MEXICO

Sian Ka'an Coastal Biosphere Reserve and Surrounding Forests

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THE CONTEXT

Quintana Roo, an isolated Federal Territory of 50,000 Km2 in the eastern end of Mexico, was declared a sovereign Mexican State in the early 1970s. The ecosystem described in this case study lies along its central coast; it is a coastal limestone flat of around one million ha where land and sea converge gradually into a complicated hydrological system. Extensive mangrove stands and creeks, salty and freshwater marshes are found even 40 Km inland from the coast. The coastline includes brackish lagoons and huge shallow bays with a varying salinity. These bays are dotted by islets and mangrove keys; the bottom of the bays is either sandy or covered by extensive beds of *Thalassia* and other seagrasses. The coastal and wetland system is protected from the energy of the Caribbean Sea by a barrier reef growing all along the coast. This species-rich coral reef belongs to the second largest barrier in the world; its growth is provided by the transparency of the waters, which depends on the lack of erosion inland. Coastal marshes and mangroves may be invaded by the sea during tropical storms, and particularly during hurricanes (one hurricane every 8 years as a mean in the last century). Thus, the reef protects the coasts, the seagrass beds and the mangroves, while the latter in turn avoid erosion, and so the degradation and siltation of the coral. The system is rich in marine and brackish species, most of which find suitable breeding and feeding habitats in the area, such as many commercial fishing species and particularly the Spiny Lobster *Panulirus argus*.

In the marshes, small variations in topography cause significant changes in salinity and flooding regimes, and the vegetation varies accordingly; coastal habitats are dominated by red mangrove *Rhizophora mangle*, and as salinity decreases inland, by sawgrass marshes with *Cladium jamaicense*, and by freshwater stands with *Typha angustifolia*. Further inland, seasonally flooded forests give way to areas where soils keep dry all year, allowing a 15-25 m high sub-evergreen tropical forest to develop; trees grow over shallow and stony soils where litter barely covers the limestone layer. This layer is several meters deep and very porous, so rainfall (1150 mm a year) drains directly through it into the underground water table, from which freshwater is easily available by pumping; there are no rivers in the area. Given the diverse array of habitats in the region, from tropical forests to coral reefs, biodiversity is high. Some noteworthy vertebrates are tapir, manatee, dolphins, cats (5 spp), 75 spp of waterbirds, crocodiles (2 spp), sea turtles (3 spp), sharks, coral reef fishes and many other.

Description of the Situation and Problems Addressed

This coastal area and its surrounding forests were sparsely inhabited by the Maya in pre-Columbian times; it was later deserted until the 1800's when some Maya people came back to Quintana Roo's inland forests escaping from the war in the neighboring state of Yucatán. Over

these poor and fragile limestone soils only the Maya had developed a self-sustained shifting agriculture, completed by gathering practices in the forests and wetlands, still today practiced in some communities. Between 1920 and 1970 settlers from other areas of Mexico arrived by sea to the coast planting the dunes with coconut palms, while inland, timber concessions for precious tropical woods as red cedar and mahogany gradually cleared the best grown forests.

By the mid 1970's timber companies were getting closer to the coast, opening accesses and leaving deforested areas to be burned out and claimed by cattle ranches. Cattle poorly thrives on these stony soils, needing over 30 ha per animal; fires were extensively used to clear fields from secondary succession and to open new areas, and most non-flooded areas were rapidly transformed. All coastal areas and surrounding forests were still owned by the Federal state; by law, anybody giving access to the land, clearing and fencing it could claim its legal property, which was one of the main reasons for settlers to open forests. At the same time, on the coast over a 90% of the original dune vegetation had been claimed for coconut palms; over 100 fishermen had settled in the area and many more living abroad arrived seasonally to fish on the reefs and bays in order to provide fish, conk and lobster to the fast growing tourist industry north of the area, in Cancún.

By 1980 the unplanned development, mainly based on "mining" forestry, tourism and unsustainable cattle ranching, was already generating a 17% annual demographic growth in the state of Quintana Roo. Deforestation proceeded at 6% a year, while hunting and fires were generalized. As in most tropical areas of Latin America during those years, deforestation was supported by the government and banks would offer credit to introduce cattle almost anywhere. Tourism facilities crawled along the coasts pumping water from the scarce freatic layer, leading to salinization of coastal wells, claiming dunes and draining mangroves, while uncontrolled visitation over the fragile coral communities had locally killed important tracts of the reef. In some places, wetlands were used as a sink for sewage.

An ecological assessment (Ornat 1981) was developed in CIQRO, the State Government research center, and a forestry diagnosis was developed by the governmental forestry agency (SARH 1982) with support from the German technical cooperation agency GtZ. Both assessments clearly pointed how the mistreatment of the natural resources and the lack of consciousness about the fragility of the limestone ecosystem was driving to a fast and irreversible degradation. The State's development was dependant on unsustainable activities while no alternatives were on scope. The traditional forest and land-uses practiced by the Maya, which had demonstrated their sustainability along the centuries, were disappearing at a fast rate. A first ethnobotanical study (Gonzalez 1983) described how Maya peasants used 185 forest and wetland plant species for over 300 different uses in food, medicine, clothing, dies, all types of building materials, etc. But Maya from the community-owned lands *(ejidos)* lent their forests to the timber companies, while the young had lost interest in their land and were leaving the area to get jobs as building workers in the developing tourist resorts on the coast. Timber and fisheries were both overexploited far over their natural recuperation rates; cattle ranching was poor and unsustainable; tourism was degrading its landscape, clean waters, reefs and other attractive assets; while degrading reefs threatened the fisheries and the protection of the coast against erosion.

