RURAL DEVELOPMENT FORESTRY NETWORK

THE FOREST EJIDOS OF SOUTH-EAST MEXICO: A CASE STUDY OF PARTICIPATORY NATURAL FOREST MANAGEMENT

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Network Paper 13c Summer 1992

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ISSN 0968-2627 (formerly Social Forestry Network ISSN 0951-1857)

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RESUMEN

La participación de las comunidades rurales en el manejo de los bosques ha recibido gran aceptación, y es considerada como un enfoque muy prometedor. En Latinoamérica se han iniciado varios proyectos basados en la explotación sostenible de madera. Este estudio hace una evaluación preliminar de una de las experiencias aparentemente más exitosas, la del Plan Piloto Forestal en los bosques Ejidos del sudeste de Méjico. Analiza los rasgos resaltantes de esta experiencia y los compara con las políticas de desarrollo forestal más convencionales, que prevalecieron en el área antes de la implementación del Plan.

Aunque el sistema no logra alcanzar su potencial económico, está progresando hacia una sostenibilidad biológica y económica, con el desarrollo de un mercado para las especies secundarias. Otros factores claves son la estabilidad de tenencia, la creación de instituciones nuevas y flexibles, la fuerza de las organizaciones de productores, la capitalización rápida y la estrategia de mercado agresiva. El estudio de caso muestra que el manejo participativo de los bosques, si bien es difícil, no es imposible cuando se dan las instituciones y los políticas de apoyo apropiadas. Además, en comparación con los otros enfoques de conservación de los bosques, puede resultar en beneficios sociales y económicos importantes, y en una sostenibilidad más alta con respecto a las presiones migratorias.

RÉSUMÉ

Il est désormais largement reconnu qu'une approche extrêmement prometteuse de la conservation de la forêt est constituée par la participation des communautés rurales à la gestion des forêts. De nombreux projets concentrés sur l'exploitation renouvelable du bois d'oeuvre ont été lancés en Amérique Latine. Dans cette étude, une évaluation préliminaire de l'une des expériences apparemment les plus réussies est présentée. Il s'agit du Plan Forestier Pilote dans la forêt Ejidos

Rural Development Forestry Network Paper 13c (**ODI**, Regent's College, Regent's Park, London) Summer 1992.

au sud-est du Mexique. Une analyse des caractéristiques les plus frappantes de cette expérience est effectuée et des comparaisons sont faites avec la politique de développement forestier plus classique qui dominait cette région avant la mise en oeuvre du Plan.

Bien que le système ne fonctionne que bien au-dessous de son potentiel économique, il semble se diriger vers une capacité de renouvellement biologique et économique avec le développement d'un marché pour des espèces secondaires. D'autres facteurs-clés incluent la stabilité du régime foncier, la création d'institutions nouvelles et souples, la force des organisations de producteurs, une capitalisation rapide et une stratégie commerciale agressive. L'étude de cas montre que la gestion des forêts en association, bien qu'elle soit difficile, n'est absolument pas impossible quand elle bénéficie du soutien d'institutions et de politiques adéquates, et qu'elle peut avoir pour résultat de nombreux avantages sociaux et économiques, de même qu'une capacité de renouvellement élevée face aux pressions migratoires, par comparaison avec d'autres approches de la conservation de la forêt.

INTRODUCTION

The need for communal or participatory natural forest management (NFM) has become increasingly recognised in the literature as one of the more promising alternatives to the traditional forest development model based on (inadequately policed) concessions to commercial loggers. This tends to set in motion the destructive sequence whereby the landless poor move into newly logged forest areas along extraction roads and practise slash and burn agriculture for a few years, before giving way to the equally unsustainable (in the long run) establishment of cattle pasture. In much of Central America, as for example in Honduras, this is an organised process with inducements given to campesinos by cattle farmers for forest clearance (USAID, 1990).

Poore (1989), for example, states the need for `models of management for the sustainable production of timber that are innovative but capable of being widely adopted', including `where, as in Honduras and Gabon, the local community is the agent of management' (p 220). Rodriguez *et al* (1990, p 12), in a literature review of communal forest management initiatives in Latin America, think that `strengthening community level organisations for the improved management of forest resources is an interesting strategy, following decades of poor experiences with centralised State management schemes, as well as the short term, environmentally costly exploitation of forest resources by private individuals or corporations' (p 23). WWF (1991), in a review of 14 NFM projects in Latin America think that `participation by local people.....is a fundamental requirement for the success of any project' (p vii).

The participatory approach argues that unless rural people, desperate for land and food, can obtain a satisfactory livelihood from the forest resource, the agricultural frontier will inevitably advance into opened up forest. This may be from timber extraction, from non-timber products or extractive reserves or both. The long term protection of the forest resource is seen to be more feasible through direct involvement by rural or forest communities in forest management, through which they can come to the realisation that the forest is of greater value to them as a continuously productive resource (if this wasn't already the case), rather than from attempts to prevent access through legal means or forest guards. It also seems reasonable to suppose that the protection of the forests against organised or sporadic destructive encroachment is more feasible where the users are also the forest owners and live in or near the resource.

Attempts to prevent access have invariably proved unsustainable, and policing of concessionaires has been equally unsuccessful: Colchester (1990) reports that in Philippines the Minister of Natural Resources revealed that over 90% of the logging companies violated the terms of their leases. While in Thailand, where the forest authority is relatively strong, the flouting of concessions led to the 1989 logging ban. Colchester also comments cynically on the idea that raising the value of the forests is the salvation. While the main beneficiaries remain the governments and badly policed loggers it will not (alone) ensure the forests' survival: `what makes forests valuable in most governments' eyes — their status as a source of ready income and debt repayments of bribes — is precisely what will ensure their destruction' (p 97).

