INDIGENOUS TECHNOLOGY TRANSFER AND THE MAB BIOSPHERE RESERVE PROGRAM

by
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A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Science
(Natural Resource Management)
in The University of Michigan
1981

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NAJA, Mexico (AP) - Anthropologists say logging, cattle ranches, and peasant squatters are killing Mexico's last virgin forest and snuffing out the culture of its most traditional Mayan tribe, the Lacandon Indians.

"When the jungle is destroyed, the world dies. There won't be any water and the roots die. When there are no roots, there is no land." Chan Kin Viejo, the 85-year-old spiritual leader of the Lacandons, said.

Anthropologists and ecologists say nearly half of the 40-square-mile jungle, a tropical rain forest near the Guatemalan border, has been cleared by loggers, cattlemen, and invading peasants, who slash and burn the natural vegetation to plant subsistence crops of corn and beans.

If the clearing continues at this rate, they say, today's 25,600 acres may be whittled down to as few as 7,000 by 1990.

The tropical forest that 30 years ago was home to more than 3,000 Lacondon, Chol and Tzeltal Indians is now home to more than 100,000 peasants who left their homes to find more land. Officials say their numbers increase daily.

"The jungle is full -- the world is going to end," Chan Kin said.

AP, December 25, 1980

ACKNOWLEDGEMENTS

The author wishes to express his deepfelt appreciation to the many persons and institutions that have aided in the elaboration of this document. Thesis committee members Kenton Miller and Bill Stapp provided continual assistance and guidance throughout the duration of the project. Several others reviewed and critiqued part or all of the thesis. They include: Rich Block, Gerardo Budowski, Karl Hutterer, Craig McFarland and Kenneth Wild. Tom Gilbert and the United States Man and the Biosphere Program and the MAB Secretariat in Paris furnished much of the background material related to biosphere reserves.

In addition, personnel participating in the Rio Platano project from the Honduran Natural Renewable Resources Department: Wilberto Aguilar, Gustavo Cruz, Marcial Erazo and others, skillfully and conscientiously labored long hours during the development of the reserve's management plan and continue to follow through with management programs. Jorge Betancourte from Honduras' National Planning Commission was not only a guiding force behind the Platano effort but has also been instrumental in directing the author's conservation based approach toward development in the third world.

A special thanks must be given to my family for their encouragement and the gracious use of their homestead farm during the long period of research, writing, and rewriting of the thesis. Finally, without the understanding and support of my wife, Audrey, this work would have never been completed.

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PERSPECTUS

Introduction

The destruction of the humid tropical forest[1] with its associated ecological and social impacts has become one of the major environmental issues of the 1980s. At the current rate of deforestation, estimated by some scientists to exceed 100 acres per minute (Myers 1979) most primary rain forests will be gone by the turn of the century (Richards 1973).

The causes of this destruction are varied, with responsibility shared by both the developing tropical nations as well as more affluent temperate zone countries (Brown 1975, Eckholm 1976, Gwynn 1976, Myers 1979). Eighty-five percent of the two billion persons expected to be added to the global populous before the turn of the century will come from third world (developing) regions (Brown 1974). This augmentation in growth is expected to exert increasing pressures upon tropical ecosystems. Forests are the principal source of many basic necessities

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[1]Humid tropical forests are defined here as tropical woodlands receiving over 80 inches of rain more or less evenly distributed throughout the year (Ayensu 1980).

for these peoples. Firewood collection, for example, supplies energy for cooking and heating to hundreds of millions but annually leaves an estimated 25,000 Km^2 of forest degraded or destroyed (Myers 1979). Timber and vegetative fibers are cut for construction of houses and other structures. Fish, wild animals and medicinal plants are all harvested in great quantities by low income peoples and serve as important nutritional supplements (Budowski 1978). With prime lowland farming areas in the tropics often dominated by large (sometimes foreign owned) agricultural enterprises, peasant farmers in many regions are forced to settle in wooded upland zones. The fragility of many rain forest ecosystems (i.e., nutrient poor soils often susceptible to erosion upon the removal of native vegetation, Richards 1973) coupled with farming practices ill-suited to these ecologic conditions has resulted in the deterioration of large areas of forest. Commercial logging operations provide inroads into previously unsettled regions which are subsequently invaded by these landless farmers. Forest industries themselves have increased production sharply in recent years in an effort to keep pace with the recent 14-fold increase in demand for tropical hardwoods by developed nations (FAO 1978). This level of utilization actually surpasses that used within the regions where the timber originates. The wood industry

and the cultivators that follow closely behind together account for the elimination of approximately 200,000 Km^2 of tropical rain forest per year (Myers 1979). The conversion of forestland to pasture for livestock is another problem which is especially acute in Latin America. Around 20,000 Km^2 of primary forest are cleared annually in Central and South America for the establishment of large ranches (Myers 1979) with a significant proportion of the cattle being exported to developed nations (Eckholm 1976). Urbanization, mining, engineering works and the careless use of toxic chemicals are just some of the other activities of man which have contributed to the demise of these tropical resources.

Until recently, much of this destruction has gone unchecked. However, there is increasing evidence that impacts from this degradation will not remain confined within the borders of developing nations but will have widespread reprecussions (IUCN 1979). The loss of wild cultigens, for example, could adversely effect the future of the temperate zone agroindustry (Myers 1979). Consequently, tropical deforestation is becoming a focal point for many international conservation and development programs. The International Union for the Conservation of Nature and Natural Resources (IUCN) has identified this problem in its "World Conservation Strategy" as a primary target for global resource protection efforts:

> Tropical forests are an important renewable resource, acting as a reservoir of genetic diversity, yielding a continual supply of forest products if managed sustainably, helping to regenerate soils and protect them from erosion, protecting areas downstream from floods and siltation, buffering variations in climate, and providing recreation and tourism. If tropical forests are exploited—as generally they are—with scant regard for their ecological characteristics, the resource cannot renew itself . . . International action to conserve tropical forests is required most urgently in West and East Africa, South and Southeast Asia, Central America and Mexico, and parts of South America (IUCN 1979).

The Agency for International Development (AID) of the United States has also recently implemented watershed and the wildland management projects in several tropical humid forest regions.

Although the loss of genetic material, extirpation of plant and animal species and general ecosystem disruption of these diverse systems has received increasing publicity, there is another rain forest inhabitant which is also disappearing -- the human indigenous cultures which have for millennia occupied and in some cases flourished within the tropical woodland biomes. They and their wealth of ecosystem knowledge have, over the last several hundred years, been radically altered by European colonization and the expansion of Western culture into these formerly isolated zones (Gross 1975). The results have been tragic. In the Americas alone, it is estimated that Indian populations have been reduced from several million in pre-Colombian times to around a million today

(Prowl, pers. comm.). In places where outright genocide did not occur, inappropriate "acculturation" programs have left many of these indigenous peoples caught between two worlds, that is, ignorant of their own cultural heritage and rejected by Western cultures (Watters 1971).

This social disintegration has been accompanied by a breakdown of traditional food producing systems. Ecologically sound techniques for harvesting and managing the tropical moist forest which took thousands of years of experimentation, were abandoned or forgotten (Miracle 1967). In many cases they were replaced with technologies and practices which were insensitive to the fragile ecological and social systems and left both of these in disarray (Nietschmann 1973).

In the developing Neotropical nation of Honduras, the global pattern of ecological and social disruption upon colonization is exemplified. Over half of that nations original forest cover and most of its indigenous population has been eliminated since the conquest (Glick 1980). Vestiges of formerly abundant Indian groups survive only in isolated zones often buffered from Western influences by intact wildland resources.[2] However, non-indigenous cultural traits and values imposed

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[2]Regions considered "wildlands" are "territories of land and water which have been little affected by modern man, or have been abandoned and are reverting to nature." (Miller 1978).

upon even these people are supplanting their native cultural heritage. Alcoholism, social disintegration and ecosystem abuse are common manifestations of this social reorientation (Glick 1980).

As with the problem of tropical forest destruction, this situation has also been the recipient of some global concern by a variety of humanitarian and even conservation and development agencies (IUCN 1980). Although many of these efforts have been minimal, some groups such as AMARU IV, the International Working Group on Indigenous Affairs (IWGIA), Survival International and others have been actively involved in aboriginal protection and development (Bentley 1979).

Like much of the earlier work in conservation, most groups and individuals involved in these efforts have taken a philosophical, humanitarian or even religious justification for promoting cultural heritage preservation. Only recently have pragmatic arguments been proposed for the defense of native peoples. Their knowledge of tropical ecological features and their appropriate use is beginning to be perceived as a human resource of international significance, which merits adequate protection. The National Academy of Science recently issued this statement in relation to research priorities for tropical biology:

> Another major gap in our scientific information concerns the functioning and adaptation of human populations in the tropics. Aboriginal populations have long existed in tropical forests and possess considerable knowledge about them. Human diversity as well as biological diversity is being reduced world-wide, and the rich variety of conceptual and agricultural expression that characterizes the thousands of people living in the tropics is of great theoretical interest . . . (NAS 1980: 35).

This concern for traditional land uses should not be construed as an argument for depriving these people the opportunity to advance and improve their quality of life. It is rather to facilitate this in such a manner that negative ecological and social impacts of development are kept at a minimum. Of equal importance is that their wealth of indigenous knowledge not only be retained but actually recorded and disseminated for implementation in biologically similar regions (Vandermeer 1980).

The peculiarities of the problem of maintaining the cultural integrity of native peoples and utilizing their knowledge—the fact that it is almost global in perspective and multidisciplinary in scope—has made it a difficult one to approach. Although much of the baseline data on indigenous lifestyles has already been gathered, little has been assayed in relation to its usefulness for introduction into tropical development programs. Also, few recommendations for actually facilitating this transfer have been proposed. With this in mind, the theoretical justification for initiating the collection

and transfer of native technologies to aid in identifying sound development practices for the humid tropics is presented in this thesis. A series of action plans and guidelines for actually initiating indigenous technology transfer programs utilizing the international Biosphere Reserve Program is also included. The Biosphere Reserve Program is sponsored by the United Nations Education, Science and Cultural Organization (UNESCO) with the assistance of cooperating nations. It is an effort to establish a network of protected wildland units encompassing representative samples of the earths major biological provinces (UNESCO 1973).[3]

Research Design

Development of this topic included both field research and literature review. Over a period of four years several investigations were carried out within the Rio Platano Biosphere Reserve located in the northwestern sector of Honduras known as La Mosquitia. The researcher worked closely with Honduran wildland planners, representatives from the Man and the Biosphere Program (MAB)—the sector of UNESCO administering the Biosphere Reserve project—and other related international conservation

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[3] The Biosphere Reserve Program is described in detail in Chapter 3.

organizations. These trips culminated in the redaction of the Rio Platano Management Plan.

Background information concerning the MAB program and biosphere reserves was collected for the elaboration of a case study on the evolution of the Platano Reserve. This was prepared for the Integrative Studies Center of the School of Natural Resources, University of Michigan. Contacts were made with the MAB Secretariat in Paris which coordinates international MAB activities, the U.S. MAB Secretariat in Washington and with several associated agencies. These include among others: the Tropical Agricultural Research and Training Center (CATIE) in Costa Rica, the Department of Renewable Resources (RENARE) and the MAB committee in Honduras, and the Sierra Club International Division in New York. Interviews with representatives involved in related efforts were held and several United States Biosphere Reserves were visited during the summer of 1980.

Under the guidance of faculty members from the Department of Anthropology, University of Michigan, an investigation of natural resource utilization practices from the humid tropics was initiated. Other anthropologists and natural resource managers with expertise on this subject were consulted.

It was during this exposure to the ethnographic literature that the author began to perceive the

relevance of anthropological data to natural resource conservation projects. When it was realized that few efforts of this nature had been attempted, a strategy was formulated which might facilitate such a transfer of information. Experience with biosphere reserves led the investigator to believe that the MAB program could provide the necessary framework for initiating such an endeavor.

Physical and managerial components needed for this indigenous technology transfer were formulated and seemed to fit into the theoretical Biosphere Reserve framework which is presented in Chapter 3. When applied to an existing reserve (the Rio Platano) this concept not only appeared to be feasible but also seemed to contribute to the successful operation of the reserve. Although true assessment of this proposal could occur only after monitoring the operation of indigenous technology transfer programs, the justification for initiating such activities as well as project guidelines for its realization are included here.