Goals and objectives of ecosystem initiatives

The combined recommendations of the ecological assessment and of the forestry diagnosis pointed at the development and promotion of sustainable economic activities, the conservation of the functionality of the limestone ecosystems, and the urgent protection of representative samples of all habitat types and biodiversity. These were ambitious goals for a piece of land the size of Costa Rica, even still scarcely populated. Specific objectives, however, could be taken one by one -if politically necessary- and would complement each other:

1. Land-use ordination based on (a) the capacity of the soils and natural resources, (b) ecological criteria (water and biodiversity protection) and (c) sociocultural priorities and capacities;
2. Replacing commercial timber harvesting with community-based sustainable forestry;
3. Protection of the mangroves and the reefs as means to protect the coast from erosion, sustaining fisheries, wildlife and tourism assets;
4. Conserve representative samples of functional ecosystems and the biodiversity they contain;
5. Promote sustainable economic activities based both on traditional and on new appropriate technologies;
6. Provision of sewage systems in urban concentrations and alternative sources of water to stop degradation of the coastal water table.

Short-term means to achieve these goals were (a) establishment of pilot forestry programmes under community management and (b) the declaration of a network of Biosphere Reserves in all remaining federal-owned lands.

Evolution of the projects

The state government, at the time headed by a young committed Governor (Joaquín Coldwell), asked to proceed with the main short term actions: stopping timber concessions to private companies, the establishment of pilot forestry programmes under community management, and the declaration of a biosphere reserve. A biosphere reserve could attract cooperation from scientists and foreign agencies to an otherwise very marginal area; while an alternative plan to manage forests could raise the development capacity of the Maya communities, generate sustainable jobs, and help conserve the last forests.

Several locations for biosphere reserves were proposed, and as a first stage Sian Ka'an was selected, while several *ejidos* (community-owned lands) close to Sian ka'an were proposed to start community based pilot-forestry programmes (see Map). Basic studies started in 1982 to know the potentiality of these resources and to propose management plans. These two programmes were ecologically complementary and chronologically simultaneous, but were managed independently by different governmental agencies and technical teams. However, both shared some research projects and there was always technical support and exchange of experience between them. In this section we will describe their evolution separately.

Sian Ka'an Biosphere Reserve:

Sian Ka'an was selected as a first priority because it comprised the highest diversity of habitat types: a total of 528,000 ha of which roughly 1/3 are tropical forests, 1/3 are marshes and mangroves and 1/3 are coastal lagoons, bays and marine habitats. Sian Ka'an is 40-50 Km deep inland, and around 120 Km long, facing the Caribbean Sea with beautifully wild white sand beaches. It is fringed by a continuous coral barrier-reef. Its marine boundaries are set at the depth of 50 m after the reef; inland, its boundaries were drawn using the administrative limits of the federal-owned lands, and as possible, those of the local watershed. Human population in Sian Ka'an is of around 1,000 inhabitants, mostly lobster fishermen organized in two cooperatives (one on each bay), some Maya peasant families inland, and around 40 coconut growers over the private coastal properties. Coconut production was in fast regression due to a palm disease and to lowering market prices, so many coastal owners were considering the promotion of tourism as an alternative. Basic studies -funded by the National Council for Science and Technology (CONACyT)- were conducted in 1982-83 to describe all resources in the area and to analyze its socioeconomic conditions. As far as possible the local people were involved in the field studies as informers, guides and field assistants.

In 1984 a process started to formulate a Management Plan with the participation of local communities. The main institutions involved from the State and Federal governments created a Steering Committee with an Operative Technical Commission to coordinate the field works. A Local Council was also established, including representatives of the fishermen, coconut growers, cattle owners, peasants, scientists and representatives of Municipalities and of the Steering Committee. Since 1984 this Council held 30 regular bi-monthly meetings; forest concessions and squatter cattle ranches were asked to gradually abandon the area, fishermen got organized to control their fishing grounds, education and awareness activities started and the main accesses were controlled. Meanwhile a zoning scheme was drafted and discussed by representatives and their represented groups, while regulations for each of the zones were proposed. A Management Plan was drafted, discussed and reviewed and finally approved by the State Government in 1986.

The project attracted the attention from international conservation NGOs as WWF-US and Conservation International (CI); on their advise, a local NGO (Amigos de Sian Ka'an) was established in 1986 to develop participatory field projects with the local communities, education and awareness campaigns, and to promote citizen participation in the conservation of the area. Important private personalities of Quintana Roo and of Mexico City agreed to be founding members together with local land owners and conservationists. The state research center CIQRO and the autonomous University of Mexico City (UNAM) develop basic biological and ecological research projects since that date. *Amigos* has promoted participatory research and development projects with the local communities inside the reserve (horticulture, lobster management, diversification of fisheries, management of useful wild palms, eco-tourism) and in the

surrounding *ejidos* (improved agriculture techniques, wildlife management, crocodile ranching); some of these projects were shared and complementary to the *Plan Forestal Piloto* initiative.

