Socioeconomic Root Causes of Biodiversity Loss: The Case of Calakmul, Mexico
Summary

Introduction

The Calakmul Biosphere Reserve (CBR) and its surrounding forests remains one of the most isolated and least populated regions of Mexico. Nevertheless, important changes are taking place in the region which threaten the conservation of the tropical forest ecosystem and the biodiversity it supports. Poor ecological conditions for agriculture drive some of the degradation, but many of the changes are driven by socioeconomic forces. Rapid immigration to the area ranks among the most important, driving an expanding agricultural frontier. The lack of real economic alternatives to slash-and-burn subsistence agriculture is equally important in shaping resource use. The political and economic marginalization of the area have made it difficult to improve local socioeconomic conditions or support sound resource use. Recent extensive changes in laws and policies shaping markets and land tenure may have important effects in the region in the long term, but for the moment remain distant from local resource use patterns. The creation of the CBR, however, has brought attention to the region. Together with important local efforts to exert control over resources, international conservation interventions in the area offer some hope of slowing the loss of biodiversity.

Mexico is an important case in the study of biodiversity loss; the country ranks fourth in the world for biodiversity. Calakmul is representative of the conflicts and problems surrounding many of the protected areas in Mexico, given unsustainable resource exploitation, inappropriate policies, poverty, population growth, and marginalization of the local population. The national policy context in Mexico, notably the liberalization of a state-managed economy, parallels that of many other developing countries over the last decade. Mexico´s tradition of communal land tenure makes this case of interest in other countries that are pursuing decentralization of resource management as a means to both development and conservation. The programs aimed at promoting conservation in the region are typical of conservation programs in underdeveloped regions in Mexico and around the world; programs focus on sedentarization of agriculture and improved management of natural resources by local communities. However, conflicting pressures for development of rural areas and for protection of biodiversity have created a mesh of incompatible programs and policies that promote land clearing and forest degradation.

Site Description

The CBR is a critical area for the conservation of biodiversity. The 723,185 ha reserve is located in the southeast of the State of Campeche. The CBR forms part of a larger system of lowland tropical forests, known as El Gran Petén, which spans about 3 million ha (Map 1). It was created in 1989, and accepted as a UN Biosphere Reserve in 1993. There are two core zones which comprise 32% of the Reserve. The forest in this region is transitional between the dryer

scrub forest of Yucatán and the humid tropical forest of the Petén[1]. Precipitation can vary greatly from year to year, and flooding is not uncommon during the hurricane season. There are no permanent sources of running water in the area, and few sources of standing water during the dry season. Soils are shallow and calcareous and overlie a limestone platform. Biological inventories[2] show that the CBR is home to at least 147 vertebrate and 18 plant species endemic to the Petén ecosystem. Twenty-five species of threatened vertebrates, including the spider monkey, tapir, jaguar, ocelot, margay, and king vulture, and 17 endangered plants are found in the region. The area is of particular importance for migratory song birds; over 20% of species recorded in the CBR are migratory winter residents[3]. Many species that are becoming increasingly rare in other parts of Mexico still have large populations in Calakmul[4]. The reserve is also noted for several Mayan archeological sites within its boundaries, which are contributing to the development of a local tourism industry.

The physical design of the CBR is inappropriate for the purpose of a biosphere reserve and the requirements of biodiversity conservation[5]. The boundaries were set with insufficient ground-truthing and little biological study of the area. The angular boundaries in no way relate to the shape of ecosystems or habitats. Nor are the core areas clearly the most important for biodiversity. The southern core area in particular is problematic because it has no buffer zone on its eastern side, precisely where there are a number of settlements. The most obvious problem with the CBR is that it is virtually broken into two pieces. The narrow middle section is cut by a highway. Perhaps most importantly, the reserve boundaries, for both the core areas and the buffer zone, include lands already allocated by the government for agricultural and extractive purposes (Map 2). Given these design problems with CBR, it is essential to consider the fate of biodiversity in the surrounding areas, since the CBR may prove inadequate for conservation.

Biodiversity loss in the region is resulting from at least two proximate causes--loss of habitat and extraction of flora and fauna. Growth in the local population over the last 50 years has clearly affected the extent of forest cover and the availability of water around the CBR land. In the CBR itself, the process of forest fragmentation is observable, especially in the central corridor where the reserve is cut by a highway and along the eastern boundary, which is

[1] About half the reserve is medium tropical semi-evergreen forest; 35% is low tropical semi-evergreen forest; 5% is high tropical semi-evergreen forest; the remainder is primarily grasslands and wetlands. See INE and CONABIO 1995.

[2] INE and CONABIO 1995

[3] Berlanga and Wood 1991

[4] Galindo-Leal n.d.

[5] Galindo-Leal n.d.

paralleled by a highway[6]. In addition to outright clearing and water diversion, biodiversity loss is probably resulting from extractive activities and hunting, which may have a critical impact on some species including the wild cats, tapirs, ocellated turkey, mahogany, and cedar.

Research Methodology[7]

This paper explores factors affecting biodiversity loss in and around the CBR. It aims to understand the root socioeconomic forces and circumstances driving biodiversity loss, and the linkages among these root causes, across various scales from the local through the international. The study begins with a description of local population and resource use patterns, which are the direct or proximate causes of biodiversity loss. From there it moves outward or upward to describe the various levels of socioeconomic factors that are shaping local resource use patterns. These include regional development forces; national policies and institutions shaping settlement, tenure, agriculture, and forestry practices; national policies defining Mexico´s relationship with the international sphere; and international markets. The final section examines local-level responses to these forces, and local understanding of conservation efforts.

The conclusions of this study were reached by asking a series of questions to examine the layers of factors affecting biodiversity in the Calakmul region to create a chain of explanation[8]. The basic questions were, What are the direct causes of biodiversity loss and/or deforestation in the region? What explains the expansion of agriculture and other unsustainable resource use in the region? What are the connections with national markets? What local patterns of resource use can be traced to incentives and limitations from national policies? What connections are there between local resource use and international markets? How are local communities trying to affect their circumstances?

The existing literature on Calakmul and on Mexico, as well as a broader literature on the socioeconomic causes of environmental change, offered a ready-made selection of hypotheses that might explain patterns of resource use in Calakmul. These hypotheses were explored in turn to determine their relevance and importance in explaining biodiversity loss in Calakmul. Existing evidence pointed to some of these hypotheses as more probable than others, and further questions were asked in the field to better evaluate their applicability.

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[6] A 1986 satellite image shows about 5% of the reserve lands in agriculture or noticeably disturbed; and 29% of the surrounding area in agriculture or noticeably disturbed (Ecosur).

[7] For a detailed explanation of this methodology and a review of the relevant literature, see Stedman-Edwards (forthcoming).