On the basis of this, a plethora of projects has sprung up in Latin America, particularly over the last five years (see for example the review of WWF, 1991). In their review, Rodriguez *et al.* (1990) judged that the Plan Piloto Forestal (Pilot Forest Plan) of `Quintana Roo is perhaps the most successful example of the new approach to forest management in tropical areas' (p 23). Poore (1989) cites it as a successful example of `the leasing of the land to local communities for

management under defined conditions' (p 201).

The purpose of this paper is to describe in some detail this poorly documented (in English at least) project, and draw out lessons for the design of similar projects, and for forest policy. The characteristics of this `alternative' model of forestry development are compared to the conventional forestry development policy practised in the same area prior to the commencement of the Pilot Forest Plan (PPF). This should help to indicate under what conditions the participatory NFM approach is likely to be successful, and what can be done to positively influence similar projects.

THE PROJECT SETTING AND FOREST TYPE

The ten `ejidos' which compose the Plan Piloto Forestal (PPF), which is the subject of this presentation, are located in the southern part of the state of Quintana Roo in south-east Mexico, bordering with Belize. Ejido is a term used for the productive grouping of people with land in common and untransferable ownership. Although the land cannot be sold, natural resources that stem from it can be.

Following the Mexican Revolution in 1918, President Lazaro Cardenas orchestrated the division of the extensive haciendas into ejidos, in accordance with the dictum of Emiliano Zapata: `the land belongs to the people who work it'. The rights of the `ejidatarios' pass down through the male line, but other landless campesinos (small farmers) and their families may live on the ejidos without proprietorial rights according to the discretion of the General Assembly of each ejido.

In the whole of the State there are some 420,000 hectares of forest divided between 50 ejidos. These form the Ejido Forest Reserve in the State Forest Plan, under the new State forest policy. The ten ejidos which form the PPF in southern Quintana Roo have a combined forest area of 117,000 hectares. Almost 2,000 ejidatarios and some 11,000 people altogether live and depend on these ejidos. Other groupings of ejidos are the subject of parallel PPFs, as for example a further ten ejidos with 150,000 hectares that form the Mayan Zone Association of Forest Ejidos.

Quintana Roo is part of the gently undulating (from sea level to 60 metres) limestone Peninsular of Yucatan. Its forest soils range from 6.4 to 7.5 pH, and although shallow and rocky, are reasonably fertile with adequate nutrient availability, a high clay content and good moisture retention. With an annual rainfall between 1,100 and 1,300 mm and annual temperature of 24 to 26 degrees centigrade, the region can be classified as sub-humid tropical according to the Holdridge classification system.

The forest forms part of the Peten forest type which stretches from northern Guatemala, through the western half of Belize, and into the Yucatan Peninsular. Its canopy height is only about 25 metres, and contains a dense main storey of pole sized trees of 20 to 40 cm diameter, with a discontinuous overstorey of larger trees up to 30 metres tall and diameters of at least 60 cm.

The forest is (and was more so) relatively rich in mahogany (*Swietenia macrophylla*) and to a lesser extent Spanish cedar (*Cedrela odorata*); species which have been commercially exploited particularly by British logging companies in the latter half of the nineteenth and first half of this century. It is also commercially important for the Chicozapote (*Manilkara zapota*) tree, which produces `chicle' (latex) from which chewing gum is produced and exported, largely to Japan.

Table 1 gives a volume breakdown of the most abundant species in the Nohbec Ejido forest (20,700 hectares). Total basal area of trees with diameters above 15 cm was 14.34m^2 per hectare, 41% of which was of commercial size, and almost half consisting of Chicozapote, Ramon (*Brosimum alicastrum*) and Mahogany. 84% of the basal area was composed of 21 marketable species, out of a total of 65 identified species. The Ejido is therefore fortunate in the species composition of its forest.

Amapola (*Pseudobombax ellipticum*) is sold as roundwood to the veneer industry, Pa'asak (*Simarouba glauca*), Jobo (*Spondius mombin*) and Chacah (*Burseria simaruba*) are important softer secondary species, while Chicozapote, Ramon, Sac'chaca (*Dendropanax arboreus*), Tzalam (*Lysiloma bahamensis*), Siricote (*Cordia dodecandra*), Granadillo (*Platymiscium yucatanum*) and Chechen (*Metropium brownei*) are among the more valuable harder and heavier, but attractive secondary timbers, which have small specialised international markets, eg in musical instrument making.

There is considerable variation in species distribution between the ejido forests. For example Nohbec has abundant Chicozapote, but virtually no cedar, while the latter is more common, along with Ramon, in Tres

Table 1. Volume of most abundant species in Nohbec Ejido Forest

Common name	Latin name	> 15cms. dbh	
Chicozapote	*Manilkara zapota*	36.41	21.47
Ramon	*Brosimum alicastrum*	15.77	5.42
Chacah	*Burseria simaruba*	11.24	3.91
Chechen	*Metopium brownei*	9.24	3.20
Pa'asak	*Simaruba glauca*	8.32	2.41
Amapola	*Pseudobombax ellipticum*	6.06	6.63
Tzalam	*Lysiloma bahamensis*	3.33	1.04

Source: La Sociedad de Productores Forestales Ejidales de Quintana Roo, S.C.