Presentation of Thesis

Following this introduction, the second chapter will describe food procuring activities of tropical forest dwellers which could have applications in comparable ecologic zones. Though not an exhaustive study, it has

been carried out to demonstrate that a plethora of knowledge on sound land use practices for tropical moist forests already exists in the literature. Much of the experimental work of institutions attempting to perfect forestry and agricultural techniques for the humid tropics could seemingly be circumvented by studying what has been done in the past or is still being practiced in some isolated regions.

After reviewing these potentially transferable hunting, gathering and agricultural activities, a strategy for further collection and dissemination of this type of information by means of MAB's Biosphere Reserve Program is outlined in Chapter 3. In Chapter 4, a methodology is presented for incorporating an indigenous technology program in Honduras' Rio Platano Reserve. Chapter 5 suggests a development sequence and guidelines for the effective initiation and operation of such projects in similar areas. The closing chapter summarizes thesis findings and includes several recommendations related to indigenous technology transfer programs.

CHAPTER II

INDIGENOUS UTILIZATION OF TROPICAL HUMID FOREST ECOSYSTEMS

The Tropical Humid Forest Dwellers

Indigenous peoples are defined as: 1) inhabitants of rural areas that practice subsistence and largely traditional agricultural and hunting and gathering techniques and have retained much of their archaic language, customs and a social structure distinct from the national culture (AMARU IV 1980), and 2) highly civilized native groups such as the highland Andean peoples, some of whom have remained culturally intact while others have adopted introduced lifestyles (Miller, pers. comm.). Much like the ecosystems in which they reside, indigenous populations occupying tropical moist forest regions are characterized by their diversity (Hutterer 1976). Even cultural groups which share the same language and tribal identification may be widely divergent in their resource utilization patterns depending on the characteristics of their habitat.

The Miskito Indians of Nicaragua, for example, have based their socioeconomic structure and their entire lifestyle around the hunting and sale of sea turtles (Nietschmann 1973). Two hundred miles north, Indians of

the same linguistic and cultural stock have no interest nor skill in capturing these reptiles. They are, however, very adept in diving for lobster (Glick 1980). The difference between the two groups can be explained by investigating their natural environment. The Nicaraguan coast has long been recognized as an important sea turtle feeding ground, primarily because of the existence of extensive sea grass beds (Nietschmann 1973). The Honduran coastal area though almost devoid of large turtle populations is, because of its extensive mangrove swamps, an area abundant in lobster and shrimp. Thus, two segments of the same cultural group have developed divergent natural resource harvesting traits.

This is true of most indigenous groups occupying humid tropical areas. Until recently, lay persons and even some scientists have mistakenly categorized rain forested areas as being homogenous and lacking any appreciable variation. We are now finding that this is far from true and even large expanses of superficially uniform woodlands such as those of the Amazon Basin are actually composed of diverse biotopes and habitats (Ross 1978). Accordingly, a variety of resource utilization practices have evolved among those forest dwellers and sweeping generalizations about their land use characteristics can often be erroneous.

One common example of the misconceptions often related to aboriginal lifestyles revolves around the stigma of slash and burn agriculture. Generally, one or a few methodologies for practicing this farming technique are described and applied to all peoples involved in swidden systems. To some degree this may be true when dealing with those groups whose lifestyles have been severely altered by outside influences. But it is seldom the case with culturally intact native groups. Literally, dozens of agroecosystems may exist for just one tribe, if they occupy varying terrain (Conklin 1957).

Another characteristic of these people is their diversified food gathering techniques. Generally, some form of hunting and fishing provides necessary protein intake. This is complemented by stationary or migrating agricultural practices which supply needed calories. In some cases, as with the Guaymi Indians of Panama, hunting and farming activities are integrated into one system termed "garden hunting", which will be discussed later (Linares 1976).

The effectiveness of any hunting and gathering or agricultural practice among these groups is determined by their level of social organization. Maintenance of religious and social ritual is of utmost importance in insuring ecologically sound utilization and appreciation of natural resources (WWF 1980). This is exemplified by

the complex system of taboos and customs which shape and direct the resource harvesting patterns of many of these groups.

Scarce and commonly shared resources such as land for agriculture and wildlife for protein are oftentimes subject to a highly structured allocation system (Ross 1978). Although this may take the form of esoteric religious or magical practices, it nevertheless is often based upon ecological principles (Hutterer, pers. comm.).

Warfare among several tribes in the Amazonian region has been an integral part of their cultural development. Many reasons for this seemingly self-destructive conflict have been proposed including the adoption of armed conflict as an adaption to low protein availability (Gross 1975). Warfare substantially regulates population growth of small native communities, thus reducing human pressures upon fragile tropical ecosystems.[1] It is also theorized that constant warfare results in the indirect creation of "no man's land" regions which serve as a wildlife refuge where animal species may reproduce unhindered by human predation, later to be harvested when they migrate out into occupied territories (Gross 1975).

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[1]Although warring may limit population growth among small isolated indigenous groups, it should be noted that the characteristic "baby booms" which follow large scale wars have generally caused global population increases (Stapp, pers. comm., and Miller, G. T. 1975).

The final yet perhaps most salient feature of primitive indigenous societies is the almost global deterioration of their social and environmental make-up upon contact with non-aboriginal cultures. Much like the ecosystems in which they dwell, they have developed a multitude of adaptations and symbiotic relationships and occupy well defined and very specialized niches. Although diverse and stable under unaltered conditions, the tropical rain forest is known to be extremely susceptible to even minor alterations in its composition (Richards 1952). Among the oldest of the planet, these ecosystems have experienced fairly uniform environmental conditions for almost 50 million years. They are characterized by complex ecological interrelationships (Gwynne 1976) and have been the home of some of the most isolated and highly adapted societies on earth. Alteration of their natural or cultural environment also sends far-reaching impacts which can disrupt all but the most resilient groups.

Under natural conditions these peoples seldom incorporate any practice into their lifestyle which will jeopordize their harmonious relationship to the environment. Generally, only with the advent of outside social and economic influence does one find evidence of native people disrupting the carrying capacity of local ecosystems (Conklin 1957).

For example, traditionally the Miskito Indians of Nicaragua have exploited local turtle populations at a rate which insures their sustained yield of protein and other goods. However, the recent inception of large scale commercial trade in turtle products has upset this system causing a severe decrease in turtle populations. This in turn is leading to the social disintegration of these peoples as their traditional communal organization gives way to independent competition which in this case may not be the most appropriate social system for their environment (Nietschmann 1973). In a similar vein, increasing pressure upon migrating agriculturalists in the form of economic incentives for surplus production or augmenting competition for their land by outsiders is the major cause of abandonment of sound swidden practices and the adoption of potentially destructive farming techniques (Rappaport 1971).

Indigenous Uses of Humid Tropical Forests

Hunting and Gathering

As mentioned previously, food producing activities of many native cultures can be categorized into hunting and gathering (which includes fishing) and migrating or stationary agriculture (which includes animal husbandry). Hunting and gathering in this paper is defined as the

harvesting of naturally occurring and propagated plant and animal species. It includes such activities as hunting and trapping of wild game and gathering of their eggs or offspring, and the collection of plants and their products. These organisms can be utilized for a variety of purposes such as protein sources, medicinal extracts, clothing, shelter, ceremony and magic, and myriad other goods and services. Several which demonstrate their potential for application in the regional development of similar areas are described. Many of these activities could profit from some modification such as the incorporation of appropriate modern technology into their design or the infusion of indigenous practices from other cultural groups. Nevertheless they present those interested in ecologically and culturally sound development a time tested base upon which to build regional development strategies.

Medicinal Plants

Over 50% of the medicines we buy in the pharmacy come directly from plant sources. Most of these plants are found in tropical areas (Myers 1979). At this time, a very small percentage of tropical forest plants have been assayed to determine their medicinal qualities. Indigenous cultures retain a storehouse of knowledge in the use and applications of these plants for medicinal

purposes. Without pharmacies they have by necessity collected this information for the simple reason of survival.

The Bayano Cuna Indians of Panama use plants to treat such varied illnesses as infections, toothaches, back pains and stomach aches (Bennet 1962). Although their average life span is below the Panamanian national average, it is still quite high considering their rigorous existence and the fact that the major disease -- tuberculosis -- was recently introduced. Treatments for this malady have not benefited from years of experimentation as is the case for more common naturally occurring illnesses.

Several anthropologists have cited the use of plants for birth control and for abortion (Bennet 1962). And not only are plants used for human illnesses, but it is also common to treat injuries and sicknesses of domestic animals with these natural cures. Piroplasma, pneumonia, sunstroke, inflammation of the throat and diarrhea, all common maladies of livestock in the Congo, are treated with plant derived medicines (Miracle 1967).

Wild Plants for Food

The great variety of edible wild roots and tubers, plants, shrubs, and tree products, not only serve as a vital dietary supplement for native peoples but also

makes up the genetic stock of many of our most important commercial herbacious foodstuffs (Myers 1979). Such important crops as rice and corn originated in the wilds and we still depend upon feral strains for the development of new varieties. The Maya of the northwest Guatemalan highlands alone cultivate 166 varieties of corn (Stadelman 1949:112). Besides these more conspicuous grains, there are an estimated 80,000 edible plants (Myers 1979), most of which have yet to be investigated by scientists. Primitive cultures, however, have for millenium harvested these naturally occurring foods and in some cases incorporated them into their agricultural systems (WWF 1980).

A good case in point is the productive yet wild occurring Sago palm (*Metroxylon* sp.) in Melanesia and Indonesia. Sago is considered to be the known plant for which man can obtain the largest yield of carbohydrates with the least amount of labor (WWF 1980). The palm itself grows in swampy areas often unsuitable for most types of agricultural activity. The Sago starch is produced by cutting the tree, pounding and straining the pith and then sundrying the starchy residue. One species of Sago is cut and left to rot. Beetle larvae which thrive in the decomposing logs are later collected and serve as an important protein source. Several naturally found palms of the Americas such as the moriche palm

(*Maurita flexuosa*) in Venezuela which is exploited by the Warao Indians also produces large quantities of carbohydrates. In the case of this Amazonian tribe, the moriche serves as their staple food (Townsend 1973).

For every plant cultivated by native peoples, many more wild ones are collected for food, medicine or shelter which can often eventuate in domestication. The ratio of the varieties of plants cultivated to those known or gathered from the wild is on the order of 1:20 in the tropical Amerindian groups (AMARU IV 1980).

Wild Plants for Construction and Clothing

At the present time, the development of the forest industry in the humid tropics has been severely handicapped by the derth of information on the construction qualities of various tree and plant species (Preston 1980). But most forest dwelling native peoples directly depend upon these materials for building shelters, furniture, tools, implements, boats and other goods. Many species which have only recently been identified by scientists have long histories of indigenous use.

In the Mosquitia of Honduras, for instance, Paya Indians have identified several hardwood species suitable for the construction of various types of boats and dug-outs (RENARE 1978). In Southeast Asia bamboo is one of

the most common construction materials, not only for houses but for furniture and tools (Budowski pers. comm.). Although bamboo grows naturally and has been introduced into several parts of Latin America, it is seldom utilized except in Ecuador because of a lack of technological expertise in working this material (Budowski pers. comm.).

Many indigenous groups presently or recently fabricated their clothing from various plant and tree species. The Luvale tribe of the Congo basin utilize the abundant raphia palm to produce the raw materials for clothing needs (Miracle 1967). The Miskito Indians of Honduras who formerly utilized the "tunu" bark to make clothing, now produce items made from this material such as vests and purses to sell to export shops in the capital city.

Hunting

Because of its extreme importance in providing needed protein and owing to the general scarcity of game species (as compared to the African savannah or more temperate regions), hunting has reached a high degree of specialization among tropical forest dwelling peoples of Latin America (Ross 1978, Gross 1974). Intricate religious and magical ceremonies often surround hunting activities and taboos placed upon certain game animals are common. It is theorized that these taboos serve to

regulate hunting of rare or easily exterminated species (Ross 1978). The Jivaro tribe in the Amazon, for example, has established taboos which prohibit harvesting several wildlife species. Upon further inspection, one finds that most of these tabooed creatures are those with low reproductivity rates or those which generally cannot tolerate extensive hunting pressure such as the tapir or capybara (Ross 1978). Investigation of hunging magic and taboos could give regional wildlife managers a fair idea of which populations would be conducive to harvesting.