[8] Blaikie and Brookfield 1987

The information in this paper is drawn from a variety of sources. These include extensive local field studies conducted on demographic change and patterns of resource use, using local surveys and interviews; and in-depth case studies of local views on the relationship between population and environment, carried out in two communities using participatative rural appraisal methodologies [9]. It also draws on several descriptive documents written by people with long-term experience working on conservation projects and on academic studies in the region[10], as well as on documents produced by the conservation programs in the region[11]. Information on the national level and international level context is drawn from documents from the Governments of Campeche and Mexico, international organizations, academic papers, and periodicals. Finally, information was collected specifically for this paper from government sources, WWF-México Program staff, and local interviews about markets, patterns of production, land tenure disputes, and investment of government funds, in order to define the relationship between local patterns of resource use and national and international factors.

Serious gaps in data on the region could only be partially filled by this study. Physical and biological data on deforestation and species loss was seriously lacking; yet deforestation was the only available proxy measure for biodiversity loss. The isolation of the region, its frontier character, and the rapid changes that are occurring there, in terms of population growth, legal status of lands, and political boundaries, make socioeconomic data scarce and unreliable. The clandestine nature of many activities in the area and the uncertain legality of others make it difficult to get honest responses from local people or government officials about local activities.

The other major methodological problem faced was in linking local activities to national and international factors. The links, for instance between national policies and local responses, are indirect. Policies pass through layers of political maneuvering and corruption, local understanding or misunderstanding, and contradictions with other policies. Then, the limited range of possible responses in Calakmul means that the response elicited at the local level may be minimal or may be unrelated to the original objectives of the policy. This limited range of possible responses may well mean that biodiversity loss is over-determined in Calakmul. Perhaps the most interesting conclusion of this study is that the effects of direct and indirect interventions by the government and of major marketplace changes on local resource use patterns are significantly limited by the isolation and poverty of options in the region.

[9] Ericson 1996, Pronatura 1997a and 1997b.

[10] Tavera, Boege, Galletti, Murphy, Galindo-Leal, March, Haenn, various dates

[11] Pronatura Península de Yucatán, Bosque Modelo, WWF-México Program, various dates

The results of this study are not offered as proof of what is happening in Calakmul, but rather as a set of hypotheses that seem to explain the dynamics of the region and for which there is some good evidence. There are, of course, many ways of understanding and describing biodiversity loss in Calakmul. This paper has sought to find a way of understanding the problem that gives a point of entry to policymakers and conservation organizations to begin to slow biodiversity loss.

The Local Context

Population and Settlements

Current patterns of settlement and resource use in and around the CBR are shaped by patterns of land tenure that were established over the last 60 years and by patterns of resource exploitation that have an even longer history. As a result of the Revolution of 1910, Mexico established a distinctive system of communal lands, known as *ejidos*. There are about 114 communities, primarily ejidos, home to about 25,000 people, in and around the CBR[12]. The lands of at least 27 ejidos and several small private properties overlap with the reserve area: Almost 52% of the CBR is also established ejido land and private property. An estimated 4,000 people live within the boundaries of the CBR, and another 6,500 hold lands within the CBR but live outside. Ejidos in the reserve retain their tenure, but have lost the right to exploit many of the land´s resources. Three types of ejidal lands are found in the region[13]. The oldest are large forest ejidal extensions, established primarily for extraction of chicle. They have been, until recently, among the least disturbed areas. In the 1960s, forest ejidos were created for timber extraction. In the 1970s and 1980s, many small, densely populated agricultural ejidos were created to accommodate a large landless population from other regions of Mexico.

Isolated by distance and the poor quality of the roads, the Calakmul region has the ambiance of a frontier. The region´s history of interaction with national and international markets has always been one in which one or two resources were extracted or "mined" from the region, without creation of local economic development and without concern for the degradation of resources essential to the local economy. The Calakmul region was one of the primary sources, worldwide, of natural chicle in the first half of this century[14]. Later, from the 1940s until the late

[12] This is the population of the newly formed Calakmul Municipality, of which the CBR forms over 40% (GOC 1997a). The most recent population census of the buffer zone and area of influence was carried out in 1995 (INEGI 1995). Population data was also collected from a number of ejidos around Calakmul by Ericson (1996).

[13] This description is based on documents from Pronatura Península de Yucatán, Boege, and Ericson, various dates.

[14] Chicle is the resin of the chico zapote tree, used for making chewing gum.

1980s, much of the Calakmul area was under the control of a large logging company, which devastated the populations of cedar (*Cedrela odorata*) and mahogany (*Swietenia macrophylla*). Chicle markets collapsed in the 1950s, following the invention of a synthetic substitute, and valuable timber in the area has been seriously depleted. Left behind is a network of logging roads that facilitates access to the forest ejidos and reserve areas.

Two features characterize the local population dynamics in the Calakmul area: rapid population growth, due to high fertility rates and migration, and rapid turnover of the population[15]. The 1970s marked the beginning of extensive spontaneous and planned in-migration to the region. Offices of the agrarian reform agency actively promoted migration to Calakmul[16]. Seventy percent of the local ejidos were only recognized officially in the 1980s. The annual population growth rate for the new Calakmul municipality is calculated at about 9.3%, implying a doubling time of about 7 years. The average age of the local population is about 19; rapid population growth can be expected to continue for a number of years[17].

The heterogenous population of the region includes migrants from 23 different states. The majority of migrants are Yucatec Maya, Chol, and Tzeltal peoples from the surrounding states of Chiapas and Yucatán or other parts of Campeche who have come in search of land or escaping conflict[18]. Yucatec Mayans, the traditional inhabitants, now constitute a small minority. Out-migration occurs frequently. Colonists come in search of land but are often driven away within a few years by the poor agricultural conditions, particularly the lack of water, the prevalence of tropical diseases, and the lack of economic opportunity. Many migrants to Calakmul have already moved several times[19]. Although the local population is comprised of indigenous and non-indigenous campesino populations, most have arrived in the last 30 years, and few of them have long-term roots in the region.

[15] Ericson 1996, Ericson 1997, Ericson et al. 1997

[16] Haenn 1996, Richardson 1995, Pronatura Península de Yucatán 1997a and 1997b

[17] Ericson 1997

[18] Pronatura Península de Yucatán 1997e

[19] Haenn 1996

Local Resource Use and Management[20]

Local resource use is significantly shaped by some local conditions. In the 1980s and 1990s, agriculture has taken on increased importance in the region as the population has grown and timber resources have declined. Cleared land has necessarily expanded. The direct or proximate cause of most deforestation and forest fragmentation in the Calakmul area is clearing for agriculture. Forest habitat degradation is resulting from extraction of wood and non-wood resources. Decline in fauna populations may be resulting from both habitat degradation and over-hunting. The creation of the CBR has, on paper, placed important limits on the use of local resources as do national laws on forestry and hunting. Given the overlap between the CBR and numerous ejidos and private lands, and the lack of clarity and lack of enforcement of resource-use restrictions, the constraints imposed by the reserve have had little effect on resource use patterns. The isolation and poverty of the region drive expanding subsistence production and exploitation of forest resources.