Garantias Ejido. Petcacab Ejido has the advantage has the advantage that colluvial `Kancab' vertisols favouring high quality mahogany form 52% of its 24,000 hectare forests.

HISTORY AND EVOLUTION OF THE EJIDO FOREST INDUSTRY

In 1954 some 540,000 hectares were given by the State in a thirty year concession to MIQRO, a Chetumal based logging company, following concessions to British loggers. A large proportion of this land belonged to the ejidatarios, who were paid a nominal `forest rights rent' by MIQRO at a small fraction of the value of their timber. Some of the ejidatarios were fortunate enough to

get employment with MIQRO. The rest were `chicleros' relying on latex extraction for their income.

Under the terms of the concession, MIQRO based its `sustainable' yield management plan on the selective felling of mahogany and Spanish cedar. However this soon ran into problems of a dwindling area. Large scale deforestation occurred in the state so that by the 1980s almost half of the original forest area had been lost. Colonisation was encouraged by a law through which campesinos could create ejido rights by land clearance, and a national policy of agricultural self-sufficiency was introduced in the 1970s, under which the banks financed forest clearance of up to 30% of the forested area.

This period was characterised by political clashes between agriculturalists and foresters, between federal and state interests, and between foresters and campesinos. However the only real dialogue was between the foresters and the concessionaries. The problems could only be perceived and analysed in terms of the traditional forest development model.

However there was another lower profile dialogue taking place and initiated by individuals who came to the realisation that the interests of the state were very close to the interests of the ejidos. The outcome of these discussions was that in 1983 the ejidos, with the backing of the State Governor, requested the non-renewal of the MIQRO concession, and instead proposed to the forestry authority, the Secretariat of Agriculture and Water Resources (SARH), that they would manage their forests themselves.

At the same time the German GTZ were working in the neighbouring state of Yucatan and were contacted with a view to enlisting their technical and financial assistance. Consequently in 1983 the initial three year Pilot Forestry Plan (PPF) was initiated. This period laid the basis for the future success of the ejido forest industry.

Using a highly participatory approach in which the ejidatarios were systematically trained in all aspects of forest planning and management, a computerised inventory system was initiated with the aim of covering 2% of the total productive forest area. Incomes were doubled on the basis of the extraction of ten as opposed to two species. Fifty-five units of forestry equipment were obtained, partly on credit, and the Society or Association of Ejido Forest Producers of Quintana Roo was established in 1986 on the basis of discussions between the PPF, the forest authority (by now convinced the alternative approach could work), the State and the ejidos.

INSTITUTIONAL FRAMEWORK AND PROVISION OF SUPPORT SERVICES

The Society of Ejido Forest Producers of Quintana Roo (SPFE) is an autonomous non-profit organisation, mainly financed by the ejidos out of forest profits, with a concession from SARH to give technical assistance to the ejidos. This is the specific responsibility of the Society's Direction (Unit) of Technical Forestry (DTF), composed of seven foresters, mainly of an intermediate technical level, and an adviser in marketing and organisation. In 1991 three of the DTF's foresters were supported by SARH, but the others were paid for by the ejidos out of profits. They also received a bonus commission payment from the ejido(s) to which they were assigned.

The four larger ejidos had one technician each, while the smaller six shared two between them.

These technicians had hardly changed since 1986, allowing a long term relationship to be developed. This would not have been possible had they been working for SARH, with its staff changes at least every political sexennial. The foresters know they are only there at the behest of the ejidos: it is the General Assembly of each ejido rather than the DTF which decides which particular forester should provide them with technical assistance.

It is important to note that little technical assistance is now required for day to day management. Training has released the technicians for more specialised tasks, like silvicultural research, as well as control of forest operations and trouble shooting problems as they arise. The intensity of technical assistance is approximately one forester per 20,000 hectares, in comparison to the situation before 1983 of one per 100,000 hectares. SARH have now eliminated their technical assistance programme due to corruption, and only undertake a policing and recording role.

This highlights a crucial aspect of the PPF model: the creation of appropriate new institutional structures and, as a hidden agenda, the deliberate marginalisation of the inadequate existing ones. Each grouping of ejidos will create its own Ejido Association and DTF.

The SPFE is also responsible for developing the ejidos' forest policy, and their marketing strategy. In these tasks the DTF is supported by the Ejido Council composed of 20 elected representatives: two per ejido. The DTF also recommend sale prices to roundwood and sawnwood buyers on the basis of costs submitted by each ejido, and have a sawnwood sale point in Chetumal, although it appears that most of the sawnwood is sold at the ejido sawmills, little economic advantage being gained from transportation in this case. It is important to emphasise that the SPFE does not actually make decisions or handle merchandise or money. The responsibility and authority for forest management and marketing lies with the General Assembly of each ejido.

GTZ continued to provide some technical assistance, mainly through one full-time forester in 1991, but clearly the project was no longer dependent on GTZ support, either financially or technically. This situation contrasts sharply with similar participatory NFM projects in Peru (Palcazu Valley Project currently supported by WWF) and Honduras (pitsawing cooperatives of the north coast supported by CIDA of Canada), where high levels of both kinds of these dependency are observable.

