestation. The Mexican experience points to the value of combining technical forest management with the common property management systems of forest-dwelling people in order to achieve biodiversity conservation, carbon sequestration, and rural development gains. Obstacles to the model include a lack of capital and technical assistance, a dearth of administrative and forest management skills among forest communities, competition from free trade and clandestine logging, and forests degraded by past mismanagement.

There remain unmet opportunities for consolidating the model among the thousands of communities now struggling with these obstacles. There are also immediate opportunities to extend it to the 6.7 million ha of commercial temperate and 5 million ha of commercial tropical forests currently abandoned to processes of clandestine cutting and conversion. Additional challenges come from the possibility of extending some form of technical management to the millions of hectares of forests and woodlands with little commercial potential, but that remain crucial sources of firewood, building materials, and craft inputs to the communities which own them. Since communities own much of Mexico's 88 million ha of degraded forests and open woodlands, strategies to encourage carbon-friendly economic uses should also encompass community-based management strategies. Management options might include plantations and agroforestry systems promoted as community projects, in contrast to commercial operations resting uneasily atop common property territories (Masera, 1996b; Montoya et al., 1995; Jardel, 1996).

The Mexican experience suggests that community-based forestry can thrive amidst parallel strategies of social investment, technical assistance, capital availability, and compensation for foregone harvests and investments in forest productivity. Several of the main benefits from community-based forestry, however, notably biodiversity conservation and carbon mitigation, accrue not to local communities or the nation, but to the global community. A CDM that converts carbon savings to foreign exchange and balance of trade improvements could help Mexico pursue a community forest management policy that provides needed social investment, improves community forest management capabilities, spreads best-practice forestry, and defrays the costs of restoration forestry. This would provide communities with the incentives and the means to manage forests conservatively, instead of cutting them clandestinely or converting them to agriculture or pasture.

Expectations of high transaction costs and low profitability typically discourage government and investor interest in carbon-mitigation projects through natural forest management. The experience of Mexico indicates that these barriers can be overcome; the vast potential of carbon mitigation in inhabited forest regions could be met with better policies and projects. Meanwhile, plantations are already the focus of significant policy attention in Mexico; if a CDM only funded plantations, this would discard the single most important component of carbon mitigation strategy in the land use sector, and might encourage deforestation through conversion to plantations or the displacement of people and agricultural activities.

Therefore, the CDM should fund improvements to forest management, especially in a community context. This would help communities convert economically

[11] The example of Costa Rica shows that CDM can go beyond isolated projects to inspire national reforestation and conservation policies (Subak, in press; Goldberg et al., 1998).

marginal forests into important components of rural livelihoods, which they vigorously defend and conserve. This argument resonates with the idea that CDM investments should fund access to information, training, technologies, markets, and otherwise overcome barriers to economically viable forestry activities that meet local needs (Smith et al., 1999).

In Mexico, 80% of forests are the common properties of thousands of communities. Elsewhere in Latin America, 80% of forests are national properties, but this de jure national ownership often rests atop de facto common property management by indigenous, acculturated, and colonist groups (Richards, 1997). Deforestation processes are complex, but a consensus is forming that the actors best positioned to confront them are these forest-dwelling communities. Throughout developing nations, national policies and development projects devolving forest management responsibilities to communities are increasingly common (Messerschmidt, 1993; Poffenberger and McGean, 1996; Foley et al., 1997; Utting, 1994). As a strategy to affect *global* environmental change, the CDM should seek synergies with the tangible sustainable development priorities of these *local* actors.

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