Indigenous hunting practices are often more effective than introduced weapons such as the rifle or shotgun. Use of poison tipped arrows and darts have been found to be very appropriate for hunting common arboreal species such as monkeys and sloths. This is because curare, the muscle relaxant used to coat the projectile points promotes the dropping of these species when they are hit. There is often a waste of meat when these animals are shot with a gun because of their reflex reaction to cling when injured (Ross 1978). These "silent" weapons also allow a hunter to down an animal without causing other potential game to flee (Ross 1978).

As mentioned before, warring tribes often establish "no man's land" regions which also serve as refuges for wildlife. In areas where there is no inter-tribal

conflict, it is common to find sacred or even "haunted" forests (Conklin 1957) which are completely protected and seldom visited. These probably serve the same wildlife and watershed management purposes.

A point which is repeated in most ethnologies dealing with subsistence agriculture in tropical forest zones, is the abundance of wildlife which congregates and often seriously degrades horticultural plots (Conklin 1957, Spencer 1966, Freeman 1955). Olga Linares, an archaeologist working in the tropical moist forest of Panama has theorized that indigenous cultures in this area actually managed this wild game in such a manner that it would continually yield adequate supplies of protein (Linares 1976). In this way, wildlife populations were artificially increased and served as a substitute for domesticated livestock.

Agricultural Systems

A thorough description of the variety of indigenous agricultural practices is beyond the scope of this paper. It is, however, feasible to outline some of the general characteristics of indigenous horticulture and identify innovations of particular groups which may have applications on a broader scale.

Agriculture in a primitive society that has remained relatively isolated from outside influences can usually

be characterized as being at a subsistence level. Surpluses may occur but they insure extra foodstuffs in years of drought or crop failure. Many times this excess (usually a starchy tuber such as sweet potato or cassava) supplements the diet of domestic animals such as pigs (Rappaport 1971).

The general agricultural strategies are: 1) systems that will require extensive labor input such as the construction of terraces and irrigation systems (as formerly practiced by the Maya and Inca) or 2) the light cyclical use of land as in slash and burn swidden cultivation. A third strategy could be considered a combination of the two and this would include some agroforestry practices where crops and trees are combined and the plots are continually manipulated to some degree.

Generally, native agriculturalists practice shifting slash and burn agriculture, a method superficially very similar to that practiced by peasant farmers around the tropics. However, upon further inspection one finds that these indigenous farmers have more often than not highly developed and oftentimes quite appropriate horticultural methods (Conklin 1957).

Intricate social and religious rituals regulate land use and allocation and many customs are very important in achieving efficient utilization of the land. The Hanunoo of the Philippines, for example, recognize a variety of

soil types and indicator species and will not plant in areas that do not demonstrate certain characteristics. Conklin describes a practice among the Hanunoo known as patuk in which a stalk of bamboo is pounded into the ground. If soil is found all the way up to the node, this is a good omen and the sign of an ideal spot for planting. If little dirt has filled the cylinder, the area is avoided for agriculture. This, like many of their magical traditions, may deal with highly technical agronomical criteria such as soil compaction and soil moisture, drainage and in the case of indicator species -- soil fertility.

Many groups establish set migration patterns to insure adequate fallow times for their crops and adequate distribution of land (Spencer 1966). Because reforestation (if not propagated by man) occurs from the sides (Richards 1952), plots are oftentimes completely surrounded by forests to promote rapid regeneration.

Slash and burn agricultural practices have been categorized by various anthropologists as varying in their complexity and sophistication. These range from merely cutting, burning and planting of crops to selective cutting, burning and planting of crops with tree species. Several characteristics of the basic cutting, burning, planting and harvesting scheme will be described.

Cutting and Burning

Whereas fires from the swidden agricultural plots of subsistence peasant farmers of the tropics often rage out of control, those of many of the primitive aboriginal cultures are strictly regulated. Among the Hanunoo, wind and weather conditions must be such that they facilitate a "good burn" yet will not run out of control. One and sometimes several fire lines are dug around agricultural plots and special techniques such as backfiring are used to direct the flames (Conklin 1957).

Several tribes in the Congo area burn vegetative refuge under piles of dirt to produce a type of compost which is rich in nutrients and organic materials (Miracle 1967). Unburned logs are sometimes laid across the grade of the slope to retain the soil (Rappaport 1971). Fences are often built with some of the downed trees and shrubs to protect crops from marauding livestock and animals (Rappaport 1971).

Planting

A wide array of planting methods are used by these forest cultures. Many groups, especially those of the Congo basin, have developed a variety of fertilizing and composting techniques (Miracle 1967). Nutrients released through burning are supplemented with compost and mulch

composed of domestic household wastes, extracted weeds and sometimes human and animal fecal matter. This is often processed in compost piles and when thoroughly decomposed, spread on fields. Sometimes livestock corrals are periodically relocated with agricultural plots replacing them. This is also true with living sites. Ant mounds and termite mounds in this same region of the Congo are often considered prime planting areas because of their concentration of organic materials (Miracle 1967).

Planting stock usually includes not only crop species but also several varieties of each cultigen. The Iban of Sarawak plant literally dozens of strains of rice which insure not only the survival of at least some of the varieties but also continual year round production (Freeman 1955). This is also true of many other indigenous agricultural groups. Aboriginal tribes in New Guinea have over 12 varieties of taro plant and one group, the Tsembaga, can name 264 varieties of edible plants representing 36 species (Rappaport 1971).

Several special planting techniques are practiced depending on local ecological conditions. Some groups design small mounds and plant crops upon them. This concentrates nutrients and decreases soil compaction which inhibits the growth of root crops (Miracle 1967). Others build terraces or dikes which can reduce soil

erosion and retain soil moisture for water adapted plants such as rice.

In many swidden plots, intercropping is the most common planting method (Clarke 1976). Intercropping is the seemingly random mixing of a large variety of cultigens in the same agricultural clearing. This practice serves many useful functions. To some degree it mimics the diversity of the primary forest ecosystems making it less susceptible to insect pests or plant diseases. Legumes intercropped with other cultigens fix nitrogen in their roots and aid soil fertility. Some of the large leafy species provide protective cover for shade loving crops.

In agro-ecosystems where fruit trees are also planted, agricultural plots actually resemble the natural forest structure. Roots from these large plants and trees help to retain soils. Leaves buffer the earth from erosional effects of heavy rains and detritus from larger plants fertilize and mulch other species (Clarke 1976). This stratification of garden plots also makes maximum use of surface area and variations in vertical dimensions (Rappaport 1971).

In his study of the Tsembaga of New Guinea, Rappaport outlined the subsistence agricultural practices of a woodland peoples which actually promoted the regeneration of the forest in their agricultural clearings.

Selective weeding is done with special care taken not to uproot tree species which have become established. As stated by Rappaport " . . . . a Tsembaga gardener is almost as irritated when a visitor damages a tree seedling as when he heedlessly tramples a taro plant." Tree growth prevents the introduction of grasses which can inhibit forest succession from occurring. However, it also makes harvesting and weeding increasingly difficult and oftentimes causes the premature abandoning of horticultural plots. The ecological adaptation of this early abandonment is that complete soil exhaustion is avoided and natural regeneration promoted (Rappaport 1971). As Rappaport pointed out, this is a classic example of the thesis that Howard Odum and Ramon Margalet have argued for years: " . . that in complex ecosystems, successful species are not those that merely capture energy more efficiently than their competitors but those that sustain the species supporting them" (Odum 1971).

Domestication of Wildlife Species

Domestication of wild species is practiced on a limited scale by some tropical forest groups although those who periodically migrate are hesitant to be burdened by animal stock. Although animal capture and propagation seems to be more of an incidental occurrance rather than an actively pursued practice (Nietschmann 1973, Bennett

1962), it still holds much potential for implementation in humid tropical regions. Many groups collect the offspring of animals which have been hunted such as paca (*Cuniculus paca*), peccary (*Pecari angulatus*) and white tailed deer (*Odocoileus virginianus*) in the American tropics and raise them in enclosed areas within their villages (Nietschmann 1973). In New Guinea, domestic pigs are allowed to reproduce with feral pigs, thus producing a hefty swine well suited for forest foraging (Rappaport 1971). Natives living in the varzea (seasonally flooded) region of the Amazon basin often capture and raise the giant Arran turtles (*Podocroemis expansa*) in small enclosed lakes. It is estimated that a one acre lake of these turtles can produce 440 times more meat annually than a one acre cattle pasture (22,000 lb./acre/year vs. 50 lb./acre/year) (Ayensu 1980).

There seems to be several species such as the capybara (*Hydrochoerus hydrochaeris*), peccary (*Tayassu pecari*) and tapir (*Tapirella bairdi*) which show great promise for domestication in the American tropics (Espriella 1975). In Africa, game ranching has become firmly established in many areas with wild species being raised for domestic consumption (Surujbally 1978).

Indigenous Technology Transfer to Regional Development Programs

Until recently, the term "technology transfer" in development nomenclature usually denoted the vertical transfer of information and technology from northern temperate developed countries to the lesser developed nations of the tropics. The results have been termed in many cases disastrous, both environmentally and socially. These practices are more often than not ill-suited for the distinct ecological and cultural features of tropical zones and have caused documented widespread ecological degradation and social disintegration (Farvar and Milton 1972). With the recent advent of development strategies which take conservation into account, consideration is given to local resources, technologies, and human and natural features in all aspects of the development process. Indigenous exploitive practices have evolved over thousands of years. Many costly and time consuming research projects related to tropical forest management could be reduced, and the tendency to "reinvent the wheel" avoided.

Some agencies and institutions are attempting to implement such programs: the National Amazon Research Institute, the Mexican Institute for the Study of Medicinal Plants, the Catholic University of Peru, CATIE in Costa Rica, the Agriculture and Anthropology Program of

the University of Florida are a few. However, efforts have been hampered by lack of funding and support from both national and international agencies. (Agroforestry, the rediscovered tropical agriculture technique is an exception with much support and interest from international aid and development concerns.) One fledgling effort in international conservation activities—the Man and the Biosphere Program (MAB) Project 8, "Biosphere Reserves"—could provide the needed organization and infrastructure for coordinating and implementing such a project. Not only is MAB 8 potentially capable of carrying out extensive investigations of this nature but it is also designed to facilitate experimentation and field trails and later incorporate knowledge gained into regional, national and international development programs.

CHAPTER III

INDIGENOUS TECHNOLOGY TRANSFER AND THE MAB BIOSPHERE RESERVE PROGRAM

Overview of the Man and the Biosphere (MAB) Program

The Man and the Biosphere Program came into being at the 1970 meeting of the General Conference of the United Nations Educational, Scientific and Cultural Organization (UNESCO). Initiation of the project was spurred by a growing awareness among the international scientific community of the accelerating global deterioration of the earth's biosphere. Also recognized was the generally ineffective results of non-integrative efforts to combat these problems. At this meeting, the International Coordinating Council (ICC) for MAB was formed and charged with designing the programs guidelines (UNESCO 1977).

The MAB program was really an offshoot of the International Biological Program (also a U.N. sponsored program) but differs from the latter in that it stresses intergovernmental cooperation and is oriented toward actual management of natural resources and their utilization (Gilbert 1978). The unique aspect of MAB is its integrative international approach to resource issues

arising from man's intervention with natural systems. It attempts to provide the heretofore missing link between scientific disciplines and application of resultant knowledge and technologies (Franklin 1977).

The major focuses of MAB efforts include:

> the general study of the structure and function of the biosphere and its ecological regions to provide an improved environmental information base for decision making;
>
> systematic observation of changes brought about by man in the biosphere in order to provide new tools for environmental planning and resource management;
>
> the study of the effects of these changes upon human populations to improve our ability to predict these effects and to develop new strategies to lessen their disruption to human lives;
>
> meeting the educational and information needs relating to these subjects. (U.S. MAB 1977.)

Thus, MAB is one of the first international organizations to provide a framework for coordinating diverse global efforts in research conservation and training. At this time 82 nations are involved in the MAB program. Activities are guided and supervised by the International Coordinating Council (ICC) which is composed of representatives from over 30 nations. It is the role of the ICC to develop international guidelines for MAB while national committees in each member country define and organize national priorities within ICC guidelines.[1]

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[1]Approximately 87 National MAB Committees had been established by 1979 (Risser and Cornelison 1979).

The ICC also organizes special working groups and expert panels to assist national efforts and coordinate international activities (Gilbert 1978). An integral component of the MAB philosophy is the promotion of the projects on the regional and sub-regional levels (i.e., inter-nation cooperation on shared environmental issues.