MARKETING AND INDUSTRIALISATION STRATEGY

The SPFE saw the marketing problem as their first priority in attempting to establish a new forest industry. The traditional view, as held for example by SARH, was that the ejidos should ensure supply continuity of existing industrial roundwood needs. However SPFE took a more radical view: since the ten ejidos could source 40% of the State demand for mahogany, they could become price makers as opposed to price takers, and alter the industrial structure according to their needs.

The adoption of an active market strategy has resulted in state forest policy changes with major impacts. Prior to the development of the PPF, state policy was to provide cheap locally supplied timber to industry through subsidies. This resulted in a protected and inefficient forest industry with little reinvestment and non-commercial practices in both the sawmills and the forests (Sociedad de Productores Forestales Ejidales, undated). When these subsidies were lifted, largely due to the pressure of the PPF since the subsidies acted as a disincentive to investment, and

markets became more open, it at first favoured the more competitive imported timber (partly contraband mahogany from Guatemala), but in time the ejido sourced timber became more competitive. Markets for sawnwood became more transparent, profits from mahogany soared, and secondary species became profitable for the first time. The structure of the industry changed with the least efficient sawmills going out of business, and others moving up the processing chain into the production of finished or semi-finished articles.

At the same time the PPF recognised the vital role of secondary or less well known species for economically sustainable management. Because of the growing scarcity of the traditionally valuable species, local markets in many countries have become more prepared to accept secondary species' logs of adequate size, form and workability. This is crucial to the economic viability of NFM since it makes it feasible to reduce extraction of the most valuable species to sustainable levels, and reduces the fixed management and extraction costs. It is recognised by Hartschorn in Browder (1990): `market acceptance of a large number of native species literally opens the door to intensive management of tropical forests as an alternative to the selective exploitation of a few species' (p 133). Apart from the higher value that this development gives to the forest resource, and therefore the greater incentive for its retention as a productive resource, it favours a larger gap size, the silvicultural importance of which was recently noted by Plumptre (1990).

The combined market share of the ejidos in the PPF, and their rapid capitalisation, gave them considerable bargaining strength, so much so that they were able to negotiate contracts in which the buyers agreed to purchase double the volume of secondary species for every unit of mahogany. Thus for example in 1991, Nohbec Ejido was able to market 3,600 m^3 of secondary species, against 2,340 m^3 of mahogany (roundwood equivalents), and in Tres Garantias Ejido the proportion was 1,300 m^3 in favour of secondary timbers. Their bargaining position may become even stronger in future as the ejidos become organised: 43 ejidos compose 85% of the production forest area of the State (Arguilles Suarez, 1991).

In practice each ejido extracts its maximum annual allowable cut of mahogany as per inventory calculations, and only a small proportion of the annual allowable cut of secondary species (almost 17,000 m^3 for Nohbec ejido). This is because of the price differential: the average roundwood value of mahogany from 1989 to 1991 was US $150 per m^3, in comparison with $78 for the softer secondary species, and $68 for the harder ones.

In addition to the local markets, there is high potential for the export of secondary species, as well as the valuable species, from a `sustainably managed' source. At present this development is being pioneered on a small scale by such organisations as the Ecological Trading Company (UK), which has already received a 20 m^3 container from Nohbec Ejido, Green Cross Certification Company and the Rainforest Alliance Smart Woods Certification Program (both USA), on the basis that green minded users and consumers are prepared to pay a reasonable price for secondary timbers from sustainably managed sources, and which make sustainable management viable in the first place.

This is a trend which looks set to continue as more narrowly commercial importers realise the economic benefit of cashing in on the heightened environmental awareness by consumers, and as the timbers become more widely known, but one which seems bound to run into labelling abuses, and the quantitative difficulties of identifying sustainable forest management. However

it certainly has the potential to change the numbers in the calculations that Leslie (1987) used in a highly influential paper that created a pervasive attitude among foresters and economists that sustainable tropical forest management was economically impossible.

The capitalisation process, largely financed from forest profits rather than loans, has been very rapid. For example Nohbec Ejido, the most successful ejido in spite of a forest which is less mahogany-rich than some of the others, had a capital inventory value of almost two and a half million dollars, excluding its 20,700 hectares of productive forest. This included two `Treefarmers' (skidders), five 12 ton lorries, two pick-up trucks, a ten ton crane, an eight inch industrial band saw, a 54 inch circular saw, trim saws, edgers, three drying sheds, offices, a vehicle maintenance workshop (run by ejido mechanics) and a carpentry workshop. Its processing capacity was 10,000 board feet per day, equivalent to 23.5 m^3 sawnwood. Future plans include a million dollar industrial workshop for furniture production.

Three ejidos have bulldozers, and five have sawmills, three with industrial band saws, the others having too small a forest area to justify their own sawmill. A `machinery park' services the equipment requirements of the small ejido forests. Mobile sawmills and a sharpening plant are presently under consideration. As yet there are no kiln drying or other artificial drying instruments; this was identified by McCaffrey (1991) as a high priority area, because of the value added losses resulting from open air drying.

In the ejidos with processing capacity, all the mahogany and most of the secondary lumber is converted into planks, with a yield of some 230 board feet per cubic metre (54% of wood used) for the softer hardwoods, falling to 150 board feet (35%) for the hardest timbers. Sawnwood point of sale is at the sawmill for the five ejidos with processing capacity, while roundwood is transported by the ejido lorries to Chetumal, a distance rarely exceeding 150 kilometres.