Pilot Forestry Programme:

By 1983 a timber company (MIQRO) was concluding its 25 year-old concession on the *ejidos*. Technical teams integrated by local forestry technicians, experts from the government and from the GTZ, and local people with forestry experience produced the dasonomic inventories and forest management plans. Training and development of the local capacity was always a priority. The local people organized themselves as the core decision-makers in land-use planning of the *ejidos*; they identified the areas which should be subject to permanent forestry activities (100,000 ha) and defined the management techniques, while the governmental Forest Service was asked to shift their role from control and vigilance to technical assistance. The first 10 *ejidos* created a "Forestry Producers Society" to produce and commercialize the timber; the mahogany *Swietenia macrophylla* had been over-harvested by timber companies, so locals initially cut down its production by 50% , while focusing in a growing percentage of common and previously uncommercialized hardwood species. Rotation cycles were preliminarily set in 25 years.

Compared to their previous income as workers in the timber company, their economic income multiplied by 19 (nineteen) in the first year (SEDE 1984). Soon after this spectacular result, another 16 *ejidos* of the Maya area joined the experience (1985) and declared another 150,000 ha of permanent forests for the *Plan Forestal Piloto*. Later the State government formalized this policy (1989), creating an strategic forest reserve (Reserva Forestal Estratégica) including almost every well conserved forest in Quintana Roo, adding other 30 *ejidos* and another 170,000 ha for a total of 420,000 ha. This Reserve has to be (a) managed by local people through their own technical services, and (b) industry must adapt to the sustainable timber yields of a growing diversity of tree species. A new community-based industry is developing using the previously ignored common hardwood species. To date, 9,000 families are living on this programme, roughly one family every 50 ha of forest.

Approaches taken; main components and activities

Political: Ecosystem management was highlighted through ecological and socioeconomic assessments presented to the State (Provincial) authorities. Maps showing land-use changes in the past years were very helpful to display the problem. Recommendations tried to be politically attractive and to help the governmental agencies do their job better. Proposals took into consideration as a priority the economic alternatives and the strengthening of the social capacity for development; at that stage environmental benefits were presented as 'secondary' results of long-term interest. Political support to these programmes greatly benefited from the lucky coincidence of these proposals with a new, committed governmental team with a leader willing to 'godfather' these as pet projects for his remaining 5-year mandate.

Land-use ordination: Preliminary broad-scale planning was done between technicians and scientists from governmental and non-governmental instances. Land-use ordination and land-tenure were the main issues.

- The basic criteria for the localization of a biosphere reserve were: (a) state-owned land (not *ejido*), (b) over 100,000 ha of well conserved forests, (c) no accesses and very low human population, and (d) head of a watershed. Sian Ka'an was selected because of its diverse habitat types: forest, wetland and marine. It is noteworthy that at that stage the government would consider mangroves and wetlands as 'wasteland', so it was easy to gain support for this proposal, which in fact included many more wetlands and coastal habitats than actual forests; additionally, the State saw on it a means to become co-manager -together with the Federal government- of these broad federal-owned lands.
- Lands for the alternative forestry programme were chosen between the *ejidos* with higher forest cover (over 65%), close to Sian Ka'an, and on which timber concessions had not yet extracted the main bulk of the most commercial woods. Land in the *ejidos* belongs to the community.

Intersectoral coordination: The State government centralized the institutional coordination into its Planning unit (Secretaría de Desarrollo Económico) which in turn created two technical commissions (one for each programme) in which the related State agencies were included, together with the delegates of the related Federal agencies in the State of Quintana Roo; governmental and non-governmental technicians and scientists were hired to form the Technical Commissions.

Participatory planning: Planning was done under the guidance of these interinstitutional and multidisciplinary technical commissions and, particularly in the *Plan Forestal Piloto*, a full participation of local communities was sought. Participation started from the very first field studies, and then continued by sharing the analysis of the situation in open workshops with the communities. The need for management plans became evident.

- Forestry plans were developed together with the communities; training of local technicians was a priority. Initially, forestry plans weren't technically perfect, a fact receiving some criticism from academic sectors -even though nobody really knew in 1983 *how* to manage a tropical forest sustainably. But these preliminary plans were a first step in the right direction; it was important to get communities organized, involved and responsible for a new path towards sustainable forest management.
- In Sian Ka'an the plan focused in a zoning scheme, trying to adapt all claims from local inhabitants into the global priority of conservation. Zoning includes (a) multiple-use zones -which are agricultural inland and dedicated to coconut, small-scale tourism and visitation on the coast; (b) gathering zones, which inland mean traditional uses which do not disturb the structure of the forest (e.g. no logging), and on the coast are fishing zones under control of the fishermen cooperatives; and (c) core zones for strict protection of biodiversity, which on the coast include fish breeding areas, mangrove keys and coral reefs. For each zone, particular regulations were proposed; these include control of road construction, house building, transportation, use of fires, pollution, research, visitation, management practices and the use of all natural resources. The Plan

was passed by the State government in 1986 but before approval at the Federal level there was a political turnover and it became 'forgotten' until 1993; it was finally formalized at the Federal level in 1996.

Legal background: Legal background was sought but not given a priority. In Sian Ka'an, since 1984, all work was done -with support from the State and local governments- as in a *de-facto* reserve, although the Federal Decree was not signed by the President of Mexico until two years later. The Decree is mandatory over all Federal Ministries, and provides for a Management Plan for the Reserve, which had already been prepared in the State during 1984-85. While the implementation of the *Plan Forestal Piloto* was a matter of the sovereignty of the *ejidos* over their own lands. In 1989, six years after it was already working, the State created a forest Reserve to cover all forests managed under this programme.