The International Coordinating Council has selected 14 project areas which receive the bulk of emphasis and effort. Projects 1-7 focus upon several of the earth's major ecosystems (forests, grazing lands, arid lands, fresh and marine water, islands, mountains and tundra). Project 8 is concerned with biosphere reserves and Projects 9-14 are oriented toward "systems and processes" (major engineering works, demographic changes, urban systems, pesticide use, environmental perception, and pollution). An integrative approach to resource management is emphasized in all of these projects. None are considered to be mutually exclusive or independent of the others.

Project 8 - Biosphere Reserves

Project 8 of the MAB program, "Conservation of Natural Areas and the Genetic Material they Contain", is designed to develop an international network of protected wildland units which represent the earth's major biological provinces.

> These protected areas are of vital interest and importance to the nations of the world because of their role in scientific research, education and training. They represent baselines or standards against which change can be measured and the performance of other ecosystems judged. They represent a mechanism for conserving genetic materials of currently or potentially useful plant and animal species. And, they are areas of land and coastal environments containing representative examples of natural biomes or habitats throughout the world protected so that as complete as possible a sample of such biomes are preserved for future generations. (UNESCO 1976.)

In 1974, a UNESCO task force met and formulated criteria and guidelines for the choice and establishment of biosphere reserves. In this same year several nations announced the declaration of reserves. Since then, 35 countries have become involved in the project (Risser and Cornelison 1979).

> The MAB Task Force for Project 8 recommended that a biosphere reserve should meet each of the following objectives: conservation, research, education and training;
>
> 1. to conserve for present and future use, the diversity and integrity of biotic communities of plants and animals within natural ecosystems, and to safeguard the genetic diversity of species on which their continuing evolution depends;
>
> 2. to provide areas of ecological and environmental research including, particularly baseline studies, both within and adjacent to such reserves, such research to be consistent with objective (1) above;
>
> 3. to provide facilities for education and training. (UNESCO 1974.)

More detailed description of reserve characteristics include the following:

1. Biosphere reserves will be protected areas of land and coastal environments. Together they will constitute a world-wide network linked by international understanding on purposes, standards and exchange of scientific information.

2. The network of biosphere reserves will include significant examples of biomes throughout the world.

3. Each biosphere reserve will include one or more of the following:

   (a) Representative examples of natural biomes.

   (b) Unique communities or areas with unusual natural features of exceptional interest. It is recognized that representative areas may also contain unique features, e.g., one population of a globally rare species; their representativeness and uniqueness may both be characteristics of an area.

   (c) Examples of harmonious landscapes resulting from traditional patterns of land use.

   (d) Examples of modified or degraded ecosystems capable of being restored to more natural conditions.

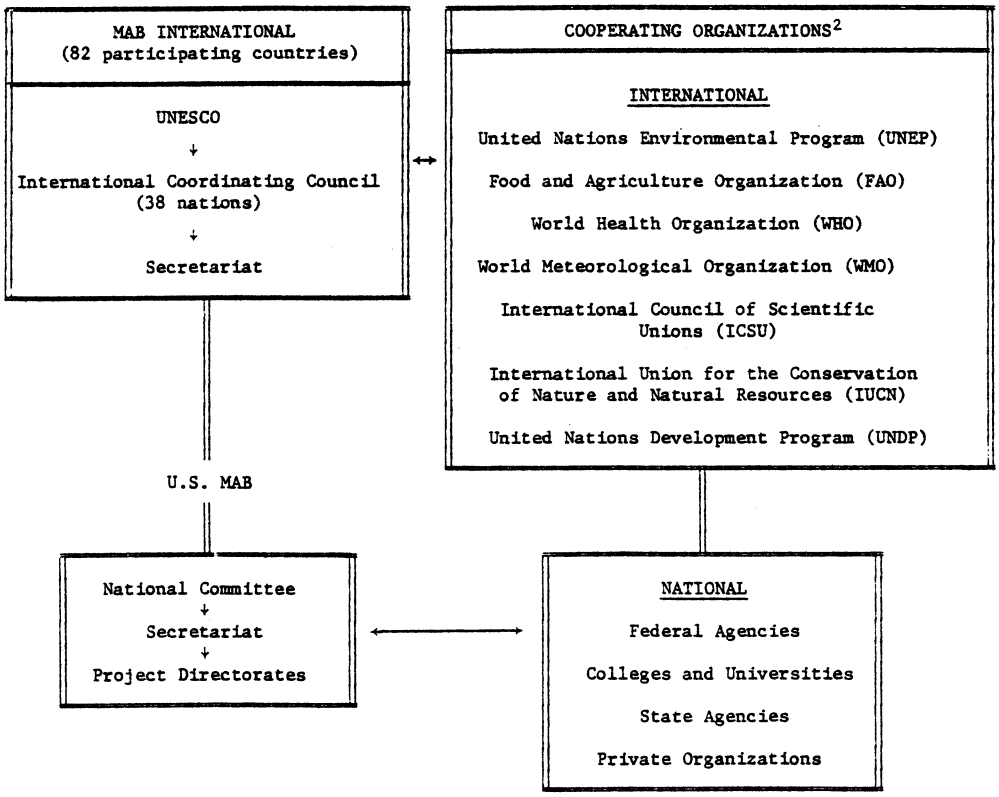
4. Each biosphere reserve should be large enough to be an effective conservation unit, and to accommodate different uses without conflict.

5. Biosphere reserves should provide opportunities for ecological research, education and training. They will have particular value as benchmarks or standards for measurement of long-term changes in the biosphere as a whole. Their existence may be vital to other projects in the MAB programme.

6. A biosphere reserve must have adequate long-term legal protection.

7. In some cases biosphere reserves will coincide with, or incorporate, existing or proposed protected areas, such as national parks, sanctuaries or nature reserves. (UNESCO 1978.)

MAN AND THE BIOSPHERE PROGRAM



Source: U.S. MAB Secretariat

[2]Cooperating Organizations include both international programs sponsored by the United Nations such as UNEP and FAO as well as national governmental and non-governmental insitutions. Aid from these organizations can range from technical assistance to actual funding of projects.

Relationship of Biosphere Reserves to Indigenous Technology Transfer

Point 3 (c) of the aforementioned list of biosphere reserve characteristics is one of the distinguishing aspects of this program which makes it conducive to the implementation of indigenous technology transfer projects. In contrast to the typical national park which generally excludes non-staff residents, a biosphere reserve may allow former inhabitants to remain in certain areas if the impacts of their lifestyle on reserve ecosystems is negligible. This would include many of the more traditional native cultures.

Point 5 justifies the collection and assessment of data on aboriginal land uses as well as the dissemination and demonstration of knowledge gained by these studies, possibly as a means of recuperating degraded areas (point 3 (d)).

As mentioned, a primary goal of the MAB Secretariat is the establishment of an adequately sized wildland unit in each of the world's biomes (IUCN 1974) for inclusion within the reserve network. Although most countries have already implemented some sort of natural area management, the biosphere reserve concept is expected to build the framework necessary to integrate these efforts into sustainable development practices. Information acquired through the study of natural and altered ecosystems within

reserve boundaries will be extrapolated for use in local and regional development, a theme similar to that proposed in native technology transfer programs. In addition, reserves should also be instrumental in formulating needed lines of communication between scientists, resource managers and educators (Miller 1978).

To accomplish these goals, management and zoning of reserves must have several special characteristics not normally found in more traditional protected wildland units. The four major land use zones of the idealized biosphere reserve as proposed by IUCN's Commission on National Parks and Protected Areas (IUCN 1978) include: the Natural or Core Zone, the Manipulative or Buffer Zone, the Cultural Zone, and the Reclamation or Restoration Zone.

The Natural or Core Zone

This area is to be managed for minimum human intervention, to serve as a baseline for the biotic region. It should represent the most primitive, pristine remaining samples of the region's natural ecosystems. The zone should be of sufficient size to function as a self-regulating biological unit even if surrounding land degradation alters adjacent landscapes. The area, although available for scientific and educational activities should not be altered by these activities.

The Manipulative or Buffer Zone

This area, which generally surrounds the core zone, serves as a buffer from outside influences. In contrast to the core zone it allows for carefully managed manipulative research, natural resource exploitation, tourism, recreation, and educational and training programs to occur. All activities within this zone should, however, be in accord with the overall management strategy of the reserve.

The Cultural Zone

The cultural zone is managed to protect and study on-going cultures and land use practices which are in harmony with the environment. Local residents and their activities are studied and this information is utilized to promote appropriate land use in other areas of the same biological region. In many cases these human settlements contain indigenous cultures with long histories of association with the land and natural resources of the zone.

The Reclamation or Restoration Zone

Generally, this zone contains areas which have been degraded by either natural or man-caused impacts. This can include areas where the carrying capacity has been exceeded, species have been depleted or where major

ecosystem alteration has occurred. Activities, research and education focus upon reclamation of resources and methodologies for restoring similar areas outside of the reserve.

The idealized biosphere reserve would contain all of these zones and would be managed by one governing organzation with assistance from related agencies. The area would contain sufficient facilities to allow for research and educational activities and would be adequately protected from both internal and external influences. The four management zones should all fall within the same biological region to permit comparability between them.

Unfortunately, owing to wildland scarcity, ownership and existing land administration and use, it is nearly impossible to find an appropriate area where all of these zones are contiguous or even exist. In this case, modifications of the "idealized" biosphere reserve must be implemented. Designation of a slightly altered primitive area as the core zone or the location of the other zones in outlying areas which are not adjacent to the core zone may be necessary.

Administratively, few biosphere reserves are managed under the idealized management concept, i.e., administered by only one agency. It is usually the case that several institutions coordinated by one agency or by the National MAB Committee, jointly manage a

reserve. In some cases where the conservation unit straddles the border between two or more nations, regional management is necessary.

The objectives listed on pages 44-49 have been formulated by the Secretariat as priority activities for MAB biosphere reserves in the current 4-year development plan. Several aspects of these objectives relate to the basic components of indigenous technology transfer programs which, although elaborated in greater detail in Chapters 4 and 5, can be briefly described as:

1. Formation of governmental and non-governmental agencies with the legal power and infrastructure capable of efficiently managing indigenous technology transfer projects.
2. Selection and establishment of biosphere reserves.
3. Involvement of local inhabitants in the management process.
4. Carry out natural and cultural resource baseline studies.
5. Formulate reserve and indigenous technology transfer objectives.
6. Design reserve zoning, identify sites or native technology projects.
7. Develop and implement native technology programs and projects. Continually assess these activities.

8. Secure long-term national and international financial and technical support.

If actually realized, the proposed operation plan for biosphere reserves would create the needed human and financial resources, organization, infrastructure and legal mandate needed to construct the framework for comprehensive native technology projects. Objectives and activities of the "Preliminary Elements of an Operational Plan for Biosphere Reserves (1978-1982)" are listed below and their relevance to indigenous technology transfer programs indicated.

Objective 1: Completion of the world coverage of biosphere reserves.

Action: Analyze and evaluate the existing network, identify obstacles in filling existing gaps and establish priorities for extending the network.

Relevance: This would provide protected areas in all of the earth's biomes where indigenous technology transfer programs could be established.

Objective 2: Full implementation and demonstration of the biosphere reserve concept.

Action: Single out pilot biosphere reserves representative of major biomes, assess their present situation needs and develop action plans. Concrete technical assistance on model biosphere reserves. Establish master management plans among others.

Relevance: As discussed in detail in Chapter 4, native technology programs are most effectively carried out when they are included from the onset in management plans. Although few biosphere reserves currently have

detailed management programs, initiation of such efforts are planned for several sites. This could give persons promoting indigenous technology activities an opportunity to lobby for their incorporation into biosphere reserve plans.

Objective 3: Implementation of ecological research in biosphere reserves and establishment of effective links with other MAB project areas.

Action: Analyze research activities and research potential of biosphere reserves and develop a plan for effective integration of such research activities with other MAB project areas.

Relevance: An integrated approach is a basic component of indigenous technology transfer research. Effective lines of communication not only with other biosphere reserves but also other MAB programs would greatly enhance the effectiveness of efforts to utilize native skills.

Objective 4: Develop means and ways for effective ecosystem and species conservation in biosphere reserves.

Action: In particular, identify and provide for proper conservation and monitoring of rare, endangered species in biosphere reserves in cooperation with IUCN. In cooperation with the scientific community develop further the theory of ecosystem conservation and translate theory into practical actions.

Relevance: As has been proposed in this thesis, indigenous technology represents a possible means of aiding in the achievement of ecosystem conservation. "Practical actions" are a cornerstone of native technology programs.