FOREST MANAGEMENT AND ADMINISTRATION

Each ejido has defined a Permanent Forest Area, and this forms the basic unit of management and administration. Each ejido annually undertakes a type of integrated land use planning exercise, in which different land uses are clearly demarcated: for example, in Nohbec Ejido the pasture area of the (ten) cattle farmers, and the area where maize milpas can be established. This avoids land use and user conflicts.

The General Assembly nominates four directors or coordinators: the President of the Commissariat, who has overall responsibility for adminstration and marketing, the Head (or Chief) of the Forest, responsible for field operations, the Head of the Sawmill, and the Head of Machinery, responsible for running the workshop, maintenance and repairs.

Under the Head of the Forest, ejidatarios are organised into `brigades' or individually for different tasks, including demarcation of the cutting area into squared kilometre blocks, road construction and maintenance, the inventory of the cutting area, individual tree identification, felling with chain saws, skidding and moving logs, marking and labelling, record keeping, cross cutting, debranching and hygiene (removal of diseased sections), seed collection (one pair in each ejido), nursery work and enrichment planting, sawmill operation, vehicle and machine maintenance, and forest protection. For the latter task, in Petcacab Ejido, a brigade of five ejidatarios had the use of two pick-ups to make reconnaissance trips to check for encroachment and fire. In case of fire there

is a set emergency routine in which all should participate. In most of the ejidos, the tasks were rotated except for the more specialised operations.

In the case of Nohbec Ejido, 125 ejidatarios were employed full time for six months of the year on 20,700 hectares. 22 of these worked in the sawmill and 10 in the carpentry workshop. A total of some 1,930 ejidatarios have been trained in different forest operations. Specialist workers like drivers and mechanics were paid more than the others: a mechanic received about $120 per week, and a driver $85, compared to about $40 for the other work (set at the minimum ejido wage), rates that were very high in comparison with most other countries in the region. In Honduras for example $10 per week would be considered a satisfactory rural wage.

The permanent forest area is divided up on the basis of a 25 year cutting cycle. Thus for example Nohbec Ejido is divided up into 25 blocks of 82 hectares. The General Assembly of each ejido decides which block should be the cutting area each year, mainly on the basis of the accessibility and compactness of each area, implying extraction costs will rise significantly in future years. An inventory is then made of the cutting area. In each `cuadricula' (square kilometre) two transects are made of one kilometre by 10 metres in which all trees with a diameter above 30 cms are identified. Two further subsamples are made: a 10 x 25 metre area in which trees above 15 cms are recorded and one 10 x 10 metres in which all plants, trees and shrubs are recorded.

The results of this inventory are then processed and analysed at the ejido level, and with the aid of computer graphics, maps and aerial photographs, a management plan is developed. GTZ has made a particular contribution in both financial and technical assistance in this area, treating it as vital participatory learning exercise (Arguellez Suarez, 1989). The management plan is then submitted for approval by the forestry authority.

Once approved, all mahogany and other valuable species trees over 55 cm dbh are marked up to the concession limit referred to earlier, and secondary species above 35 cm diameter up to the perceived demand. The Head of Forest then decides on the location of log collection areas or landings, and skidder trails feeding in to the roads and landings. Extraction roads are planned and constructed. Timber extraction occurs mainly between January and April in the dry season, so damage to the forest floor is minimised.

SILVICULTURE

Under the MIQRO concession only two species were extracted, representing some 2% of the forest's merchantable volume. Apart from the tendency to mine these species as a result of attempting to maintain production on a dwindling area as discussed earlier, this resulted in a suboptimal gap size. Thus a silvicultural system, based broadly on the classic Ugandan system, has been developed with three types.

The first gap type is that made by the individual felling, leaving an average gap size of 100 square metres. The second gap type is the skidding trail. The combination of only working in the dryer months and wide rubber tyred skidders ensures minimum damage to the forest floor. The trails are laid out with an east west orientation thereby favouring heliophilic species, and the author was able to observe healthy regeneration a year after harvesting.

The third gap type is that of the log landings, which range in area between 2,000 and 4,000 square

metres. In this area wherever possible seed trees, particularly of mahogany, are left in situations that favour seed dispersal by the wind. All other trees are felled. These larger gaps are more favourable for natural regeneration of many of the light demanding softer commercial secondary hardwood species, as well as mahogany, as noted by Plumptre (1990). McCaffrey (1991) observed a higher density of mahogany and cedar in old landings in Nohbec and Tres Garantias Ejido.

This silvicultural regime opens an average of 27% of the forest canopy, and its efficacy is reflected in a study which revealed that 92% of the regenerating species came from six commercially significant species, including mahogany (Arguelles Suarez, 1991). It is backed up by a system of seed collection, nursery establishment and enrichment planting when necessary. Seeds of the best mahogany trees are collected by pairs of ejidatarios in each ejido. Annually some 25 kgs seed (40 to 50 thousand seeds) are collected between the ten ejidos. The seeds are planted directly in the different gaps with two by two metre spacings, after observing natural regeneration in July and August, some three to six months after harvesting. If these don't germinate, nursery stock may be planted.

The ejidatarios appear to have developed a sound silvicultural knowledge of the more commercial species. They know for example that mahogany prefers a semi-open light, and an excess of direct sunlight makes it susceptible to the Hisyphilla grandella pest. Thus the amount of technical assistance required is minimal. However the forester technicians do play an important role in silvicultural research. Petcacab Ejido, for example, has established 100 permanent sample plots of 500 square metres, possibly too many to have confidence in the quality of the data. In each ejido, ecological and phenological studies are being undertaken to examine the silvicultural consequences of extraction, and identify ideal gap sizes for different species. Arguelles Suarez (1989) also reports a long term study of the growth characteristics of 16 species, with 150 observations per species.