Modified sectoral programmes: Sustainable forestry based in the experience of the *Plan Forestal Piloto* became the official policy in the State with the second next political turnover in 1993. Cattle ranching and deforestation were not allowed any further in the Reserves. Fisheries in the Sian Ka'an area were left under control of the cooperatives. The Decree establishes that no more population settlement programmes can be conducted in Sian Ka'an. Tourist development must adapt to the strict regulations in the Management Plan.

Biodiversity Conservation: The fragility of the limestone ecosystems became obvious after the first decades of uncontrolled development; this fact eased the way to conservation proposals, particularly in areas considered by the government as marginal from the socioeconomic point of view, either poor *ejidos* with few social services and difficult access, or wild areas without any access and considered unhealthy. We always had support for the idea of protecting, within these 'marginal' areas, representative samples of all habitat types, their biodiversity and flagship species, and the functionality of the system (freatic table, wetlands and mangroves), as a necessary means to sustain the rich lobster fisheries, the coral reefs and the tourist potentiality.

People as part of the ecosystem:

- Planning was done with the people and taking into consideration the people's needs and capacities; however, the protection of biodiversity and the functionality of the ecosystem was an underlying priority. No peasant or fishermen ever argued against the need for conservation; but conservation was defined as "using sustainably", not as "forbidding the use"; so different human needs were located in different zones.
- Zoning reflects this concept: Sian Ka'an and the *Plan Forestal Piloto* compose at least four concentric zones with gradually stricter regulations, in which the use of natural resources aims at being optimal for both man and nature. Even in the core zones the *no-use* is optimal when considering their fragility, high biodiversity and ecosystem functions: the best for man and nature is to leave them wild and inaccessible. Communities better understood zoning through the concept of 'multiple-use'; the word 'Reserve' was not welcome (it made the Maya think on indigenous enclosures under governmental control), while the surname 'Biosphere' did not help much either!

Land-tenure, people's responsibility and demographic growth:

- Since the Mexican revolution (1910) the land in the *ejidos* belongs to the communities; but in Sian Ka'an the land is federal-owned and its inhabitants, who strictly can be considered illegal, were initially concerned about their future land-tenure rights. Also managers wished to establish a controlled buffer zone around all accessible areas of the Reserve: a stable populated belt with improving life standards for local people should be the best warranty to avoid squatting inside the Reserve. People need to be linked to their piece of land to develop a responsibility for its conservation, so they need stable land-use rights. The reserve proposed 90 year concessions over agricultural lots; concessions are subject to following the Reserve's regulations, and can be lost otherwise.
- Interestingly, this concept was also applied to the sea; unique in Mexico as an experience, the lobster fishing grounds in the two bays were divided by the fishermen into fields; 110 fields were drawn in Ascension Bay for the 110-member cooperative. Strictly, this modality can not be legalized, but is already a 'traditional use' in Sian Ka'an; each fisherman cares about his field, devoting efforts to improve the lobster habitat there; conservation is almost granted and there is a strict vigilance by the cooperatives against poachers or outsiders, in contrast with most fishing areas elsewhere in which resources are grabbed by the first one arriving to the spot or by those with a better fishing equipment.
- On the few private lands on the beaches special use regulations were established, including conservation of natural vegetation, no new access roads, no sand extraction, water captured from rainfall and not from coastal wells, piers on poles to avoid erosion, smaller lots at least 50 m ocean-front, maximum built surface 15% of each lot, maximum building height of 8 m, no lights eastwards on sea turtle breeding areas, etc.
- In Sian Ka'an the natural growth of the local population is expected to be controlled by the maximum number of agricultural plots which were set in its buffer zone, the minimum size of ocean-front plots on the coast, and the maximum number of members allowed by the fishermen in their cooperatives, which is related to the number of fishing fields.

<u>Local production integrated with biodiversity</u>:

- The Maya have a deep traditional knowledge of their ecosystem: their right of gathering in the wild and hunting for self-consumption is recognized by the zoning scheme.
- After land-use rights were granted in multiple-use areas, communities expected the development of economic alternatives. These were based on the sustainable use of local resources, and departing from the traditional knowledge of communities. Pilot productive projects were started in many fields with support from outside agencies. Some criteria used for the selection of these projects are: to be developed in the land of the beneficiaries under a shared financial responsibility with them; to seek diversified production and maximum use of products and subproducts; alternatives must illustrate the recommended use of soils for that particular zone; technology must be appropriate and easily replicated by others; projects may be used for technical and administrative training of local inhabitants; and all research should be participatory.
- In the *Plan Forestal Piloto* the volumes of the most commercial timber species are being gradually cut down while alternative industrial uses are sought for the common

hardwood species. Research, in cooperation with Sian Ka'an, has being conducted in order to evaluate forest resources other than timber (ornamental plants, tourism, wildlife management and regulated sport hunting).

- In Sian Ka'an pilot projects have been conducted in several fields: all involve local technicians and workers, and aim at being an example both inside the Reserve and in the surrounding *ejidos*: wildlife breeding (crocodiles, butterflies); horticulture and organic agricultural plots in 0.5 ha per family; alternatives to the use of wild palms for building, for which communities finally declared a permanent close-season; diversification of fisheries to crab and fish; use of lobster sub-products; and eco-tourism.