Objective 5: Identify future monitoring functions of biosphere reserves and implement monitoring schemes on a pilot basis.

Action: Develop suitable monitoring schemes in cooperation with UNEP/GEMS, WMO and WHO. Identify priorities for monitoring in biosphere reserves and evaluate monitoring potential of biosphere reserves. Implement monitoring schemes on a pilot basis.

Relevance: The evaluation and monitoring of indigenous land uses is one of the prerequisites for transferring native skills. Once these technologies have been disseminated, further monitoring is essential to assess their appropriateness to their new practitioners. Monitoring of man's impact on the biosphere is of obvious importance in these reserves.

Objective 6: Establish education and training programs for biosphere reserve managers and populations living within or close to biosphere reserves. Use biosphere reserves for in situ training of researchers in MAB. Strengthen biosphere reserve functions in the field of general environmental education.

Action: Identify training needs for management staff of biosphere reserves. Identify on-going training schemes which could be used by MAB. Adapt curricula to specific training needs of biosphere reserve personnel. Identify environmental education needs of populations living within or close to biosphere reserves. Develop programs and models for participation of local populations in biosphere reserve development schemes. Identify a number of biosphere reserves suitable for in situ training of MAB researchers, define programs for in situ training and provide for support. Identify biosphere reserves with important mass education functions and use their interpretation programs as models for other biosphere reserves.

Relevance: Environmental education is both a necessity for and a by-product of indigenous technology transfer programs. Both native peoples and the recipients of their knowledge must achieve an adequate level of understanding of the program, its relation to environmental conservation and the

biosphere reserve concept. While this will, in many cases, necessitate an outside input, i.e., environmental educators, much information is expected to be generated by the native peoples themselves as their lifestyles and skills are studied and documented.

Objective 7: Improve flow of information.

Action: Establish a computerized information system for biosphere reserves clearly describing the specific nature, functions of biosphere reserves and links with other conservation, research, monitoring and training efforts. Establish a computerized address list of institutions in charge of biosphere reserves for direct distribution of information.

Relevance: Once again the importance of effective lines of communication with relevant agencies, individuals and conservation activities for native technology programs must be stressed. The proposed computerized information system for biosphere reserves could aid in this effort.

Objective 8: Provide for proper legal protection of biosphere reserves.

Action: Establish guidelines for legal protection of biosphere reserves. Monitor legal status of biosphere reserves and enforcement of legislation. Assist countries in elaboration of legal measures for biosphere reserve protection.

Relevance: Including the establishment of indigenous technology transfer programs in legislation securing protection of biosphere reserves would insure long-term legal protection for these programs. As discussed later, assurance of continued funding and support is necessary for implementing native technology activities.

Objective 9: Link up biosphere reserves with other protected areas.

Action: In particular, promote nomination of selected biosphere reserves as world heritage sites. Stimulate creation of new biosphere reserves in association with existing protected areas.

Relevance: Other protected wildland areas besides biosphere reserves may contain indigenous peoples or remnants of their civilizations. This information should be easily available to persons involved in native technology programs. The link between these various conservation units and biosphere reserves could insure a complete flow of information between them.

In general, some of the more salient features of the current and projected MAB 8 program which are related to facilitating the transfer of native knowledge are the following:

1. The MAB program represents a consortium of agencies and individuals from many nations with the technical expertise in the variety of skills needed to manage these Indigenous Technology Transfer programs, i.e., wildland planners and administrators, anthropologists, foresters, agronomists, archeologists, environmental educators, psychologists and sociologists, biologists, community developers, etc.
2. MAB stresses the integrative approach to solving natural resource problems. Although they have emphasized local solutions to local problems, MAB also supplies the technical backstopping of the global community through the organization of an international communications network.

3. MAB Project 8 contains several elements related to the development of native technology activities. First, through zoning and management programs, indigenous peoples are allowed to remain within protected wildland units. Study of their use of natural resources is encouraged as is the assessment of their impact upon these ecosystems. The educational and research aspects of biosphere reserves including the option of buffer zones, cultural zones, and recuperation zones would indicate that activities needed to collect, analyze, disseminate and implement native skills could all be carried out within the management framework of a biosphere reserve. Even if indigenous people did not reside in an area or were not practicing sound technologies, the MAB link with other reserves and information sources could insure adequate technical input needed to launch such projects.
4. Finally, the Man and the Biosphere Program falls under the auspices of UNESCO, perhaps the international organization most capable of the collection and global distribution of educational materials. Education, science and culture; the three target subjects of UNESCO efforts are also the essential elements of indigenous technology transfer programs.

Indigenous Technology Benefits for Biosphere Reserves

It has recently become evident that wildland administrators are of necessity going to have to expand their management concerns beyond the borders of reserve boundaries (Hendee et al. 1978, Miller 1978, Pyle in Soule and Wilcox 1980, Myers 1980). Recent insights into island biogeographic theory demonstrate that wildland areas which have become islands of natural vegetation surrounded by a sea of development will inevitably lose many of their species (Wilcox in Soule and Wilcox 1980). Thus, a challenge to natural resource managers is not only to protect pristine vestages of wilderness but also to insure that adjacent regions are not severely degraded.

Indigenous technology in areas under development stress bordering biosphere reserves could not only aid in stemming ecosystem degradation but also begin the process of environmental restoration. The establishment of native land use projects such as agroforestry, for example, may diminish political pressure for the installation of possibly more destructive land uses such as mining or cattle ranching. These plots of mixed secondary and cultivated vegetation would also provide plant and animal sources for colonization of successional patches within the natural core area (Gilbert in

Soule and Wilcox 1980). Furthermore, efforts of this nature could relieve pressure on natural forests by providing firewood, building materials, food and wildlife formerly collected in core areas. This could show regional and national residents the role of biosphere reserves in maintaining a sustained yield of renewable resource products. By demonstrating the economic advantage of sound resource management, governments placing major financial backing only on development projects showing a monetary return would be more apt to support these wildland conservation activities.

Finally, the education programs which must accompany indigenous technology transfer projects may assist in instilling an environmental awareness among reserve and regional inhabitants. This awareness is a prerequisite to forming concern and interest in environmental protection. Generally, peoples that recognize their link to and dependence upon natural resources begin to treat those resources with enthusiastic care and respect (Sharpe 1976).

Biosphere Reserves with Current or Potential Indigenous Technology Programs

As of 1979, UNESCO had officially designated 162 Biosphere Reserves proposed by 35 nations (Risser and Cornelison 1979). MAB has issued brief descriptions of

these sites as well as the identification of current and planned research in each area. Much of this material would seem to indicate the potential for incorporation of native technology projects in several reserves. However, reserve administrators in most of these areas have not initiated such programs. This could be a reflection of the fact that many sites (at least in the developing nations) are still in the initial stages of establishing management guidelines. Even so, as noted earlier, the implementation of indigenous technology activities is best facilitated if included from the very onset of reserve planning.

A review of documents describing current Biosphere Reserve programs was carried out to determine the existence of, or potential for, programs dealing with native technologies.[3] Although most emphasis was placed on reserves in developing countries containing tracts of humid tropical forests, other areas are described to demonstrate the applicability of this concept even to developed countries with temperate and arctic ecosystems.

Some areas chosen contain, or formerly contained, indigenous cultures. Others currently exclude these groups but have native peoples residing in close

[3]For more detailed information on activities in biosphere reserves the reader is referred to: UNESCO 1980, Risser and Cornelison 1979, UNESCO 1979, Franklin and Krugman 1979, and UNESCO 1977.

proximity to reserve boundaries. Still others are located in regions or countries devoid of primitive peoples yet conducive to the implementation of indigenous development practices.

As shown in Table 1, the degree of effort (both programmed and inadvertant) placed upon incorporation of indigenous technology transfer projects into the reserves varies considerably. In some areas, little or no action has been taken in this direction. However, at the other sites a framework for realizing these programs is becoming established. At one area in particular—the Rio Platano Biosphere Reserve in Honduras—not only has the necessary managerial structure been formulated but the acutal process of study, assessment, transfer and implementation of native skills is beginning. What follows in Chapter 4 is a detailed account of the planning elements and methodology utilized by wildland managers in Honduras in relation to possible indigenous technology transfer opportunities in this biosphere reserve. It is included as a case study of one tropical nation's attempt to approach the problem of ecosystem degradation in a systematic manner utilizing the MAB Biosphere Reserve concept and elements of native resource knowledge.

TABLE 1

BIOSPHERE RESERVES WITH CURRENT OR POTENTIAL INDIGENOUS TECHNOLOGY PROGRAMS

Country	Reserve Name	Biogeographical Province (Udvardy)	Reserve Characteristics	Indigenous Technology Transfer Opportunities
Australia	The Unnamed Conservation Park of Australia	Southern Mulga/ Saltbush 6.10.7	This virtually pristine park encompasses 2,130,600 ha of semi-desert dunal systems. The area is very remote and almost completely unknown to scientists, yet representative of much of Australia's arid interior.	The park borders the Northwest Aboriginal Reserve. As of 1980 no zoning scheme had been elaborated for this reserve. A buffer zone in the interface between the park and the Aboriginal Reserve would provide an area for scientists to study aboriginal uses of desert resources and perhaps opportunities to implement research and experimental programs. Aboriginal peoples could also aid Australian scientists in the inventory of park resources as few ecological surveys have thus far been realized.
Australia	Ayers Rock-Mount Olga National Park	Central Desert 6.9.7	This arid park of 126,132 ha is characterized by enormous stone monoliths which rise vertically from the sandy plain. Several endangered animal species reside	At this time 3 members of the park staff are aborigines. Their involvement in park research and interpretation should be stressed. The projected zoning scheme includes no provisions for indigenous culture zones or a buffer zone. Inclusion of either or both

Table 1. -- (Continued)

Country	Reserve Name	Biogeographical Province (Udvardy)	Reserve Characteristics	Indigenous Technology Transfer Opportunities
			within the park and abundant evidence exists of former aboriginal activities in the area.	of these areas would provide reserve managers with the policy mandate needed to implement native technology projects within or bordering the reserve.
Bolivia	Parque Nacional Pilon-Lajas	Madeiran 8.6.1	This 100,000 ha area includes Amazonian highland jungles intersected by forested valleys. The typically diverse rain forest flora and fauna has been little affected by man although a small population of the indigenous Chimanes occupies the zone.	Because this park is still in the early planning stages several opportunities still exist to develop indigenous technology programs. Members of the Chimanes tribe should be utilized in all levels of park staffing and can take an active role in the development of the management plan. Zoning of the area could include a cultural zone and a buffer zone. Indigenous technology deemed sound and transferable can be applied in the buffer zone regions.
Bolivia	Reserva Biologica de Ulla Ulla	Puna 8.36.12	This Andean reserve of 200,000 ha contains peaks over 5,000 m in altitude. Vegetation is sparce but alpaca and vicuna find	Raising the valuable vicuna and alpaca represents one of the few viable economic activities suited to the high Andean regions. Indigenous peoples of these zones have practiced this animal

Table 1. -- (Continued)

Country	Reserve Name	Biogeographical Province (Udvardy)	Reserve Characteristics	Indigenous Technology Transfer Opportunities
			suitable habitat in the high plateau and tundra. About 800 Aymaran Indians reside in the area.	husbandry for centuries. Their methods are currently being studied and national vicuna and alpaca conservation and utilization programs are being implemented in several regions in Bolivia and Peru. Programs of this nature would be quite suitable for designated zones of this reserve.
Cameroon	Waza National Park	West African Woodland/Savanna 3.12.7 and Western Sahel 3.12.7	This 170,000 ha park of low relief is forested on its western side and grassland on the east. Faunal species migrate between the two areas during wet and dry seasons.	Little information is available on this park but the variety of habitats and proximity of indigenous peoples would indicate possibilities exist for native technology projects.
Central African Empire	Basse-Lobaye Forest	Congo Rain Forest 3.2.1	Pristine rain forest is the primary natural feature of the 18,200 ha Basse-Lobaye Reserve. In addition to abundant plant and animal populations (monkeys, chimpanzees,	Recognizing the importance and value of the Aka nomads, the Centre Eurafricain de Biologies Humaines initiated in 1974 an investigation of their ecology and relationship to the tropical forest. Extensive studies have been carried out. The next logical

Table 1. -- (Continued)

Country	Reserve Name	Biogeographical Province (Udvardy)	Reserve Characteristics	Indigenous Technology Transfer Opportunities
			forest elephant, panther etc.) a group of Aka forest nomads also inhabit the zone.	step would be to apply this knowledge in similar areas of the region.
Central African Empire	Bamingui Bangoran Conservation Area	West African Woodland/Savanna 3.4.4	This large area -- 1,622,000 ha -- is comprised of a variety of habitats ranging from dense dry forest and wooded savanna to gallery forests and wetlands. Wildlife is abundant and the area is sufficiently large to encompass much of their migrations. Some indigenous peoples reside in the reserve.	Besides designating a natural core area, reserve staff have also included a buffer zone and a zone of traditional cultivation. Detailed studies of the native peoples are currently in the planning stages. Information gleaned from these studies should be applicable in demonstration plots of the manipulative and buffer zones.
Congo	Parc National d Odzala	Congo Rain Forest	Ninety percent of this 110,000 ha reserve is forested. Faunal species are numerous and include the great forest gorilla.	Although little information is available on this area there are probably pygmy groups within or near the reserve borders. Detailed studies on them should be carried out and their participation in determining management policy for the reserve arranged.