ECONOMIC CONSIDERATIONS

Table 2 gives a breakdown of gross income from Nohbec Ejido in 1991 from a roundwood harvest of 2,341 m^3 mahogany and cedar (very little), 3,000 m^3 of the softer secondary species and 600 m^3 of the harder ones, a relatively low yield of 0.3 m^3 per hectare. The average annual extracted roundwood volume yield over the ten ejidos was only about 0.2 m^3 per hectare according to SPFE.

The higher sawnwood price of the harder secondary species in comparison with the softer ones may appear confusing in view of the higher roundwood price of the latter. The explanation is that the higher roundwood value of the softer secondary species is due to its higher log yield rather than its quality. The harder woods have a higher unit sale value (as sawnwood) as a result of more specialised uses and markets, eg musical instrument making.

Table 3 gives the estimated costs of roundwood extraction, based on mahogany. These figures, calculated by the SPFE, serve as a running guide to aid management, and should be treated with caution, but with a roundwood price of $150 per cubic metre they indicate a very healthy profit margin.

The equivalent calculation for secondary species was about $65 per cubic metre, with the

technical assistance cost set arbitrarily low ($2 per m^3) in comparison with mahogany, and stumpage just less than one dollar. With roundwood prices at $78 and $68 for the softer and harder secondary species respectively, profit margins were slim if not negligible. Cross subsidisation from mahogany to these secondary species is however a very sensible long term policy (see sustainability discussion below).

Table 4 presents the net income from three ejidos in 1989, when Nohbec Ejido harvested considerably less of the secondary species. It includes chicle but not game, valued at $139,000 for Tres Garantias, but unavailable for the other ejidos. It reveals a very large variation in returns to land and especially labour: the net income per ejidatario was over seven times higher in Nohbec than Caoba. Net return per hectare was $24 per hectare for Nohbec but only $7 per hectare for Caoba. Not all the net income was distributed as profits: in the case of Nohbec some $260,000 was distributed in 1990 according to SPFE, the balance being reinvested in the forest industry or spent on community development projects, notably education, health and rural infrastructure. Each ejido makes these decisions.

Table 4 also reveals the large contribution of chicle extraction to net income: 24% for Caoba, 39% for Tres Garantias, and 34% net for Nohbec. Some 18 tons are harvested, mainly in the wetter months from June to December. Agriculture, hunting and bee-keeping are other additional food and income sources for many ejidatarios. It should be remembered that forest work only occupies most of the ejidatarios for six months of the year, the exceptions being the sawmill operators, carpenters and mechanics.

Finally the Nohbec data allows a very rough estimate of the rate of return to total capital. Taking $100 per hectare as an estimate of the value of the forest (relatively undisturbed forest of the same type in neighbouring Belize had a market value of $20 to $40 per acre in 1991), the value can be estimated at approximately $4.5 million. With a net income of about $650,000, allowing for a game value estimated by SPFE to be at least $100,000, and the higher production of secondary timbers in 1991, the return on total capital may be in the region of 14% to 15%. This compares favourably to alternative investment opportunities and could be considerably increased for example by investment in drying kilns, improved sawmill equipment, and the production of more sophisticated final products (McCaffrey, 1991).

Table 2. Gross income from timber sales in Nohbec Ejido 1991 (US dollars)

		Volume[1] m^3	Prices[2] $/m^3$	Gross income $
Mahogany and Cedar	Roundwood sales	0	150	0
	Sawnwood sales	1,264	494	624,416
Softer 2ndry species	Roundwood sales	2,100	78	163,800
	Sawnwood sales	486	191	92,826
Harder 2ndry species	Roundwood sales	0	68	0
	Sawnwood sales	210	280	58,800

Total gross income		$ 939,842
Notes:	[1] one m^3 roundwood is equivalent to 0.54 m^3 sawnwood of the softer hardwoods, including mahogany, and 0.35 m^3 of the harder woods.	
	[2] price of sawnwood calculated from the roundwood equivalent value of sawnwood, and using the above conversion factors.	
Source:	La Sociedad de Productores Forestales Ejidales de Quintana Roo, S.C.	

IS IT SUSTAINABLE

Based on this case study, a number of additional social and economic benefits from participatory forest management, as opposed to conventional forest development approaches, can be identified, apart from the obvious economic and environmental benefits from the reduced rate of resource depletions. Since the beneficiaries live in or near the forests, protection costs are reduced to a minimum; desirable development objectives (improvements in rural infrastructure, health and education services) for a section of the population with a high welfare weighting can be achieved without recourse to scarce government expenditure of aid funds; and distribution of the forest rent to a section of the population with a high marginal propensity to consume results in an increased level of consumption, lack of internal effective demand often being cited as a major constraint to economic development.

Table 3. Costs of mahogany roundwood production 1991 (US dollars per cubic metre)

	$/m^3$
Administration	4.33
Research	0.53
Forest demarcation	0.47
Felling preparation and marking	1.00
Felling and debranching	2.53
Cross sawing and hygiene (removing diseased sections)	0.90
Enrichment planting inc. seed collection, nursery	1.33
Skidding[1]	23.67
Loading lorries[1]	7.83
Transport to sawmill[1]	20.00

Technical Assistance fees (paid to DTF)	12.27
Stumpage fee	4.55
Total costs per cubic metre of mahogany	79.41
Note:	[1] the cost of skidding and transport operations includes a 20% depreciation factor, and a `capital reserve' factor of some 25% of the capital value of the machinery, in lieu of an opportunity cost interest figure.
Source:	Sociedad de Productores Forestales Ejidales de Quintana Roo, S.C.