Organizations involved and management structure

The institutional arrangements for the formulation and launching of these two programmes were described in A.4 and A.5. Their present organization and management structure is summarized here:

- The *Plan Forestal Piloto* depends on the *ejidos*. Four community-driven Societies for production and commercialization have been established along the years, each one including 10-20 *ejidos*. These have their own technical services where local technicians assume the management role. The State forestry Agency plays the role of technical advisor and facilitator.
- Sian Ka'an is managed by a Steering Committee including representatives from the Federal, State and Municipal governments, the state research institute (CIQRO), the national institute of archaeology (INAH) and the fishermen cooperatives. It is chaired by the Federal Ministry of the Environment, who proposes a Reserve Director. This Committee hardly meets once a year; in fact, the Reserve Director works in the field by holding bilateral meetings when necessary with the other stakeholders. In its first years, the Reserve had an active Council of Representatives which met bimonthly, advising the Reserve Director before taking decisions involving investments or the use of natural resources inside the Reserve. Unluckily, this body was discontinued after the first political turnover in 1987. However, by that date the fishermen cooperatives were already well established and a point on the management of Sian Ka'an was included by the fishermen in the agendas of their regular monthly meetings.

Donors and funding

Atypically, these programmes had a very small input from external donors. The initial proposals were formulated by the state center CIQRO -for Sian Ka'an- and by the "Acuerdo Mexico-Alemania" -for the *Plan Forestal Piloto*. The latter is a technical office established by the Mexican forestry directorate and the German GtZ.

- The *Plan Forestal Piloto* was implemented by the communities through their 'Forestry Societies' together with technical advise and support on basic infrastructure from the "Acuerdo Mexico-Alemania". The Mexican CONACyT initially covered basic research studies on wood applications, forest regeneration, and wildlife management.
- Basic studies for Sian Ka'an (1982-83) were covered by the CONACyT at a cost of US $ 125,000 in total. The process of involving the communities and formulating a

Management Plan (1984-85) was covered almost entirely by the State and Federal governments, with a cost of around US $ 50,000 for both years. Ever since, the official budget for Sian Ka'an (Federal Gov.) has rarely exceeded this amount each year. Basic research projects have been conducted by CIQRO and UNAM. Pilot projects with communities, environmental education and awareness are ran by the local NGO of *Amigos* since 1986. *Amigos* started with an annual budget of US $ 40,000 and has grown today to around US $ 200,000; operation funds came initially from CI, a US based conservation NGO, and funds for the pilot projects came from the WWF-US; at present most operation funds come from membership and through small grants from other donors and NGOs from Mexico, USA and Canada.

RESULTS

Areas for multiple-uses, sustainable-forestry, and protected areas, were legally established in most of the ecologically sensible areas and now cover a 27% of the State. No more deforestation and extension of cattle ranching has occurred since 1985; new settlements were stopped, land-use rights granted, land-use regulations have been set and, to date, tourism development has been controlled. Sustainable harvest of key natural resources is pursued by local communities. Samples of almost complete ecosystems are granted protection, e.g.: Sian Ka'an and the surrounding *ejidos*, with around 800,000 ha, almost completely cover two neighboring watersheds, ranging from far inland through coastal wetlands, into marine environments and coral reefs.

Management tools have been developed with local communities, strengthening their capacity to understand and administrate their own resources, which should be a basic component of 'development'. These tools include: local organization for production and commercialization; development, based on traditional and alternative techniques, of appropriate production systems for a growing diversity of local resources; participatory research and monitoring (particularly with the two main resources: timber and spiny lobster); and improved technical capacity of local people, e.g.: a community based technical forestry service has trained 32 local technicians who take care of the 420,000 ha community forests; while numerous technicians trained in Sian Ka'an are today holding key positions in most environmental programmes in the State.

Ecosystem knowledge has grown considerably as compared to the situation in 1982, when even vegetation and land-use maps were lacking. Basic studies were carried out on most ecological and biological topics: soils and hydrology, biological inventories, characterization of all habitat types (mainly reefs, sea grass beds, sand-dunes, mangroves, and forests); population studies (palms, fine woods, spiny lobster, migratory and colonial birds, threatened mammals and reptiles); and management-oriented studies on ethnobotany and traditional gathering practices, forest regeneration, improved agricultural practices, and on marine resources as conk, rock crab, reef fish, fishing techniques and product diversification. Many of these results have a key importance in ecosystem understanding, e.g.: most marine resources are dependant on management practices hundreds and even thousands of km away from our area, in the coasts of Honduras and Nicaragua. Basic information exchanges have been carried out with several research centers in southern Florida, a very similar limestone environment.

Most importantly, public responsibility and awareness for conservation has grown; zoning and the combination of multiple uses are internalized by communities, who in some cases drew the zone limits themselves, taking care of their control and vigilance. Also, four State-based environmental NGOs have been born from these initiatives; altogether their public awareness and education work has reached most schools in the State and moved citizen's support. Every six months since 1986 *Amigos* issues information and updating bulletins on Sian Ka'an, regularly publishes research papers and produces a series on "The Ecosystems of Sian Ka'an". These dossiers include complete sets of scientific information, education materials and field and lab practices for teachers and children (on wetlands, reefs, and forests), emphasizing how ecosystems function, regulate and complement each other, avoiding erosion, siltation, drought and flooding, protecting from storms and producing water, biodiversity and economic resources.