Table 1. -- (Continued)

Country	Reserve Name	Biogeographical Province (Udvardy)	Reserve Characteristics	Indigenous Technology Transfer Opportunities
Denmark	Northeast Greenland National Park	Arctic Desert and Icecap 1.17.9	This 70,000,000 ha National Park includes all of the major ecosystem-types of the high arctic environment; inland ice, mountains, tundra, lakes and rivers, coast, continental shelf, sea ice and ice pack. Sparse vegetation is found in areas not completely covered with ice. Several large mammals such as polar bear, musk ox, walrus and seal have adapted to this harsh environment.	Although there is currently no resident human population in the area, there once was. Archaeological sites dating from 3000 B.C. to about 1822 A.D. have been found in the reserve. Investigation of these former cultures could give 20th century man valuable information related to the human ecology in the arctic and man's impact upon these resources.
French Polynesia	Atoll de Taiaro	Southeastern Polynesian 5.4.13	This 2,000 ha bush-covered atoll encloses a lagoon which is slightly saltier than the sea. Well developed coral reefs provide suitable habitat for a wide array	This is another area where archaeological survey and research could provide insight into former indigenous resource exploitation patterns which may be applied today.

Table 1. -- (Continued)

Country	Reserve Name	Biogeographical Province (Udvardy)	Reserve Characteristics	Indigenous Technology Transfer Opportunities
			of tropical marine species. Though unoccupied except for a caretaker, the atoll was once a center of the Polynesian Kingdom.	
Honduras	Rio Platano Biosphere Reserve	Central American 8.16.4	The 400,000 ha watershed of the Rio Platano contains a diversity of habitats: coastal and brackish water ecosystems, pine savanna, lowland and upland rain forest and cloud forest. Two indigenous groups reside within the zone.	Reserve managers have attempted to involve indigenous inhabitants of the area into all aspects of reserve planning and operation. The resident director and the reserve guards are natives of the zone. Studies are currently being carried out to document native technologies and land use. The zoning plan includes a buffer zone where manipulative experimentation including indigenous technology transfer could be carried out.
Indonesia	Cibodas Reserve	Java 4.22.12	Though small in size (1,040 ha) the tropical wet forests of this reserve harbor a variety of animal species such as the	Local villagers living adjacent to the reserve have illegally cut wood within the borders of the protected area. Implementation of native technology programs involving these peoples could

Table 1. -- (Continued)

Country	Reserve Name	Biogeographical Province (Udvardy)	Reserve Characteristics	Indigenous Technology Transfer Opportunities
			leopard, muntjao and wild pig.	reduce pressure on primary forest ecosystems. Creation of a buffer zone surrounding the core area would provide terrain for experimentation.
Indonesia	Tanjung Puting Nature Park	Borneo 4.25.12	This biologically rich lowland area of 205,000 ha is made up of swamp and mangrove forest as well as primary and secondary dipterocarp woodlands. The endangered orangutan inhabits this region.	Though information on this area is not of sufficient detail to discern whether indigenous peoples reside within the park, it is certain that if not there they are at least within close proximity. These people, the Dyaks have developed agricultural and resource utilization systems suited to this humid tropical region. A zoning plan for the reserve which designates buffer, cultural or manipulative zones would provide areas where native technology transfer could be facilitated (no zoning has occurred). Indigenous people of the area should also be among the staff and administration of the park.

Table 1. -- (Continued)

Country	Reserve Name	Biogeographical Province (Udvardy)	Reserve Characteristics	Indigenous Technology Transfer Opportunities
Indonesia	Lore Kalamanta Game Reserve	Celebes 4.24.12	This forested hilly reserve of 131,000 ha contains fine examples of several representative Indomalayan ecosystems.	Indigenous peoples residing within the reserve have thus far not been incorporated into the zoning scheme of the area. This should be carried out to insure their participation in the management of the reserve and effectively utilize their knowledge.
Ivory Coast	Parc National de Tai	Guinean Rain Forest 3.1.1	This 330,000 ha swath of humid tropical rain forest protects the last remaining portion of the vast woodlands which once stretched across much of Ghana, Ivory Coast, Liberia, and Sierra Leone.	Extensive research is being carried out in this reserve as part of a MAB effort to assess the impact of man's activities on natural forest ecosystems. Cultivation plots in the buffer zone are monitored and controlled.
Kenya	Mount Kulal Biosphere Reserve	Eastern Sahel 3.13.7 Somalian 3.14.7 Lake Rudolf 3.26.14 Ethiopian Highlands 3.26.14	The 700,000 ha Kulal Reserve includes deserts, semideserts, hotsprings, volcanos, rain forests and cloud forests. Several endemic plants and animals are found in the region. The wide	The long history of human occupation in this area provides a laboratory for studying methodologies for sound utilization of arid lands. Extensive research programs of this nature are currently in the implementation stage. Studies on both present day nomads and their prehistoric

Table 1. -- (Continued)

Country	Reserve Name	Biogeographical Province (Udvardy)	Reserve Characteristics	Indigenous Technology Transfer Opportunities
			variety of ecological zones has resulted in myriad faunal species.	forebears are providing scientists with data related to this theme.
Kenya	Mount Kenya Biosphere Reserve	East African Highlands 3.21.12	This 71,759 ha water catchment area includes the 5,199 m Mount Kenya and its wide array of life zones. Floral and faunal types range from lowland species such as the elephant and cedar forests to alpine rodents and lichens.	Though largely uninhabited, zoning should include a buffer region where ecosystem utilization practices of indigenous groups surrounding the zone can be studied and employed.
Mexico	Mountes Azules	Campechean 8.1.1	This 331,200 ha reserve protects some of the least disturbed broadleaf and pine forests remaining in Mexico. Several rare or endangered animal species such as the jaguar and harpy eagle reside in the zone. Mayan ruins have also been discovered in the region.	The rain forests of Chiapas Mexico are being destroyed at an unprecedented rate as are the cultures of the jungle dwelling indigenous groups of this zone. The Lacandons that live in the region of the Montes Azules Reserve should be intensively studied before their resource knowledge is lost. They could be fully integrated into the management of the area and their rights protected from outside special interest groups. Zoning

Table 1. -- (Continued)

Country	Reserve Name	Biogeographical Province (Udvardy)	Reserve Characteristics	Indigenous Technology Transfer Opportunities
				might include a cultural area where they can continue practicing their indigenous skills and a buffer zone where these practices can be transferred to the peasant farmers which are currently invading their territory.
Peru	Parque Nacional Manu	Amazonia 8.5.1 Yungas 8.35.12	This vast 1,881,200 ha reserve stretches from the high Andean region to the lowland Amazonian rain forests. Ecological formations include nearly all the life zones of eastern Peru: humid forest, humid subtropical forest, very humid subtropical forest, very humid low mountain forest and in the highest elevations subalpine humid forests. Plant and animal populations are extremely diverse with many rare or endangered species residing in the zone.	Within the reserve are several indigenous groups, some of whom are virtually unknown to science. They are currently protected. Information obtained from studies of these peoples could later be put into practice in the already established buffer zones where agriculture and resource utilization is allowed. Indigenous inhabitants have been incorporated into the park staff.

Table 1. -- (Continued)

Country	Reserve Name	Biogeographical Province (Udvardy)	Reserve Characteristics	Indigenous Technology Transfer Opportunities
Philippines	Puerto Galera Biosphere Reserve	Philippines 4.26.12	Situated on a coastal plain this 23,525 ha Bisophere Reserve includes tropical rain forests in all stages of development -- recently cut to primary. Over 5,000 ha are under cultivation. Indigenous peoples as well as newly arrived squatters and logging operators dwell in the reserve.	Studies on the Mangyans cultural group living in the area have already been implemented. However, removal of these people is being contemplated. Efforts should be made to accommodate this group through zoning and to control the invasion of non-native farmers and loggers into their territory.
Thailand	Hauy Tak Teak Reserve	Thailandian Monsoon Forest 4.10.4	This 4,700 ha area is comprised principally of pure stands of planted teak and some natural forest.	Because this area has been devoted almost exclusively to manipulative experimentation it lends itself to the incorporation of indigenous technology projects. Some agriculture is allowed to occur within the reserve and these plots could be used as testing sites for more appropriate farming practices.

Table 1. -- (Continued)

Country	Reserve Name	Biogeographical Province (Udvardy)	Reserve Characteristics	Indigenous Technology Transfer Opportunities
United States	Everglades National Park	Everglades 8.12.4	The Everglades National Park includes terrestrial and aquatic ecosystems totaling 566,796 ha. Mangrove swamps, mixed hardwoods, sawgrass marshes and pine woodlands are just a few examples of the natural communities in this reserve. There are 25 native land mammals, 60 species of reptiles and amphibians and over 300 species of birds.	Although not originally native to the area, the Seminole Indians fled to this zone to escape capture in the 1800s. Here they adapted to the environment of the everglades, some still living a relatively primitive existence in this area. They probably have learned much about these ecosystems and this knowledge should be recorded.
United States	Great Smokey Mountains National Park	Eastern Forest 1.5.5	Over 200,000 ha of eastern deciduous woodlands are protected within the reserve. This area represents the richest biological formations in the contiguous United States. Although much of the area had been logged, secondary growth has	Living history programs in the park demonstrate pioneer and indigenous uses of the areas resources. An area has even been set aside especially for the demonstration of these skills. Further investigation, especially among some of the older members of the Cherokee Indian tribe which is adjacent to the park, may yield additional insight into

Table 1. -- (Continued)

Country	Reserve Name	Biogeographical Province (Udvardy)	Reserve Characteristics	Indigenous Technology Transfer Opportunities
			all but erased the effects of this cutting.	alternative uses of the deciduous woodlands.
United States/ Puerto Rico	Luquillo Experimental Forest	Greater Antillean 8.40.13	This 11,340 ha reserve represents the largest tract of contiguous undisturbed forest in Puerto Rico. The area is mountainous and although wildlife is not abundant, two endangered species: the Puerto Rican parrot and boa, are found in the area.	Although indigenous peoples do not reside in this area, the research infrastructure and personnel available in this forest make it a possible spot for the implementation of indigenous technology experimental plots. Knowledge from native peoples in similar ecological zones could be established and manipulated here.
United States	Noatak National Arctic Range	Alaskan Tundra 1.13.9	The 3,035,200 ha Noatak reserve includes pristine representative samples of a variety of arctic ecosystems. Mountain, tundra, glaciers, coastal beaches and estuaries are all protected in this refuge. In vegetated areas there are	Inupiat Eskimos are the principal human occupants of this region. Archeological evidence documents their prehistoric presence in the area. Involvement of these people in the management of this zone is mandatory if the park and its resources are to be adequately conserved. Investigation of Inupiat knowledge of this harse environment could provide planners with

Table 1. -- (Continued)

Country	Reserve Name	Biogeographical Province (Udvardy)	Reserve Characteristics	Indigenous Technology Transfer Opportunities
			spruce forests, arctic brushland and tundra. Mammalian and bird populations are varied and while numbers of most of the larger species are not high there are an estimated 240,000 caribou.	information that may reduce or mitigate the impacts of development on fragile arctic biomes.
Zaire	Reserve Floristique de Yangambi	Congo Rain Forest 3.2.1	Approximately 250,000 ha of tropical rain forests are protected by this reserve. The ecosystems of the zone harbor various species of monkeys, elephants and other representative animals of this biogeographical province.	Indigenous groups including the Mbuti pygmies dwell in or near this region. Many of them maintain their traditional culture and wisdom. Although zoning of the reserve has identified a core natural zone, provisions for the protection and study of native peoples and the utilization of their technology has not been developed to any extent.
Zaire	Forest Reserve of Luki	Congo Rain Forest 3.2.1	Although largely altered forest, this 33,000 ha lowland woodland reserve now is completely protected. Faunal species are	This area has been well studied and is slated for the initiation of several silvicultural experiments. Although this reserve is not inhabited by native groups, the country of Zaire in general

Table 1. -- (Continued)

Country	Reserve Name	Biogeographical Province (Udvardy)	Reserve Characteristics	Indigenous Technology Transfer Opportunities
			representative of the province and floral species are extremely diverse.	still retains a rich indigenous cultural heritage. Information collected in other but similar zones could be established for observation and research purposes in this reserve.