Finally Colchester (1990) cites `the high rate of return expected on capital investments' (p 115) as a major cause of overharvesting: it appears that at least in the early stages of such projects, the beneficiaries may not need to overexploit the resource and earn such high rates of return (except to repay loans) in order to achieve a standard of living vastly superior to the alternatives available. Lower opportunity costs and material expectations (in comparison to commercial loggers) appear to give a vital economic breathing space.

The sustainability question raises a number of issues beyond whether sustained yield management is being achieved. In terms of social and institutional sustainability the PPF approach does appear to be sustainable: financial, institutional and technical assistance dependency seems to be minimal, and it clearly has strong grass roots support. This sustainability can be attributed to the organisational strengths of the ejidos, the participatory training approach adopted by the PPF, the apparent absence of paternalism in which decision making authority and responsibility is in the hands of the ejidos, and the autonomous nature of their guiding association, the SPFE.

On the technical issue, it is not within the scope of this paper to make the necessary calculations and technical judgements. This would need detailed quantitative data, including volume by size and age class, logging rates, yields and growth rates by species. However Synott (personal communication, 1991) has made some personal observations on the sustainability of the annual average mahogany cut based on the Nohbec Ejido inventory. This revealed an average annual potential yield of mahogany (with a very small amount of cedar) of 2,850m^3, a figure close to current harvests. However this average figure disguises a timing problem.

Mahogany forms less than 5% of the volume, basal area and tree numbers in the 35-55 cm diameter group. This implies that the biological sustained
yield of mahogany will be about 5% of total volume production in this size and age range. Since the total annual volume yield (unknown) is unlikely to exceed one cubic metre per hectare of cleared logs, or about 20,000 cubic metres on the whole Nohbec area, Synott tentatively (on the incomplete evidence) concludes that the future annual mahogany harvest may be about 1,000m^3. The next two cutting cycles are therefore likely to

Table 4. Net income from timber and chicle production of three ejidos in 1989 (US dollars)				
		Caoba	Tres Garantias	Nohbec
1989 roundwood harvest:				
Mahogany/cedar	m^3	874	43	2,341
Soft secondary spp.	m^3	373	0	1,125
Hard secondary spp.	m^3	137	799	0
Percent. converted	%	100	100	68
Roundwood net income:				
Mahogany/cedar	$	67,944	65,514	182,015
Soft secondary spp.	$	7,571	0	22,860
Hard secondary spp.	$	1,417	8,250	0
Chicle net income	$	30,020	63,367	17,3035
Total net income[1]	$	123,633	161,491	503,750
Salaries	$	63,704	55,662	91,563
Hectares forest		18,000	15,500	20,700
Net income/Ha[1]	$	7	10	24
No ejidatarios		300	100	125
Net income/Man[2]	$	624	2,171	4,762
Timber only				
Net income[1]	$	93,613	98,124	330,715
Net income/Ha[1]	$	5	6	16
Net income/Man[2]	$	524	1,538	3,378
Notes:	[1] salaries deducted in net income calculation			
	[2] salaries added to net income to give return to labour			
Source:	Sociedad de Productores Forestales Ejidales de Quintana Roo, S.C.			

yield much less mahogany, although it should be remembered that not all the trees above 55 cm are being harvested in the first cycle. The good observed natural regeneration and the effects of enrichment planting will not come on stream until the third and mainly fourth cutting cycle, in view of mahogany's estimated growing span of 75 years to a diameter of 60 cm.

Therefore the present mahogany harvest may not be sustainable in the second and third cutting cycles (2010 - 2060), and unless real mahogany prices increase very considerably allowing mahogany revenues to be maintained on reduced harvests, future economic sustainability will depend critically on the development of local and international markets for secondary timbers, on improvements in drying and processing technology and on new products like poles and posts in the local markets, as mentioned by McCaffrey (1991).

At the same time, Synott (op cit) does go on to say that although he does not consider it very efficient or productive the `PPF is already operating a sustained yield management system, without any visible conflicts which are likely to cause it to break down'. The conclusion is perhaps that sustainability is achievable, but certainly in the case of Nohbec relies on the future of secondary timbers. By contrast, Petcacab Ejido with its higher mahogany inventory volumes may be already operating a biologically and economically sustainable system.

FOREST POLICY DISCUSSION: THE TRADITIONAL FOREST DEVELOPMENT MODEL AND PPF APPROACH COMPARED

Before 1983 the forest development policy was one of concessions to logging companies, and the role of the forest authority (SARH) was one of policing the concessions, and keeping out slash and burn agriculture. It was determined by business interests and conventional neo-classical economic thinking, eg the importance of economies of scale in forest management and timber processing. Classic sustainable yield management plans based on highly selective felling were drawn up, as in the case of the MIQRO concession. Foresters consulted with concessionaries, argued with agriculturalists about land use priorities, and attempted to keep the campesinos out. According to the SPFE, the forest authority did not carry out forest inventories and had no mandate for giving technical assistance for sustainable yield management. The State subsidised local timber supplies to the sawmill industry, thereby reducing outside competition and encouraging non commercial practices in both the forest and sawmill.