Some expected results have not been achieved yet. In Sian Ka'an fishermen are a well organized sector but other than this the Reserve still lacks a participatory body to share its management responsibility. It is positive that most field activities are funded by national sources, but funds are insufficient for the size of the area. Governmental budgets are extremely low. There is a lack of control over poaching in areas where no local communities exist, including both fisheries and wildlife. Tourism operators are already using Sian Ka'an without external control of their activities, and it yet remains to be seen if the regulations in the Management Plan will be truly enforced when the time comes for big tourism investors to express their interest in developing the 120 km-long wild coast of Sian Ka'an; as a matter of fact, the new State government has approved building an airport in the southern limit of the Reserve. In the surrounding *ejidos* the long-term sustainability of the timber extraction practices needs further research, while many other forest products have not found commercial applications. And anywhere, the medium-term effects of in-migration and of natural demographic growth remain to be assessed.

Factors contributing or hindering the achievement of results

Some of these achievements seem spectacular, particularly when expressed in a few written pages; but these are results of long and tangled processes taking many years and energies. While some phases were smooth and positive, the process also went through long periods of "one step forward - two steps backwards".

The *Plan Forestal Piloto* benefited from the marginality of the socioeconomic situation left behind after the period of timber concessions, from the lack of credit and alternatives -other than for a poor cattle ranching- and from the fact that lands were owned by the *ejidos*, so the decision on their destiny had to be agreed upon the community; here, the traditional forest culture of the Maya surely played a basic role in the decision of taking a chance for forestry. Sian Ka'an on its side benefited from its Federal-owned lands, almost pure limestone soils unattractive to farmers, extensive wetlands and difficult access. Both initiatives benefited from the lack of economic interests and development plans for these 'marginal' areas, from the political will of the State government, from the almost militant dedication and enthusiasm of

environmentalists and technical teams, and from the cultural traditions of respect to nature between the Maya people. However, once the programmes were launched the main factor contributing to their success and sustainability has been the active participation of the communities in the land-use planning and in the management of natural resources. The independence from external funds has also contributed.

The main factor hindering these processes has been the discontinuity in local and federal governments; after political turnovers new officials may block successful initiatives from previous authorities. The participation of the civil society and the appearance of the first NGOs -therefore decreasing the governmental influence- the involvement of some foreign technicians and even very low foreign funds, were all brandished against. Between 1987-1990 many energies were devoted to fight for the continuation of both programmes. The *Plan Forestal Piloto* continued because communities were already managing it; in Sian Ka'an the Reserve's direction was taken by politicians, the local Council of Representatives was abolished and NGOs had to keep the lowest possible profile. However, a few years later both programmes continued yielding worthy results and had gained enough popularity so that the threat of discontinuity in political support disappeared, hopefully forever. Political aspects are of particular importance in a country like Mexico with a very influential -and overgrown- governmental sector. Economic and financial issues, even secondary in this case, also hindered the process. No bank loans are found for sustainable and alternative production; communities are having problems to adequate their equipment and thus to produce and find commercial ways to their new products, particularly hardwoods. On the coast, even lobster prices are always high, the area was hit by two strong hurricanes driving the cooperatives to a serious debt and to over-harvesting of natural resources. In general, the lack of experience in sustainable production of tropical goods, and the scarcity of technical personnel, always claimed extra efforts in research and training, while at the same time production had to continue to ensure the collaboration of the communities. Sustainability is not yet granted, but in fact, who knows where sustainability stands and what it actually means for this ecosystem. However, we know that our best chance to continuously progress in that direction.

Adaptations made during the life of the initiative

The boundary of the Sian Ka'an watershed is difficult to find, as in some cases it is not a line but a flat wetland area whose run-off depends on winds and tides. In 1993 the southern limit was localized far more to the south and a new decree was prepared (Bezaury *et al* 1995) and passed in 1995: 89,118 new ha were added to Sian Ka'an, mostly wetlands. The first objective of this new protected area is to "preserve the quality, volume and flood-rates of the waters draining towards the Sian Ka'an Reserve".

Other adaptations pertain technical aspects of commercial production. In the *Plan Forestal Piloto* ongoing studies and management experience (Argüelles *et al* 1992) allowed to get closer to the sustainable volumes and rotation cycles for each timber species: e.g., those for Mahogany have been set in 13,000 m3/year, a mere 22% of what private concessions were extracting in the early 1980s. On the coast, lobster habitat and refuge has been enlarged by fishermen introducing artificial shadows, a kind of board with short legs on the sandy bottoms; initially

built with palm trunks -this particular palm is now protected- are now home-made with cement; but hurricanes have damaged or lost many of them; this has urged the diversification of fisheries to shark and fish species.

Factors affecting the sustainability of the initiative

Given the overall results of both initiatives, policy support, as explained elsewhere, should be granted. The concept has been accepted by the government and internalized by the communities. There was no need to create new institutions, only to coordinate the existing ones; while most of the field action in both initiatives is, after all these years, in non-governmental hands -a warranty for continuity. The local capacity has grown considerably as well, e.g.: community organization, sustainable production, technical assistance, financial administration and product commercialization. The almost complete independence of these programmes from external funding agencies strongly contributes to their sustainability.