CHAPTER IV

IMPLEMENTATION OF AN INDIGENOUS TECHNOLOGY TRANSFER PROJECT IN THE RIO PLATANO BIOSPHERE RESERVE, HONDURAS--A CASE STUDY

History of the Rio Platano Biosphere Reserve Development

Although no larger than the state of West Virginia, Honduras with 112,088 km^2 (Brooks 1979) is a country that is biologically and geographically diverse. The 400 miles of Caribbean coastline on the east, a mangrove fringed Pacific shoreline to the south and numerous interior mountain ranges have produced a variety of habitats composing eight life zones (Holdridge 1962). Added to these geographic features is the fact that Honduras represents the transitional region between Nearctic and Neotropical plants and animals. Tropical species are commonly found in juxtaposition with those of more temperate zones.

But like many developing nations, expanding populations (2.7% annual growth, Banks 1979), and technologies and land uses unsuited to the fragile tropical ecosystems, have resulted in serious deterioration of the natural resource base. Over 50% of the original forest cover has been destroyed or severely degraded by migrating

agriculturalists, loggers, firewood collectors, cattle ranchers, multinational agrobusiness and urban sprawl. This has left entire watersheds subject to massive erosion from seasonal rains. In 1973 over 10,000 persons died as a result of a hurricane which struck the Caribbean coast of the country. Most of the death and destruction was caused by widespread mudslides during the storm which were triggered at least in part by the extensive deforestation of the steep coastal forests (Betancourt, pers. comm.).

In the early 1970s the adverse economic and social impacts resulting from deficient resource management became more apparent to the Honduran government. This spurred policy makers to begin promoting the development of personnel and agencies necessary to utilize yet conserve Honduras' natural heritage. In 1971, the Honduran Forest Service was removed from the Ministry of Natural Resources and given the mandate, infrastructure and personnel to become one of the most politically and financially powerful institutions in the country. The Direction of Renewable Resources—RENARE—was reorganized to include the Departments of Fisheries, Wildlife, Ecology and Wildlands. RENARE technicians, aided by US Peace Corps volunteers and international conservation agencies began a national inventory of wildland units. In 1977 an interdisciplinary RENARE team investigated the watershed

of the Rio Platano, in the heavily forested eastern sector of the country known as La Mosquitia. Nearly all of the 400,000 hectares (RENARE 1980) proposed for protection was in primary or nearly primary condition. A wide variety of habitat types (pine savanna which borders the Caribbean beaches, two large brackish water lagoons and the broadleaf forested ridges of the upper watershed) harbored a multitude of floral and faunal species. Animals sighted or believed to exist within the area include 350 species of birds and several mammals which have been categorized as rare or endangered including the jaguar (*Felis onca*), ocelote (*Felis pardalis*), tapir (*Tapirus bairdii*), manatee (*Trichechus manatus*) and others (RENARE 1980).

Two indigenous groups, the Paya and the Miskito Indians also inhabit the zone. The coastal Miskitos formerly tended their agricultural plots and supplemented their diet with fish and wild game. More recently, the advent of commercial lobster fishing has brought an influx of money and manufactured goods, but also alcoholism and social disintegration (Glick 1980).

The more isolated Payas and Miskitos of the interior live in small villages and homesteads near the river. Here they practice slash and burn agriculture working their small patches of yucca, platano, beans and corn and making periodic forays into the jungle and upriver

LOCATION OF THE RIO PLATANO WATERSHED

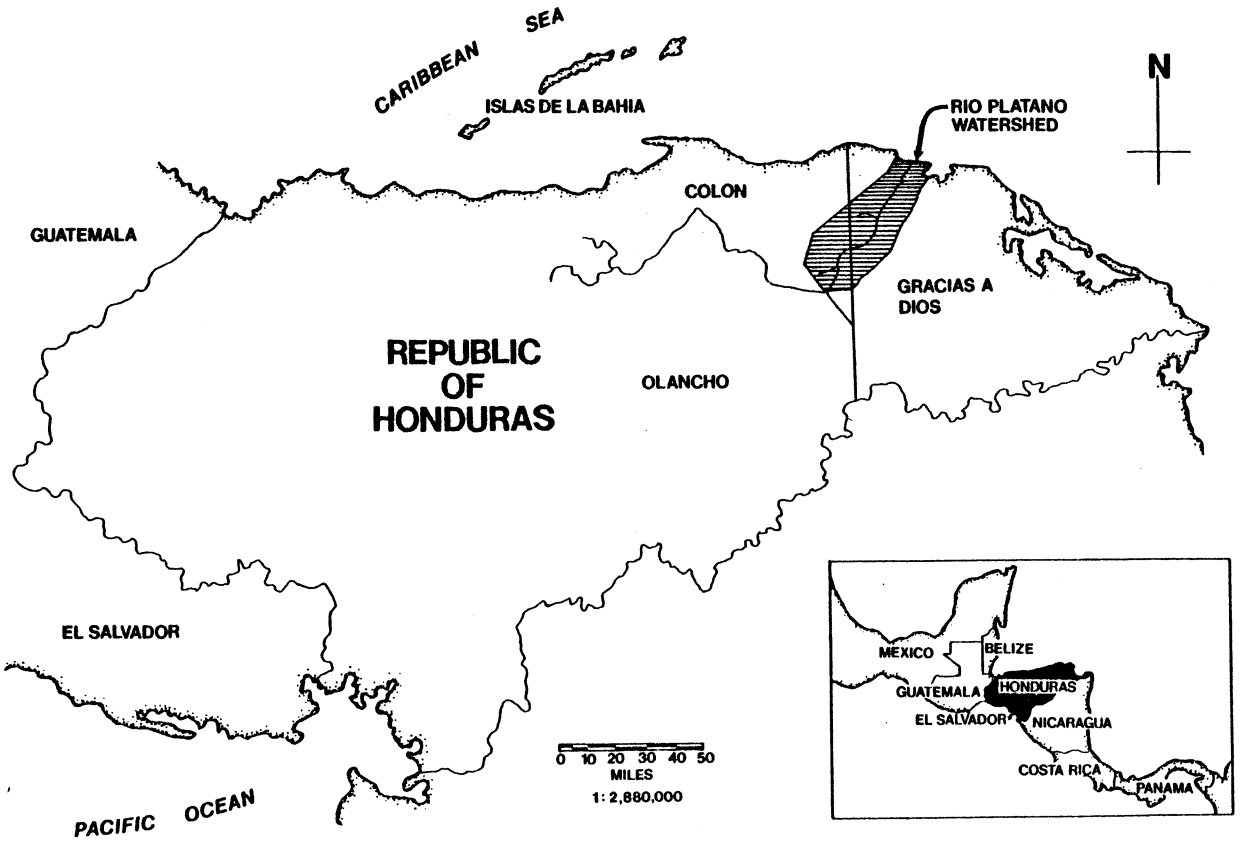
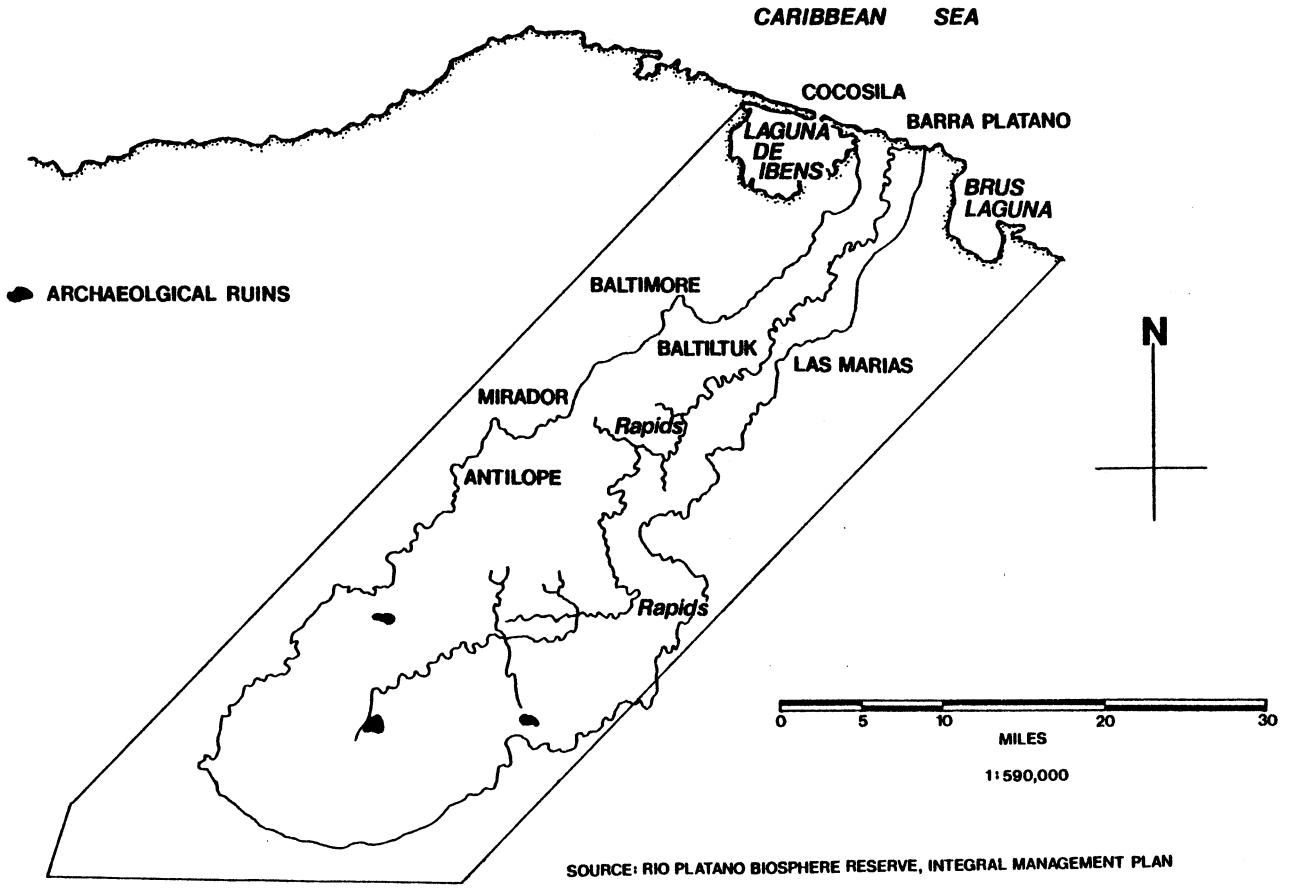


FIGURE 1

SOURCE: RIO PLATANO BIOSPHERE RESERVE, INTEGRAL MANAGEMENT PLAN

MAP OF THE PLATANO WATERSHED SHOWING MAJOR VILLAGE SITES, MOUNTAINS, AND ARCHAEOLOGICAL SITES



SOURCE: RIO PLATANO BIOSPHERE RESERVE, INTEGRAL MANAGEMENT PLAN

FIGURE 2

for fish and game. Although the acculturation process is well underway, many of the inhabitants still retain some of their indigenous customs, languages and ecosystem knowledge. In most cases these upland peoples maintain an environmentally sound existence within the opportunities and limitations offered by the tropical moist forest.

The RENARE team investigating the area was divided into two groups: one which studied the upland terrestrial ecosystems while the other followed the Platano River upstream for several weeks. A film maker who was to record the trip for the production of educational and public relations presentations traveled with the river group. Expertise of other participants included biology, botany, ecology, wildlife management, park planning, and sociology. Each specialist concentrated on his field of study although noted and recorded data that would be of interest to other members.

For almost 3 weeks the teams collected data on flora, fauna, geology, and geography. They also documented the cultural characteristics of the local inhabitants and located several archaeological sites.