Poverty is ubiquitous in the Calakmul region[21]. Cash is earned from sales of agricultural and forest products, and from day labor, but subsistence agriculture provides the main source of support for most of the local population. Agriculture remains small-scale as a result of ecological and economic limitations. Serious ecological challenges to agriculture include a chronic shortage of water during much of the year, poor quality of soils, high frequency of pests, and unpredictable weather patterns. Ejidatarios make varying use of the forests[22]. The forest ejidos pursue more diversified production strategies, extracting timber, chicle (*Manilkara zapote*), xate palm (*Chamaedorea sp.*) and allspice (*Pimenta dioca*), and producing honey, among other forest products. The small ejidos concentrate on agriculture. Cultural traditions are very important in determining the range of activities pursued by ejidatarios[23]. While Yucatec Maya have a good knowledge of forest resources, recent immigrants have introduced commercial production of chile peppers and cattle and see little value in the forest.

Traditional slash-and-burn methods are used for both subsistence and commercial crops. Ejidatarios farm an average of 4.5 ha[24]. At least 10,000 ha are planted in the immediate area each

[20] The information on agricultural and extractive activities presented here is based primarily on a field study by Ericson (1996) of four local ejidos, Galleti (n.d.), Boege and Murguia (1989), Boege (1993, 1995), and interviews carried out for this study (Tavera 1997).

[21] Educational and health care services in the area are poor. Illiteracy levels are high, commonly 25% or more. Campesinos, on average, spend 60% of their income on food (Ericson 1996).

[22] Ericson 1996, Murphy 1992

[23] Boege 1995, Haenn 1996, Richardson 1995, Ericson 1997

[24] Ericson 1996. Data from PROCAMPO confirm this estimate.

year; the total area affected by agricultural production is much higher because plots are shifted every few years[25]. These practices are degrading lands as fallow periods are shortened in response to population pressures and as new migrants, with little knowledge of local conditions, expand the area under agriculture. Subsistence agriculture accounts for most of the planted land, and almost every family has a plot of staple crops. Corn and, to a lesser extent, beans, squash and other crops are planted. The primary commercial crop in the region is chile. The heavy investments required for chile production and the frequency of crop failures have prevented large-scale production from becoming wide-spread. Although many ejidatarios are interested in cattle production, the shortage of water has prevented much development of cattle ranching. Corn and other subsistence crops are sold only locally, and are often repurchased later in the season as the need arises; more often, they are used for barter purposes. Chiles and squash seeds, used for oil, are sold to itinerant buyers known as *coyotes.*

A variety of products are extracted from the forest, both for subsistence use and for sale. The extent of timber extraction[26] in the region is unclear, since possibly as much as 80% of felling is illegal. Recent efforts to place legal controls on timber extraction and implement management plans have been markedly ineffective. While some ejidos have obtained permits for legal extraction, cutting often exceeds legal rates on those ejidos. The core areas of the CBR, along with the contiguous Guatemalan Maya Biosphere Reserve, may be furnishing much of the illegal production of high-value timber. Because harvesting is very selective, and because it depends on old logging roads rather than creation of new ones, the direct impact on biodiversity may be low. However, over-harvesting of valuable timber species is reducing the standing value of the forest. Like agricultural products, timber is sold to *coyotes.* Local efforts to develop a processing industry have failed because of mismanagement, corruption, and lack of access to markets.

Calakmul remains one of the most important areas for the production of chicle, which is largely exported. The collapse of chicle markets, as well as forest clearing and extensive damage to chicle trees from over-extraction, however, have reduced local production. Even with careful practices, few tree survive more than 5 or 6 tappings[27]. The development of a new cooperative

[25] This figure is based on figures from PROCAMPO, a government agriculture program, for 44 ejidos in the area of the CBR, plus an estimate from PROCAMPO of the agricultural area not covered by its program (Tavera 1997). Other information suggests that PROCAMPO is underestimating the area outside the program. We estimate, given productive use of 3 years and fallow periods of 5 to 10 years, that the area affected by agriculture may be from 23,000 to 40,000 ha in a five year period alone.

[26] The highly value woods, namely mahogany and Spanish cedar, in the area are reputed to have been largely exhausted but their exploitation continues. Other species commonly harvested include *Lonchocarpus castilloi, Platymiscium yucatanum, Cordia dodecandra, Bursera simaruba, Pseudobombax ellipticum,* and *Metopium brownii*.

[27] Snook and Jorgenson 1994, Jorgenson 1993

system in the region seems to be boosting both production and profits for chicleros[28]. Honey is another product which appears to offer sustainable use of the forest[29]. Honey is primarily produced by Yucatec Maya in the region, who have many years experience with beekeeping[30]. Apiculture has received extensive support from the state and from environmental organizations. The local cooperative has provided important assistance to producers but still suffers from management and marketing problems. Hunting[31], for both commercial and subsistence purposes, may be having a substantial impact on local biodiversity, particularly jaguar, puma, peccary, ocellated turkey and great curassow. Many people rely on game as an important source of protein. Hunting is carried out in farm plots and, by loggers and chicleros, in the forest. Since most hunting is illegal in the region, figures on numbers of animals taken for subsistence use or by sport hunters are unreliable.

Despite the variety of activities available, subsistence agriculture remains the backbone of the local economy. Since timber and chicle, the two primary resources of the area, no longer offer serious possibilities for development of the region, the local population is left dependent on unproductive agricultural lands. Most other activities, such as chicle extraction and beekeeping, can be integrated with subsistence agriculture. While it would appear to be more financially profitable to plant commercial crops or work as day labor than to plant corn, ejidatarios routinely choose the security of subsistence production[32]. Conservation activities in the area have aimed to curb the expansion of agricultural land by improving agricultural productivity and increasing incomes from forest-based activities. It is uncertain that improved forest-based incomes would reduce the expansion of agricultural land in the absence of substantial land-use planning[33]. Extraction of forest products is not a substitute for, but rather a complement to, subsistence agriculture. Campesinos adjust their production patterns within the limited range of production

[28] Tavera 1997

[29] A study is now being conducted to determine the impact of beekeeping on other species in the forest (Galindo-Leal n.d.). This impact may prove to be substantial.

[30] Africanization of bees in recent years has diminished enthusiasm for beekeeping, but new efforts are underway to boost participation and production.

[31] Aranda n.d., March 1991a and 1991b, Weber 1997

[32] This conclusion is based on figures from Ericson 1996 and from INEGI 1995. The decision to plant corn reflects corn´s traditional role as a the staple of life in Mexico, as well as the scarcity of other, more secure, sources of income.

[33] Murphy (1990) found, in a study of a Maya region in the neighboring state of Quintana Roo, that a "successful" sustainable forestry program ignored the importance of subsistence agriculture, both economically and socially. Rather than slowing the expansion of agricultural land, improved incomes from forestry may have had the perverse impact of providing the capital needed to expand agricultural land.

possibilities, given limited natural resources and limited capital, to meet subsistence and cash needs.