Perhaps the most serious remaining threat over the coastal areas is the potential economic pressure from the tourism industry that has so strongly developed in the rest of the State. Other than this, ecological sustainability is still the main question; both initiatives have grown under ecological principles but are too pioneering to ensure productive sustainability. The diversity and functionality of the ecosystem are locally protected, but the long term response of some natural resources to global ecological changes and to present extraction rates also remains to be assessed in the long run.

Not enough time has passed to know the natural regeneration response of forests to the new management practices, but there is a recognized worry on possible overusing of precious tropical woods and on the difficulties to mechanize and commercialize the common hardwood species (Argüelles *et al* 1992). Research has also found that spiny lobster populations depend on post-larvae recruitment rates, which arrive as plankton along the coastal currents and in varying densities from the lobster breeding grounds far south in Central America; also, the densities of zooplankton and particularly *Copepodae* in the coastal bays depend on currents and prevailing winds. It seems clear that coastal ecosystems and marine resources are open to global influences beyond the areas' boundaries. Finally, around 2/3 of Sian Ka'an is below 3 m over sea level; the possible effects of global warming and sea level raising have not been yet analyzed in this area. Environmental monitoring should be a priority programme, but is still nonexistent.

Factors affecting the replication and scale-up

Both initiatives have known significant enlargements in the last years. The *Plan Forestal Piloto* initiated with 10 *ejidos* in 1983, grew to 26 in 1985, and to 56 in 1989. The main constraint has always been technical assistance, followed by local organization. Local capacity does not always grow at the same pace as local expectations; the situation has been preliminarily overcome now with the training of 32 local technicians, but ecological sustainability worries remain. The Sian Ka'an experience has also been replicated by government, issuing the Decrees of other 3 Biosphere Reserves in the State of Quintana Roo. These important initiatives set

apart for conservation purposes the best remaining areas in the State. All together, they create an almost complete system of protected areas representative of all the state ecosystems. The problems are the governmental shortage of funds to manage and protect these huge wildlands and the lack of present capacity to work with all the involved communities. But some lessons learned from the Sian Ka'an experience have been now applied from the beginning: an NGO arose to co-manage, together with local communities, the Yum-Balam reserve in the north of the State; and the marine Biosphere Reserve of Chinchorro Key will also be co-managed by the government, the traditional fishermen and a local NGO. These protected areas are almost physically linked by *ejidos* in the *Plan Forestal Piloto*, which should act as biological corridors; a project recently started in *Amigos* to promote the completion of these corridors.

LESSONS LEARNED

The most common and deeper ecosystem threats come from ill planned, short-term economic activities; ecosystem protection depends on many sectors, not only on the environmental agencies. Sectors as agriculture, forestry, fisheries, waters, tourism, can benefit from ecosystem protection and should participate in it.

Sustainable and innovative productive alternatives should be pursued; these should be placed through a new land-use ordination which takes account, not only of soil capacity as it is the usual practice, but of the potentiality of all other resources, biodiversity included, and of the social capacity and cultural traditions in each area. Based on this integrative analysis a zoning scheme can be devised to allocate all possible uses. Local people must understand and participate in this process. The State does not usually have the capacity to control most of the ecosystem management; only co-management practices and shared responsibilities, with economic sectors and with the communities, can accomplish this complex goal. Ecosystem management is a process; programmes can only set a general direction and start the wheel turning, trying to strengthen the local capacities (institutional, organizational, technical, financial) at each turn.

The monitoring of basic ecosystem and natural resource indicators is needed to keep coherence with long term objectives and to regularly evaluate the process. For all innovative programmes, the disposal of the best possible scientific information is essential in order to respond to the many unforeseen counter-pressures from short-term viewers and developers.

Main lessons learnt from ecosystem project organization

These initiatives did not really need large funding to start-up. Money can be used as a catalyzer but the most important factors in these experiences were political will, institutional coordination, integrative planning, continuity, and the role of motivated technical teams; against the usual practice, legal background and external funds arrived pretty after the former important factors had already been set.

Ecosystem management is a long term goal and continuity is essential. To internalize these processes relatively successful periods of up to 10-20 years might be necessary. However,

continuity is constrained by budget shortages and political changes; in our case the involvement of local communities and NGOs was essential to continuity. It also proved positive a high degree of financial independence, even it is not worth to start this type of programmes based on limited and inconsistent budgets. Money which arrives easy goes easy; external finance may induce to a false commitment; local commitment does not arise from donor cooperation but from a common diagnosis of needs and how to reach them.

Different sectors and institutions always have roles to play in ecosystem management; meetings and dialogue are necessary to find each other's complementary, non-competing missions. Institutional roles are better identified through field practice; to this end, it is important to avoid the most conflictive issues, and focus initially on one or two of those in which everybody seems to agree, thus building trust and cooperation experience between partners.

In our case, the best home for the new plans was the State agency of planning, rather than any sectoral one. Coordination was granted through ad-hoc Committees; instead of creating new organizations, it proved appropriate to use the existing ones, strengthening their capacity to develop their new roles better. This included the creation and training of inter-institutional technical teams. Field activities were planned in common for each year and budgets complemented; proposals to external donors were discussed in common. From our experience, constant feedback between planners and technicians is also essential: planners should have practical responsibilities in the field, while those implementing the field programmes should also have a participation in planning. Motivated and coordinated technical teams are the core to success and continuity; the best teams are inter-institutional and multidisciplinary, and with the highest possible participation of local personnel.