Meanwhile some 50% of the State forest was cleared from 1954 to 1983, largely for subsistence slash and burn agriculture. The classic but inflexible forest management plans produced an uncontrollable situation, as a dwindling forest resource attempted to maintain output: the resource users were not the resource owners, the resource owners had little incentive to maintain the forest since they were not deriving a satisfactory livelihood from it, the forest authority with its entrenched paternalism was incapable of finding solutions to the problems, and the State Governor was very concerned at the rate of forest clearance. It was realised that State and ejido interests were really one and the same: the campesino was the means to forest conservation.

Thus the ejidos were encouraged to request SARH not to continue the concession to MIQRO on the basis that they themselves, with adequate information, training and technical assistance, could manage the forest sustainably and halt, or slow down, deforestation. To do this new autonomous and flexible institutional structures were needed which would minimise the need for inter-institutional coordination, which was observed to operate very poorly in the State and elsewhere, as well as to allow staffing continuity, a bottom-up approach in which responsibility for forest management would be handed over as soon as possible to the ejidos, and new technical assistance functions emphasising field work, silvicultural research and control of forest operations, as opposed to policing and recording activities (Galleti and Argueilles, 1987). Pressure was put on the State to lift subsidies and promote market transparency leading to more efficient

management practices. An active as opposed to passive marketing strategy involving rapid capitalisation was crucial to take advantage of the market opportunities.

PROBLEMS

This report suggests that the PPF is moving towards sustainability, but it would be misleading to suggest that there are no problems. Apart from the serious worry that mahogany is being overexploited, possibly exacerbated by the inventory brigades overstating the inventory in order to increase the annual allowable cut, and that its quality is declining (McCaffrey, 1991), these problems include the high wastage levels; the lack of artificial drying facilities; damage by shoot borer moths; the overabundance of mature chicozapote trees that have stopped producing latex and use up valuable canopy space; illegal mahogany from Guatemala depressing timber prices; administrative malpractices, and conflicts caused by the receipt of bribes by ejidatarios from timber buyers keen to gain the support of the General Assembly for their competing bid, a problem witnessed by the author; and social problems that may be arising due to the rapid increases in cash incomes, eg high alcoholic consumption levels (personal observation only).

CONCLUSIONS

It could be argued that the relative success of the PPF has resulted from a unique combination of advantages which may not be repeated en masse elsewhere. These include the tenure basis, the organisational strength and social solidarity of the producer organisations, the high commercial value of the forest (including the existence of a high value non timber product), ease of extraction due to topography, market accessibility, political support in the vital early stages, relatively low demographic pressures, and political and social stability. Many of these underlying conditions contrast sharply with similar participatory initiatives, such as the pit sawing cooperatives of northern Honduras, and the Yanesha Cooperative of the Palcazu Valley, Peru. However this does not mean that there are not a number of salutary lessons for such projects.

The most important lessons for participatory NFM approaches elsewhere seem to be the following: the vital role of tenure security; the creation of autonomous and flexible institutional structures; a marketing strategy which views the forest resource as the basis for capitalisation and industrial development rather than as an opportunity to supply an already existing market, and which actively promotes the acceptance of secondary species essential to the viability of sustainable yield management (this may imply some scale factor in such projects since the market share becomes crucial to bargaining power); an appropriate policy environment; the absence of paternalism — technical assistance should be paid for by beneficiaries as soon as possible, loans and grants kept to a minimum, and decision making left to the beneficiaries; continuity of financial and high quality technical assistance; and last but not least the need for strong producer organisations, especially vital in forest planning and administration.

Unfortunately the list of factors covered in the last two paragraphs is long and therefore successful participatory NFM initiatives are likely to continue to be rare. However the inherent lack of sustainability of conventional approaches to NFM based on inadequately policed concessions will inevitably increase their number. The forest development policy that existed before 1983 was never socially sustainable and always moving away from biological and economic sustainability. The participatory forest development policy pioneered in the PPF is clearly socially sustainable, and appears to be moving towards biological and economic sustainability with the development

of the market for secondary species. The institutions and policies responsible for forest development before 1983 would not have allowed the PPF approach to flourish as it has done.

Perhaps above all this case study shows that adequately trained campesinos, given the right sort of information and institutional support, appear to be capable of profitably managing a tropical forest under a sustainable yield management regime, **if they are allowed to**. It shows that a participatory approach to forest management and conservation can result in a number of social and economic benefits over conventional forest development models, as well as being more sustainable in the face of alternative land use pressures.

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ABBREVIATIONS

CIDA	Canadian International Development Agency
DTF	Dirección Técnica Forestal
GTZ	Gesellschaft für Technische Zusammenarbeit
MIQRO	Maderas Industrializadas de Quintana Roo
NFM	Natural Forest Management
PPF	Plan Piloto Forestal
SARH	Secretaria de Agricultura y Recursos Hidricos
SPFE	La Sociedad de Productores Forestales Ejidales de Quintana Roo, Sociedad Civil
USAID	United States Agency for International Development
WWF	World Wide Fund for Nature

Acknowledgement

The author wishes to thank the U.K. Overseas Development Administration for financing the period of field research and analysis. The views expressed in this report are entirely those of the author, who would also like to thank Ing. Manuel Aldrete in particular, and the ejidatarios of Petcacab Ejido and the staff of the Dirección Técnica Forestal of the PPF in general, for their full and cheerful cooperation.

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