Market failures in both agriculture and forestry shape resource use and economic development in the region. Yet, participation in the market economy is essential for ejidatarios in order to meet food, transport, education, and health expenses. Almost all products are sold to *coyotes*. These itinerant buyers of wood, chicle, and other local products have control over prices as long as their numbers are limited and producers are not organized. Even when prices are guaranteed by the government, the government office often refuses to buy local agricultural products. Local producers have neither the resources nor the knowledge to seek out better markets. New national policies, however, assume the efficacy of markets in fostering development.

National Context

Mexico´s neo-liberal economic reform package has included major reforms in agricultural policy, land tenure laws, and forest laws, all of which are intended to change land use and production patterns at the local level. Mexico has also been undergoing profound political changes, and democratic competition is becoming a reality. The isolation and poverty of the Calakmul region, and the small range of production possibilities, clearly limit the range of possible responses to these changes. Until the shift toward market-based policies in the 1980s and 1990s, Mexican policy sought to raise agricultural production and relieve rural poverty largely through the redistribution of land[34]. Agricultural and land tenure policies have both promoted clearing for extensive agricultural production. Development policies, focused on land distribution and increases in agricultural production, have outweighed conservation-oriented policies. Forestry laws, which offer some protection to biodiversity, have been notoriously complex, which has contributed to general evasion of the laws and the development of bureaucratic impasses in their implementation. Recent dramatic changes in agricultural policy and ejidal law may lead to changes in production patterns, but they may not provide better incentives to conservation. Some common hypotheses about their role at the local level are considered here in an effort to understand their impacts on land and forest use, and thence biodiversity, in Calakmul.

Government interventions are often contradictory, in part because a variety of government agencies have responsibilities in the Calakmul region. As a prime example, the creation of the CBR occurred at the same time that the agrarian reform agency was allotting land in the area. The federal government has intervened directly in the region, not only through the creation of the

[34] About 30% of Mexico´s population lives in rural areas, producing only 7% of GDP. 70% of Mexicans living in poverty live in rural areas, despite the distribution of about 42 million ha of ejidal lands since the Revolution (DeWalt and Rees 1994).

CBR, with all of its attendant land tenure issues, but also through sponsored colonization and development programs. Development-oriented agencies provide funds for infrastructure and other projects without consideration of the requirements of conservation. Resource use and development within the CBR should be governed by a management plan; but no management plan has yet been approved. Current development plans focus on road construction and tourism. Construction of an airstrip on the edge of the CBR, intended to boost tourism, is underway. There is also a large-scale water project underway that will service 22 ejidos[35]. Improvements in infrastructure are encouraging migrants to remain in the region[36].

Eco-Tourism Prospects in Calakmul

The growth of tourism in the region offers prospects for both economic improvement and a stimulus to conservation, if development is carefully planned. The large number of Mayan ruins in the area, in addition to the presence of the Biosphere Reserve, offer considerable attraction to tourists. Numbers of visitors to the region have increased notably in recent years, and many plans are in the offing for investment in tourist facilities. An airstrip is being constructed in Xpujil and the Ramada chain has opened a hotel nearby. Other land has been bought up in Xpujil for construction. Local highways are being improved, and a new highway from Calakmul to Tikal in Guatemala, intended to promote tourism, is being discussed.

Current plans for tourism development do not take into account the requirements of conservation in the CBR area or the need of local communities for improved economic opportunities. Construction of the tourism corridor is planned along the highway which cuts across the narrow part of the CBR. Further construction in this area will completely separate the southern and northern halves of the reserve. Nor have plans properly considered the shortage of water in the area which will be aggravated by an increased number of visitors. Equally important, plans do not foresee benefits for the local population in terms of creation of jobs or sharing of revenues. Although a number of local community members have been trained as eco-guides to the reserve, they have received no further support and their services are rarely used.

The failure to resolve social conflict and poverty issues elsewhere in the country, particularly in Chiapas, drives continued migration to the region. Very limited efforts to resolve local land tenure questions or to enforce protection of the CBR make it clear that government priorities lie elsewhere. Ejidos are demanding compensation for what they see as effective

[35] Ericson 1997

[36] Ericson et al. 1997

expropriation of their land rights, while illegal loggers and poachers are benefitting from lax enforcement of conservation laws[37]. Many local residents see the CBR as a mechanism by which the government or other outsiders, including conservation organizations, are appropriating resources that are rightfully theirs[38]. Moreover, given the local abundance of forests and wildlife, no sufficient rational has been presented to them for permanently setting land aside. The government has a softened the blow of this appropriation of resources through funding from agricultural subsidies and development funds. Indirectly, the government has avoided opposition to the CBR and environmental restrictions by poorly enforcing these laws.

Agricultural Policies

Through the 1970s, government policy in Mexico aimed for self-sufficiency in agricultural production[39]. Under the recent liberalization program, many of the supports to domestic agriculture have been reformed. The aim of current policy is to promote the competitiveness and productivity of the sector. Until recently, staple crops were supported by guaranteed prices. This system has been replaced with the PROCAMPO program, which was intended to cushion the impact of the removal of trade barriers and price subsidies. The stated purpose of the PROCAMPO program is to induce more market-based decision-making among small farmers: they are expected to move from traditional crops to more profitable forms of land use. The program provides direct subsidies to farmers, based on hectarage planted.

Ejidal agriculture has rarely provided more than the minimum needed for subsistence[40], either because of the small amount of land granted, or, as in the case of Calakmul, because of its poor quality and distance from markets. Government support to subsistence production has long served to mitigate rural poverty and to compensate in small part for the marginality of the lands disbursed to most ejidos and for the lack of capital and credit available to ejidatarios. Protection of subsistence producers, primarily corn producers, continues *de facto* under the PROCAMPO program. PROCAMPO contributes significantly to the income of ejidatarios in the Calakmul area

[37] Tavera 1997

[38] Haenn 1996, Ericson et al. 1997

[39] Under self-sufficiency policies, rates of deforestation were high, and the agricultural frontier expanded rapidly. From the late 1940s to the mid-1960s, the agricultural sector grew by more than 4% a year boosted by a variety of subsidies (World Bank 1995). Most growth was achieved through expansion of land area in agriculture rather than increases in productivity. Agricultural expansion reached Calakmul as new ejidos were allotted to accommodate migrants in search of land.

[40] Morett 1992, DeWalt and Rees 1994. In order to make a reasonable living, most ejidatarios throughout the country combine agriculture with other activities, including work outside the community, day labor, and small commercial activities.

but has not altered production patterns, given their limited access to markets and reliance on subsistence crops. The government has also provided assistance to Calakmul in the form of food, water supplies, and job creation in years when hurricanes and droughts have destroyed crops. In effect, support to subsistence producers may have maintained the rural population on the land[41] even when harvests are poor[42].