Main lessons learnt from community involvement

The concepts of 'Reserve' and 'Buffer' seemed to be more technical than popular; communities better understood the concept of 'multiple uses' through a 'zoning' scheme. In general, local people were more tolerant to conservation prospects than businessmen or new settlers. But it seems that communities will only protect their ecosystem as long as tangible benefits are clear, either in jobs, economic development, life quality, development capacity or sovereignty. To this end, conditioned concessions over state-owned resources and lands worked very well; new incentives, pilot economic activities, social services and training, all strengthened the will for participation and the sense of a shared responsibility.

Some means to involve local people from the beginning are to develop a community diagnosis in participation, and to hire locals as guides, informants, trainees and technical assistants. The best results were achieved when helping the communities develop the initiatives that they identified as **their** priorities -as long as being consistent with the long-term conservation goals. Institutions and technicians may serve as facilitators and advisors for these initiatives, in contrast with our generalized tendency to modify reality by adapting community initiatives to our own plans and structures. We learned that working with communities is slow and difficult; as communities seem simple and uneducated there is the wrong tendency to consider this a secondary job that can be worked out by a non-expert. No false expectations can be raised; their

priorities and timing, and their internal structures must be respected; it is also better to use the existing community organizations than to push any new ones.

Alternatives should be introduced gradually, starting with simple changes and being open to corrections and constant adaptations. All activities must have a strong component of training and strengthening of the local capacity. Technical facilitators should live within the communities; a common problem is that technical personnel may leave the projects, after gaining experience, to get better jobs in governmental or cooperation agencies in the cities. We also learned not to work **only** with the community leaders, who may be pursuing their own agendas, but to work as a priority with the full communities.

RECOMMENDATIONS

Ecosystem management is a complex goal involving many partners; it is not possible for a single organization to do it all. Co-management practices and shared responsibilities between governments, economic sectors and communities may be needed. Sectors as agriculture, forestry, fisheries, waters, tourism, all benefit from ecosystem protection and should be involved. Sustainable ecosystem management results from long-term processes involving participatory planning and implementation activities, rather than from particular projects. Ecosystem projects may stimulate these processes by setting a general direction and starting the wheel turning; their best contribution is to strengthen the local capacities: institutional, organizational, technical, and financial.

An inter-institutional Committee with a more operative technical team may play the basic coordination and assistance roles to these processes. The team should be inter-institutional and multidisciplinary, and with the highest possible participation of local personnel. In our case, the best home for the new plans was the State agency of planning, rather than any sectoral one. As a start, it is important to avoid the most conflictive issues, and to focus on one or two of those in which everybody seems to agree. Land-use ordination and zoning was the most significant initial activity in our case. Ecosystem projects should have purposes that can be reached: for the politicians, the objectives should be politically and economically viable; for the communities, it is necessary to proof the benefits. Communities will protect their ecosystem as long as tangible results are clear, either in development capacity, economic improvement, or life quality. Working with communities needs some expertise and sensibility; no false expectations can be raised; their priorities and timing, and their culture and internal structures must be respected.

Ecosystem management is a long-term goal and continuity is essential. In our case the involvement of local communities and NGOs has been a key to continuity, together with some degree of financial independence. External funds can be used as a catalyzer but the most important factors in our experiences were political will, institutional coordination, integrative planning, continuity, and the role of motivated technical teams. The monitoring of basic ecosystem and natural resource indicators is necessary to keep coherence with long term objectives and to regularly evaluate the process.

REFERENCES

Argüelles, A., D.G.Cortés and M.A.Terrazas. 1992. El Desarrollo Forestal, una Estrategia de Conservación de selvas de los propietarios forestales en Quintana Roo. Soc.For.Ejidal de Q.Roo, Cd.Chetumal, Mexico.

Bezaury, J. (and 11 collaborators). 1995. Conservación de la cuenca hidrológica alta de la Bahía del Espíritu Santo, Q.Roo, Mexico. Sian Ka'an, Serie Documentos No.3, pp. 1-37. Amigos de Sian Ka'an A.C. Cancún, Q.Roo, Mexico.

Gutierrez Glez., Efraim. 1983. Etnobotánica. *In:* Sian Ka'an: Estudios Preliminares para una Reserva de la Biosfera. Secretaría de Desarrollo Urbano y Ecología (SEDUE) y Centro de Investigaciones de Quintana Roo (CIQRO), Puerto Morelos, Q.Roo, Mexico. pp.147-179.

López Ornat, A. 1981. Diagnóstico Ecológico de Quintana Roo. Centro de Investigaciones de Quintana Roo (CIQRO), Puerto Morelos, Q.Roo, Mexico.

López Ornat, A. and J.J. Consejo. 1986. Plan de Manejo de la Reserva de la Biosfera de Sian Ka'an. Gobierno del Estado de Quintana Roo. Cd.Chetumal, Mexico. 141 pp.

SARH, 1982. Diagnóstico Forestal y Propuesta para un Plan Piloto para Quintana Roo. Gobierno del Estado de Q.Roo y Acuerdo Mexico-Alemania de Cooperación Técnica. Subsecretaría Forestal y de la Fauna, Secretaría de Agricultura y Recursos Hidraulicos (SFF-SARH). Coyoacán, Mexico.

SEDE, 1984. Informe Anual de Gobierno. Secretaría Estatal de Desarrollo Económico, Gobierno del Estado de Quintana Roo. Cd.Chetumal, Mexico.