Under a larger rural development program, the Solidaridad program established under President Salinas, of which PROCAMPO is a part, the government provides cash for local development projects if the local community provides labor and some materials. Since this requires some coordination and cooperation on the part of communities, the program has increased the importance of community and grassroots organizations throughout the country. In Calakmul, it gave the impetus and the funds for the development of a local union of ejidos, known as the Consejo Regional de Xpujil (CRAX). Solidaridad has since been renamed, Alianza para el Campo, and expanded under President Zedillo. Funding in Calakmul has been primarily for road construction, water infrastructure, and reforestation. Investments under these programs have been uneven and highly politicized, answering the immediate demands of communities in hopes of garnering support for the ruling party[43].

New Laws and Ejidal Rights

The failure of the ejidal system to produce an agricultural surplus or resolve the problem of rural poverty has led, finally, to some significant reforms in the Mexican agrarian law[44]. The debt crisis and the turn toward liberalization created the context in which it became both politically possible and necessary to change some fundamental features of the system. The impact on conservation of the new ejidal laws, in combination with changes in the forest law, is being debated widely; as yet the reforms have only just begun to effect changes in land use patterns and the long-term consequences remain unclear. The land tenure system, at least prior to the recent reform, has encouraged deforestation and forest degradation[45]. The system has

[41] Levy and van Wijnbergen 1992

[42] In 1995, for example, when hurricanes affected crops, a survey of four families in the region found that 36% to 61% of their income came from government subsidies (Haenn 1996).

[43] Economist 1993

[44] About 42% of Mexican land is held by ejidos, including about 15 million ha of forests (DeWalt and Rees 1994). There are about 9,000 forest ejidos in Mexico (World Bank 1997).

[45] See, for example, World Bank 1995, Reed 1992

Land Tenure Rights and the CBR*

Protected areas in Mexico are threatened by long-established resource-use rights, which have not been altered by recent reforms. The federal decree creating the CBR, the Environmental Law, the Forestry Law, and the Agrarian Reform Law all have some bearing on land tenure in the reserve. Legally, however, the extensive property rights granted by the Constitution take precedence over the resource-use restrictions imposed by these other laws. According to the Constitution, the government cannot impose limits on property rights without a judicial hearing. Article 14 states that, "No one can be deprived of.. his property, possessions, or rights without judicial proceeding." Article 27 adds that ejidal property is protected "equally for human settlement and productive activities." Other articles support these strong property rights. As a result, ejidos and private property owners have great leeway to carry out various activities on their land. Two ejidos located in the CBR, which were threatened with expropriation, have taken the case to court and won--the government now makes no effort to control their use of land even within the core of the reserve.

The restrictions on resource use imposed by the CBR, therefore, are legally tenuous. The government does not have the legal right to confiscate property or restrict property use without due compensation. Many ejidos with land in the CBR want to have that land expropriated, given the restrictions imposed on its use. The decree which created the reserve, however, does not foresee compensation for expropriation of the land. In fact, it states that residents "will be required to conserve the area." At least four communities, which have been denied access to their land since the imposition of the CBR in 1989, are planning to go to court. They are demanding not only payment for *de facto* expropriation of their land but also compensation for the income lost over the last 8 years. They appear to have the law on their side.

Even if the environmental laws had full legal force, they allow for extensive human use of the CBR. Virtually any activity is legally permissible within the reserve, according to the decree creating the CBR, once the appropriate authorization is obtained. The law is unclear whether this includes the core as well as the buffer zones. The Environmental Law states that only those communities that were living in the reserve before its establishment have rights to its resources. However, this limitation appears to be superseded by the Agrarian Reform Law. While the decree creating the CBR expressly prohibits the creation of new ejidal lands within the reserve, several ejidos were established on reserve lands after 1989. These ejidos have the same legal rights as those established before 1989. Long-time squatters in the ejidal and national lands of the CBR have the right to demand title to the lands they have occupied, with complete rights to use of that land. Estimates of the number of squatters in the CBR vary, but the population appears to be substantial.

* Most of this information is from Tierra y Liberdad 1997.

favored allocation of cleared parcels to ejidos. Ejidos are granted usufruct rights only, so their tenure is insecure and access to credit is limited. Ejidal law has required that ejidatarios keep working their land. Moreover, the boundaries between public lands and ejidos, and between ejidos, have been ill-defined. Clearing provides a way of claiming disputed lands, as logging provides a way of claiming disputed forests. All of these factors add up to a preference for clearing and immediate appropriation of natural resources. The new agrarian law addresses the failure of the ejidal system to provide tenure security and demarcation for cleared lands but not the tenure issues on forested lands. Incentives for deforestation remain strong.

Under the new Agrarian Reform law, approved in 1992, ejidatarios now have the right to parcelize ejido lands and to sell them. Commercial operations, which were previously prohibited from owning agricultural land, now have the right to purchase ejidal lands. Ejido property will now be treated much more like private property. Some predictions suggest that the reforms will lead to little immediate change in the sector[46], given the marginality of much ejido land. Titling and registration will not solve the fundamental problems, which are lack of capital and, as in Calakmul, poor ecological conditions for agriculture. It is unlikely that the private sector will provide services, such as credit, technical assistance, and agricultural research, that have been provided, however scantily, by the government for such marginal lands.

Ejidal forest lands are treated differently under the new law than agricultural lands, with serious implications for conservation. Forest ejidos can enter into joint ventures or offer long-term concessions for the exploitation of their forests with private companies. However, lands considered forested by the law cannot be parcelized or sold. If an ejido privatizes its agricultural lands and disbands, its forest lands revert to the state. Yet forest lands are often considered by ejidatarios to be agricultural lands held in reserve. Ejidos in the Calakmul region have un-officially parcelized their land, in *parcelas* of 20 to 100 ha, much of which is forested land[47]. There is a clear moral hazard inherent in the law: Ejidatarios have every incentive to clear forest lands if they are planning on privatizing their land. The law is faulty too in that it applies a single definition of agricultural and forested land to all of Mexico. Not only does the law need to encompass vastly different ecosystems, but also vastly different systems of agriculture and forest use. In areas such as Calakmul where shifting agriculture is commonly practiced and agriculture depends on the existence of large areas of secondary forest, separating agricultural from forest lands in this way is not possible. There is an ongoing debate among various government agencies involved about how to handle this situation. In the Calakmul region, little official parcelization

[46] DeWalt and Rees 1994

[47] Ericson et al., 1997

and titling has been carried out. Ejidatarios do not see that they will gain anything by giving up their claims to forest lands[48].

Forest Policies

Over the last century, Mexican forest policies have attempted to counter the effects of land tenure and agricultural polices that have promoted deforestation. However, land rights and agricultural objectives have generally taken precedence over forestry or conservation concerns. Government control and intervention in forestry have been heavy. Overly exigent forestry laws have handicapped forest ejidos and the timber industries; the forestry sector has been plagued with inefficiency. Forest management plans are at the heart of Mexican forest policy. While the requirements for a extensive management plans and other documents may be admirable on paper, in fact they create insurmountable obstacles for local ejidos[49]. Poor ejidatarios retain the rights to the forests but rarely have the resources to manage them effectively. The difficulty and expense of complying with government regulations promote corruption and deforestation. A 1986 forestry law increased the onus on forest ejidos by adding environmental regulations to existing requirements. The Forestry Law was revised in 1992 to shift the focus of government forest agencies from direct intervention to a more normative role. Legislation for forests and wildlands remains over-ambitious, however, given the government´s limited resources. Enforcement, at least in the Calakmul region, is minimal, and those willing to participate in illegal logging are able to extract private income from a community resource.

Conservation-oriented forestry laws have also been undermined by policies in other sectors favoring not only conversion of land to agricultural use but also commercial exploitation of timber. In addition to subsidies to agriculture and livestock, import barriers in the timber sector have favored exploitation, and timber industries have been allowed easy access to resources. Direct protective measures have often failed, illegal logging is common, and many large reserves are virtually unprotected. The 1992 Agrarian Reform has not clarified ownership or responsibility for forest lands; the land titling program leaves many forests as virtually open-access resources and still encourages people to clear land to claim ownership.

Markets and Politics

The obstacles to local resource management and successful participation in markets are the result not only of legal arrangements but also of institutional arrangements that foster poor access to markets, enforcement failures, corruption, and political maneuvering. Intervention and

[48] Tierra y Liberdad 1997

[49] World Bank 1995, Boege and Murguia 1989

involvement by business and government in Calakmul has been limited by the fact that the surplus available for extraction is small; however, the influx of funds for conservation and sustainable development is attracting interest to the area. The government has routinely provided assistance when problems were particularly severe in the region. Campesinos expect that the government will step in during times of crisis and they operate accordingly[50]. Not surprisingly, current environmental regulations and conservation-oriented programs appear to campesinos as just another in a series of government efforts to control their resources[51]. On the one hand, campesinos seek to evade the government demands and restrictions that limit use of natural resources although, at the same time, they rely heavily on the government to provide land, income, and services. On the other hand, the government has granted campesinos little more than what is needed for their survival. Calakmul has served as a last resort for campesinos without access to land, and as a dumping ground for Mexico´s poor. Although government subsidies form an important part of local income, the government has not solved basic problems in the area such as the lack of water and health services. The imposition of the CBR is seen locally as a restriction on basic rights to agricultural land and forest resources. The government is seen to be giving with one hand and taking away with the other[52].

Neither the agrarian reform law nor the various changes in the forestry law address the situation in Calakmul. There is a complete disjunction between the goal of the agricultural policy changes, which is to create greater efficiency and commercial productivity, and the evident marginalization of Calakmul and subsistence needs of the population. Likewise, the conservation goals of the forestry law, which emphasizes long-term planning but is jeopardizing community management of forests, are at a disjunction with the needs of the expanding local population for an immediate cash income, which timber and forest products can provide, and for land for subsistence agricultural production.

International Context

The international pattern of Third World debt default, structural adjustment, and liberalization, has been played out in full in Mexico. Trade has been liberalized, debt renegotiated, extensive privatizations carried out, the exchange rate liberalized, foreign investment substantially increased, and import-substitution policies abandoned since the 1981 crisis. Mexico has dramatically liberalized trade with accession to the GATT and NAFTA. These changes in Mexico´s relations to international markets were forced by the crisis of the early 1980s, but open participation in international markets is now accepted as the key to Mexico´s economic

[50] Haenn 1996, Ericson et al. 1997

[51] Haenn 1996

[52] Haenn 1996

development. Like the changes in national sectoral policies, trade liberalization is intended to increase productivity and efficiency of domestic production. The effects on natural-resource based markets, particularly timber and agriculture, have the most relevance for the Calakmul region.

In agriculture, exposure to international prices and opening to new market opportunities is expected to decrease small-scale subsistence production, which is uncompetitive, and boost efficient commercial and export production. A shift from staple foods, destined for domestic use, to production of fruits and vegetables for the US and Canadian markets is predicted. Optimistic projections, from the standpoint of forest clearing, suggest that agriculture and livestock production will be concentrated in the most suitable lands. Such projections, however, make strong assumptions about the absorption of rural labor by commercial agriculture and urban economies[53]. Continuing rapid population growth in rural areas is likely to mean continuing deforestation for subsistence production. Ejidatarios on poor agricultural land are unlikely to have the option of purchasing better land in areas more suitable to agriculture. Population growth in Calakmul continues to far outpace emigration, and the ready availability of land in the area combined with a shortage of capital continues to make subsistence agriculture attractive.

In Calakmul, limited physical, economic, political, and knowledge resources shape agricultural production patterns more than international market prices. Subsistence agricultural production falls outside of the market. The isolation of the Calakmul region and its marginality to national and international markets has precluded large-scale production. Falling prices of staple goods induced by liberalization cannot be expected to affect production by ejidatarios such as those in Calakmul who remain in agriculture because land is their only asset, and who produce corn for their own food security. Changes in external agricultural markets may have little impact on deforestation or production of staple crops locally.

Nationally, timber markets may change substantially under liberalization as the price of imported timber falls. Because of high costs of transport and processing, Mexico currently cannot compete internationally in most wood products[54]. While market liberalization may eventually spark investments to increase competitiveness, in the medium term when Mexican wood is still uncompetitive, liberalization may result in more conversion of land to agriculture as the commercial value of the forest falls. Mexican tropical timbers have a comparative advantage under NAFTA, since they are produced only in Mexico. There is also a limited but growing demand for certified sustainably harvested tropical timber. However, of the tropical woods, only

[53] DeWalt and Rees 1994, Levy and van Wijnbergen 1992

[54] At the time of the NAFTA agreement, Mexican wood was 10% to 30% more expensive than US or Canadian wood (World Bank 1995).

mahogany and cedar have apparently unlimited market potential. In much of the Calakmul area these are scarce, and competition with cheap, largely contraband, mahogany from Guatemala and the CBR core reduces incentives for sustainable management of these species. Moreover, the access of ejidos to timber markets is seriously limited by the cost of transport, lack of capital, and lack of technical and business knowledge. Recent attempts to establish a local processing industry in Calakmul have been stymied by lack of expertise, limited markets, and corruption.

Regardless of the behavior of international timber markets, many localized Mexican timber markets will continue to function, given transport and commercialization costs. Moreover, much timber use lies outside the market, including extensive use of fuelwood[55]. The fear has been expressed that, by lowering the price of timber, liberalization will reduce the apparent value of forest conservation and thus provoke more clearing. However, given the current small contribution of timber to local income, and given the dependence on agriculture and preference for cattle, it seems unlikely that falling timber prices will spark more clearing than is currently occurring in Calakmul.

Local-Level Responses to Degradation and Conservation

Both local campesinos and international conservation interests recognize the problems created by the lack of local control over the socioeconomic and ecological situation. International funding to promote conservation in the Calakmul region has had important effects not only through its direct contribution to the local economy and to improvement in resource management but also, indirectly, by attracting political attention to the region. Creation of the new Calakmul municipality in 1997 should further this process. Local campesinos and conservation groups, however, have different goals and understandings of development and conservation. These divergent views spark resentment of conservationists on the part of the campesinos and reduce the effectiveness of conservation initiatives.

The development of the local union of ejidos, CRAX, in 1990 differs from the formation of earlier grassroots organizations in that it was established, with government assistance, to attract government and other funding[56]. CRAX represents more than half of the ejidos in the buffer zone. It has functioned almost as a government institution in the area, given the lack of other local representation[57]. CRAX now bills itself as a the key local organization promoting

[55] Estimates of rural use of local timber for firewood suggests that as many as 90% of rural households burn wood, accounting for 5 times the legal annual extraction of timber (World Bank 1995).

[56] The area has a 20-year history of grass-roots organizing, which began in response to perceived abuses by the timber companies; this history is responsible for some of the government interest in the area (Boege and Murguia 1989, Boege 1997, Ericson 1996).

[57] Haenn 1996

sustainable development. Many of its programs are conservation related; however, it has substantial interests in other development projects. CRAX is responsible for most federally funded conservation-oriented programs in the region--primarily agroforestry, reforestation, and apiculture. Almost all NGOs in the region work with CRAX in some way. Projects supported by CRAX include several committees which function essentially as cooperatives. There are committees for honey, chicle, and allspice producers, among others, which provide marketing services, credit, and technical assistance. They have also been stymied, however, by their lack of preparation for participation in markets and internal corruption. CRAX has recently been dysfunctional because of problems of politicization and corruption. A recent turnover in the governing committee may resolve these problems but CRAX appears to be losing its local strength. NGOs relying on the local participation offered by CRAX cannot avoid entanglement in local politics and risk overlooking many ejidos and ejidatarios not linked to CRAX.

The two largest internationally funded conservation programs working to protect the CBR are those of Bosque Modelo and Pronatura Península de Yucatán. The Bosque Modelo program, jointly funded by the Canadian government and the Mexican government, aims to foster sustainable management of forests and sustainable development of rural communities on the eastern side of the CBR[58]. The program is predicated on the idea that, by improving agricultural production and increasing incomes from diversified use of well-managed forests, land clearing will be controlled and local people will come to see the value of standing forests. Bosque Modelo works through CRAX, which designs and implements the projects. Specific projects include forest assessment and management, water conservation, wildlife management, beekeeping, and environmental education. Matching government funds have gone for reforestation, agroforestry, integrated forestry management studies, and plant nurseries. The program has been successful in promoting apiculture and sustainable agriculture, and in fostering the establishment of several wildlife reserves on ejido lands. Projects have been introduced in 40 ejidos, and management plans developed for 16 ejidos. The greatest obstacle to the forestry component of the program has been the lack of marketing capacity and markets for local wood products; very little timber has been legally harvested and marketed under the program.

Pronatura Península de Yucatán, a Mexican NGO, also predicates its work on the idea that sedentarizing agriculture and generating economic value from sustainable forestry will decrease deforestation in the area[59]. Pronatura has supported strengthening of the management of the CBR, sustainable development and environmental education programs for the local communities, ecotourism, and basic research. Pronatura´s work in Calakmul was one of the pilot Integrated Conservation and Development Programs (ICDPs) supported by TNC, WWF, WRI,

[58] Model Forest Network and SAHR 1994

[59] Pronatura Península de Yucatán 1996a

and AID funds. Sustainable development programs are promoted primarily through support to the organizational development of CRAX and to CRAX projects in organic agriculture, beekeeping, environmental education, and water conservation. In order to reduce deforestation for slash-and-burn agriculture, Pronatura has promoted low-input sustainable agriculture, using green fertilizers, reduction of agrochemical inputs, and elimination of burning. Local trainers have been trained to disseminate knowledge of new practices to the ejidos. The agricultural project has reached at least 720 campesinos and been implemented on 1,000 ha with apparent success; at least 120 ejidatarios have adopted beekeeping. However, neither of these programs can keep pace with the rapid expansion of the local population.

The sustainable development programs in the area have spread the word about conservation. How successful they have been in instilling their message is unclear. Some ejidos in the region have taken a deliberate decision to accept no more ejidatarios[60]. Others recognize that they may have reached a saturation point but have not yet made the decision to accept no more immigrants. The decision of ejidos to restrict the number of newcomers may play an important role in slowing population growth in the area. A number of women in the area have expressed interest in family planning, but access to these services remains limited and family size is large[61]. There remains an optimistic expectation that the government will provide more lands when they are needed, including lands in the CBR[62]. Ongoing illegal logging, hunting, and clearing show little commitment to conservation.

The various legal restrictions on land and resource use that have been imposed, if not enforced, within the CBR, are widely viewed as restrictions placed on campesinos' ability to make a living. Conservation programs are little different from other development programs campesinos have experienced. They appear as another set of policies to be taken advantage of or avoided. They will choose the programs that offer them the most benefits up front in exchange for the least sacrifice. Some ejidatarios, and most notably CRAX, have adopted the language of conservation, and are receiving substantial benefits in terms of cash, food aid, and training. However, their focus on getting more resources from the conservation programs has led to significant factionalism within ejidos and exclusion of many community members from the benefits of these programs. These programs have not addressed expanding resource needs or wants in the area nor addressed the problems of marginalization or the disjunction between the demands of conservation and local subsistence needs.

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[60] Haenn 1997, Pronatura 1997a and 1997b, Acopa et al. 1996

[61] Pronatura is sponsoring a new Population-Environment initiative which will include a reproductive health program and community land use planning (Freudenberger and Boege 1995, Ericson et al 1997).

[62] Pronatura 1997a and 1997b

Conclusions and Recommendations

Biodiversity loss in and around the CBR is driven by local population growth and the heavy local reliance on natural resources, particularly cleared forest land. Underlying these immediate driving factors is the failure to resolve the problems of poverty, population expansion, and social conflict in Mexico. Population growth in Calakmul cannot be attributed to the attractions of the region. But for a campesino with no other options, a plot on an ejido in Calakmul can afford at least a meager living. Frontier expansion is driven not by the profits that can be extracted in terms of timber, other forest products, or agriculture, but rather by the large population that is excluded from other economic opportunities. The continued dependence of local ejidatarios on the meager agricultural products of the area and government aid reflects their limited access to other resources in the economy. They remain at the margins of the economy in terms of financial resources, knowledge resources, and political resources.

In the Calakmul region, some forest ejidos have maintained their forests largely intact, but where population is denser, clearing has been extensive. The maintenance of forest reserves reflects a lack of resources for agricultural expansion as often as an understanding of the value of the standing forest. Various factors underlie the unsustainable use of the forest. Ejidatarios trying to produce timber products on their own face competition in the market from private companies for which they are unprepared. Government corruption, complicated controls, and unclear resource-use rights discourage long-term planning for forest use. Clearing and illegal extraction are facilitated by poor enforcement of laws and the lack of clarity about land and forest tenure in the region. Nevertheless, the need to expand agricultural production must take a greater share of the blame for deforestation than the failure of forestry, land tenure, or protected area policies. Agriculture is essential to the support system of the local population.

The array of laws, government interventions, and changes in government policies designed to shape agricultural practices, forestry, and most notably the conservation of the Calakmul Reserve, have had a limited impact on the region. Despite the ubiquitousness of commercial activities, subsistence remains the backbone of the local economy. Trade and price liberalization are unlikely to affect patterns of land use and deforestation in marginal, tropical areas such as Calakmul in the foreseeable future. In the short-term, subsistence farmers will not change their choice of crops, which is based on tradition, food security needs, and local markets. Government policies are taken advantage of when they increase local incomes, as is the case with PROCAMPO funds, and evaded when they may reduce local control over resources, as is the case with the current titling program. This is possible in part because of contradictions among various government efforts, such as the creation of a reserve on ejido lands. And it is possible in part because of the disjunction between government goals and policies and the situation in Calakmul, epitomized by a land titling program that does not account for shifting agriculture or forest lands. Perhaps the greatest gap is found between the overall direction of current Mexican policies, which

emphasize the role of the market in economic development, and the marginalization of Calakmul from the market economy.

The campesinos of Calakmul face the classic problems of a marginal economy. Although they are dependent on the cash economy, they are not able to participate in that economy on an equal footing. All of the government programs and NGO programs in the area have failed to address the problem of securing access to markets. Nevertheless, better access to markets would not compensate for the poor agricultural conditions. The exhaustion of valuable timbers and the small-scale of today´s chicle markets have left the Calakmul region without competitive products. New prospects are offered by production of honey and certified timber and, most promisingly, by tourism. If the problems experienced with timber and chicle are to be avoided, careful planning of the development of these resources is essential. Protection of biodiversity will require not only real protection of the CBR but also economic alternatives for the local population that truly wean them from forest clearing and over-harvesting of natural resources. Sustainable development programs have not accomplished these goals.

Sustainable development programs in the Calakmul region have for the most part addressed deforestation and biodiversity loss at the local level. While there is clearly further work to be done at the local level, the connections between local resource use and outside factors must not be ignored. Work in the region must recognize the broader context in which the CBR is situated. We must ask what are the appropriate and feasible roles of international organizations, the national government, the state government, and local organizations. Most importantly, these various groups need to work together in planning for land and resource use in the region that will not only promote conservation but also provide long-term economic alternatives to the local population. Serious consideration must be given to whether there are any real options for development in the region--options that would move local campesinos beyond a precarious subsistence living but that would not threaten biodiversity. The recommendations below are offered as some general directions for thought.

On a broad scale, the following issues and problems, which are common to many protected areas in Mexico, need to be recognized, understood, and addressed:

- **The variety of forces driving migration to the area**.
  Migration to the area may continue at high levels for a number of years. Problems in other regions, including social conflict, lack of land, and perhaps, under the new law, sales of ejidal lands, drive migration to the region. Calakmul is not attracting people but rather accepting people who have nowhere else to go. These problems must be addressed if population growth in the CBR or the surrounding forest areas is to be controlled.

- **Marginality and dislinkage of the local communities from the national economy and national policy decisions.**
  Current policies of market liberalization at the national level and opening to international markets will not resolve the problems of Mexico´s economically marginalized areas in the near or medium term. Political decisions and policy frameworks that do not recognize the socioeconomic reality of areas such as Calakmul may only serve to aggravate existing poverty and unsustainable resource use. Production in these areas is driven not by profitability but by the lack of alternatives. Adjustments in prices may have little effect on production levels or practices.

- **Lack of clarity in land tenure and resource use law that promotes land clearing and over-harvesting of resources.**
  Despite significant changes in the law to increase tenure security and impose controls on resource use, in protected or forested areas such as Calakmul the failure to clarify land ownership and use rights leaves broad leeway and incentives for land use incompatible with conservation. Before serious land-use planning can be carried out, the discrepancies in the agrarian law and in the laws on protected areas and in their implementation need to be resolved.

- **Absence of land-use or development planning.**
  Development in the region has been haphazard and without planning for development of sustainable economic activities and without consideration of impacts on conservation. Government investment in the region has focussed on meeting the immediate demands of settlers for land, roads, and water, without any planning for development or conservation. The results of this failure can be clearly seen in the development corridors along the eastern side and across the middle of the CBR.

In addition to these general considerations, many particular issues need to be recognized and addressed by conservation efforts:

- **This land, as agricultural land, will not provide more than subsistence living**.
  The continued use of this land for subsistence agriculture cannot be seen as a long-term option for the region. Currently, government supports allow people to remain in the area even when the land will not adequately support them. Continued expansion of agriculture in this area comes at the cost of loss of forest land that has a value for conservation and possibly for forestry higher than the agricultural value of the land.

- **Extraction of wood, non-timber products, and hunting may be having a major impact on the CBR**.
  The role of these activities in the local economy needs to be addressed more realistically, with the understanding that increasing incomes from other sources, such as honey production, sustainable agriculture, or tourism, may do little to control this out-flow of resources. Management plans will be ineffective unless illegal trading is ended and communities accept the limitations imposed by the plans. Moreover, sustainable uses, such as extraction of forest products and tourism, may not adequately support a population of the current size.

- **Ejidos need to participate in limiting population growth in the buffer and preventing settlement in the core zones.**
  Given the current overlap between many ejidos and the CBR lands, control of the population in the buffer and core zones of the CBR must rest with the ejidos. Only if ejidatarios are convinced of the necessity of controlling land clearing and resource use will they be motivated to limit in-migration and their own population expansion. Provision of readily available reproductive health services would make an important contribution.

- **Local development projects need to be carefully considered and planned to prevent prejudice to conservation.**
  Various projects underway in the area, including the large water diversion project, the paving of roads, and the development of a tourism corridor, have been undertaken without consideration of the effects on the CBR, local population growth, or resource use. Land use planning not only at the ejidal level but at a regional level is essential to prevent serious compromise of the reserve´s potential contribution to biodiversity conservation.

- **Market access for sustainably produced products must be improved if they are to provide a real option to shifting agriculture.**
  Conservation programs have promoted production of managed timber, honey, and other "sustainable" products without addressing administrative and marketing problems. If these efforts are unsuccessful, local interest in pursuing sustainable options will diminish rapidly.

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