All features were preceived in reference to their relation to the possible management scheme for the region. Residents were informed of the projected plans for the area and their initial impressions and ideas were solicited.

Most of the information gathered was gained through observation, collection and interviews. Several vegetative transects were also run in different habitat zones of the reserve. A light plane used by the local missionaries was chartered and an overflight was made to identify forest types, outstanding natural features and the extent of man-induced forest alteration.

After several weeks in the jungle both groups rendezvoused at the base camp to compare notes and organize the structure of the resource inventory report. After two days of post-investigative discussion, the team flew back to RENARE offices in the capital to draft the document. Each specialist elaborated his particular focus of the inventory and continuous informal discussions were held between team members to insure an integrative perspective. In addition to discussing the physical, biological and cultural features of the area, lengthy conversations were held to consider appropriate management strategies for future action plans needed in the reserve.

The final report was later used as the baseline information document for formulating the management plan. It also served as a valuable publicity tool for a RENARE Biosphere Reserve public relations campaign. This report, entitled "A Preliminary Study of the Natural and Cultural Resources of the Watershed of the Rio Platano" was organized in the following manner:

3. Trails
4. Radio
5. Possibility of Highway Construction to the Area

Locations of Populations

Activities of the Marava Missionaries

Education

Habitations

Nutrition and Health

Economics

1. Livelihood of the Populous
2. Agriculture
3. Cattle
4. Utilization of Vegetation
5. Impacts of these Activities on the Watershed

Chapter III - Significance of the Area

Major Nature Themes

1. The Jungle
2. The Platano River
3. The Mountains
4. Waterfalls
5. Wildlife

Information taken from this report was utilized to write the script for a short color film on the reserve. This, as well as several pamphlets and slides were utilized in the aforementioned Rio Platano educational project. The goal of this campaign was to present the concept of the reserve to both decision makers and the general public. Another facet of this effort was the many press releases covering both the expedition and related activities.

Although inventory participants were impressed by the natural and cultural diversity of the zone, they were not certain if the Biosphere Reserve category was the most appropriate management classification. The major reason for this uncertainty was the general lack of understanding of this new concept. It was agreed that in order to gain a better perspective on the MAB program as well as to add credibility to RENARE efforts, input from an outside consultant well versed in the Biosphere Reserve Program would be needed.

Assistance from UNESCO Paris was solicited via the Wildlands Management Unit of CATIE. In April of 1977, a representative from the MAB program arrived in Honduras. After meeting with several government officials as well as with RENARE personnel involved in the project, the consultant, a representative from CATIE and a biologist from RENARE visited the proposed reserve and made an extensive over-flight of the area. The MAB representative was impressed by the site and believed that the International Coordinating Committee of MAB would not hesitate to officially ratify reserve status for the region. He also noted that the area had potential to become "an ideal reserve" referring to the fact that the zone included all of the components that a reserve should theoretically contain.

During the consultant's visit, several informal workshops were held with RENARE personnel. It soon became evident that the MAB concept fit well into the context of RENARE's wildland management plans for the country which stressed the rational use of resources for sustained development. It also seemed appropriate for the socio-economic realities of the Platano region. The Reserve could be utilized as an experimental area for the identification of sound development practices which can be applied in similar regions. This would be accomplished not by compromising the areas most valuable resources but through a zoning plan. The plan would allow for manipulative experimentation in some areas, cultural utilization of other zones and complete protection for still others. An important contribution of the MAB representative was the elaboration of necessary steps needed to implement the project. These included the following activities:

1. Biosphere Reserve Nomination -- Using the suggested MAB format, the Honduran government must nominate the reserve to the MAB International Coordinating Council (ICC) in Paris. The ICC would then decide whether or not the area merited Biosphere Reserve classification.
2. Formation of a National MAB Committee -- The ICC recommends that each participating country in the

MAB program forms a National Committee which will coordinate MAB and biosphere reserve activities at a national level. It was suggested that this group be interdisciplinary and representative of all natural resource related government and non-government agencies.

3. Planning of the Reserve -- Without a comprehensive management plan, appropriate development and protection of the reserve would be difficult to achieve. The MAB representative recommended that immediate plans be made to formulate management goals and action plans and to implement them as soon as possible. To assist in this process he drew up a preliminary zoning scheme for the area. This identified general regions for designation as the natural zone, buffer and manipulative zone, and the cultural zone. In addition, he described appropriate uses and management criteria for each of these areas (Gilbert and Glick 1978).

Another important aspect of this report was the emphasis placed upon implementation of a strong national and international publicity campaign to gain support for the reserve. It was added that training of personnel at all levels of reserve administration, protection and maintenance would be mandatory if the project was to be successful.

Finally, the report urged that the necessary legal framework needed to establish and operate the reserve be drawn up immediately. This would insure control over land use as other agencies and individuals began to develop the adjacent regions.

A schematic work plan for the establishment of the Rio Platano Biosphere Reserve appears in Table 2.

TABLE 2

SUGGESTED WORK PLAN FOR THE ESTABLISHMENT OF THE RIO PLATANO BIOSPHERE RESERVE

Activity	Phase 1	Phase 2	Phase 3	Phase 4
Obtain interagency agreement on establishment of B.R. in Honduras	X			
Establishment of National MAB Committee		X		
Presentation of Biosphere Reserve Proposal to UNESCO Paris		X		
Preparation of Decree for Establishment of the Reserve		X		
Allocation of Personnel to administer and protect area			X	
Begin detailed planning of the reserve and its management			X	
Implement research projects				X

Within a few months after the MAB consultancy, several important actions related to the project had been realized:

1. A National MAB Committee with representatives from over 10 governmental and non-governmental institutions had been formed and was meeting regularly.
2. A presidential decree for the reserve had been elaborated and submitted to the appropriate government officials for approval.
3. The film and educational materials produced on the project had been presented to several government and civic groups.
4. Support for the reserve had been promised by many agencies including among others: the Honduran Institute of Tourism, the Institute of Anthropology and History, and the University of Honduras.
5. A preliminary work plan for the reserve had been proposed and funding from both national and international agencies seemed certain. World Wildlife Fund pledged $20,000 for the project and MAB offered technical assistance for further planning activities.
6. A Honduran biologist had been assigned as coordinator of the project and a U.S. Peace Corps volunteer was preparing to move to the site to

serve as an assistant to the reserve director (to be chosen from the indigenous residents of the area).

7. In response to a request from RENARE, a letter writing campaign directed at high level Honduran decision makers was organized by the Wildlands Unit at CATIE. Several well-known national and international conservation proponents such as the World Wildlife Fund, IUCN, the Natural Resources Defense Council, the President of Costa Rica, and others sent messages directly to the Military Junta and the President of Honduras. These letters applauded the government's efforts to protect native peoples and manage wildlands (stressing the long-term economic benefits of such activities) and urged them to officially declare the creation of the Platano Reserve. The response of the Junta was positive and soon after, personnel from RENARE were called to the Presidential Palace to explain the project to Honduras' highest government officials. Their presentation was well received and financial aid and administrative support were promised.

With both national financing and a grant from the World Wildlife Fund, personnel from RENARE began preparation for their third major trip to the area. The primary

objectives of this visit were to:

1. Launch an ambitious environmental education and public reactions campaign within and adjacent to the reserve. This would serve to explain the concept of the project to local indigenous people, as well as solicit their ideas and input for incorporation into the planning process.
2. Continue collecting data on the natural and cultural resources of the area.
3. Begin designation of appropriate sites for development of the reserve infrastructure.
4. Initiate construction of the headquarters of the reserve.
5. Choose and begin training of the resident director.

An important accomplishment of this trip was the explanation of the concept of biosphere reserves to local inhabitants. Also, basic ecological principles related to the interactions between man and his environment in La Mosquitia were presented. Insights gleaned from these experiences were later utilized in the production of more appropriate environmental education materials in the indigenous language of Miskito.

During this trip plans were being finalized for a follow-up expedition to the area with the expressed purpose of elaborating the provisionary management plan. RENARE and CATIE now felt that the project had evolved

to the point where development of this document was needed and could realistically be drafted, i.e., enough background information had been collected.

An important first step in the elaboration of this plan was the organization of interagency cooperation and participation. The Honduran MAB committee met with project personnel from RENARE and the CATIE Wildland Unit. The strategy for developing the management plan was explained and questions and input from MAB committee members solicited. They were also invited to make a personal visit to the area and to assist in the development of the plan.

Planning team members represented a diverse group of disciplines including an ecologist, botanist, biologist, park planner, anthropologist, sociologist, environmental educator, forester, and a member of the Honduran National Planning Board.

Of special note was the fact that the anthropologist was a Miskito Indian born in La Mosquitia. His role was not only to collect data on socio-anthropological characteristics of the reserve inhabitants, but also to assist the RENARE personnel in their environmental education program.

The group spent two weeks in the proposed reserve site. In addition to collecting further data on the natural and cultural features of the region, the team

carried out several other important activities related to the development of the management plan. In each of the communities located within the reserve boundaries, meetings were held with local residents and illustrated talks were given (in the Miskito dialect) on the concept of the Biosphere Reserve. Committees were formed in each village with the objective of creating a formal link between local residents and reserve administrators. These committees, as well as other individuals, provided the planning team with valuable information on current and projected land use. The concept of zoning was explained and this citizen input was utilized in drawing up proposed boundaries for the reserve's management zones.

After returning to the capital city, the group began the task of actually formulating the management plan. Other meetings were held with the MAB committee to discuss the findings of the expedition and to design immediate work plans for the elaboration of the management scheme. The following format (a modified version of Kenton Miller's suggested management guidelines for wildland areas, Miller 1978) was proposed as an outline for the plan. It was agreed to utilize this proven methodology because of its appropriateness to wildland planning in developing nations and because of its thorough, systematic approach. The outline included the

following topics:

I. National Context--Honduras
   A. National Conservation Strategies
   B. Biogeographical Provinces
   C. National Transportation Systems

II. Regional Context--La Mosquitia
   A. Natural Features
      1. Topography
      2. Watersheds and Drainage Patterns
      3. Hydrologic Resources
      4. Climate
      5. Geology and Geomorphology
      6. Soils
      7. Vegetation
      8. Fauna
      9. Role of Fires and other Natural Forces
      10. Critical Areas in La Mosquitia
   B. Cultural Features
      1. History
      2. Archaeology
      3. Anthropology
      4. Contemporary Cultures
   C. Socioeconomic Features
      1. Regional Economy and Land Use
      2. Demographic Characteristics
      3. Regional Transportation and Communication Systems
      4. Regional Tourism, Recreation and Infrastructure

III. Analysis of the Conservation Unit--The Proposed Rio Platano Biosphere Reserve
   A. Biophysical Features
      1. Topography
      2. Watersheds and Drainage Patterns
      3. Hydrologic Features

4. Climate
5. Geology and Geomorphology
6. Soils
7. Vegetation
8. Fauna
9. Role of Fires, Hurricanes and Floods
10. Critical Areas and Activities inside of the Reserve

B. Cultural Features
1. History
2. Archaeology
3. Anthropology
4. Contemporary Cultures

C. Socioeconomic Features of the Area
1. Actual and Projected Land Use
2. Demographic Characteristics
3. Transport and Communications System
4. Visitor Use of the Area

IV. The Integral Management Plan

A. Management and Development
1. Objectives
2. Limitations and Restrictions

B. Management Zones
1. The Cultural Zone
2. The Buffer Zone
3. The Natural "Core" Zone
4. The Special Use Zone

C. Management Programs
1. Environmental Management Program
1.1 Protection Sub-Program
1.2 Investigation Sub-Program
1.3 Resource Management Sub-Program
1.4 Monitoring and Scientific Cooperation Sub-Program

2. Public Use Program
    - 2.1 Environmental Education and Interpretation Sub-Program for Visitors
    - 2.2 Tourism Sub-Program
    - 2.3 Public Relations Sub-Program
3. Resident Ecodevelopment Programs
    - 3.1 Health Sub-Program
    - 3.2 Agricultural Sub-Program
    - 3.3 Forest Management Sub-Program
    - 3.4 Wildlife Sub-Program
    - 3.5 Environmental Education Sub-Program for Visitors
4. Operations Program
    - 4.1 Administration Sub-Program
    - 4.2 National Cooperation and Coordination Sub-Program
    - 4.3 Construction and Maintenance Sub-Program
5. Integrated Development Program
    - 5.1 Development Areas
    - 5.2 Training and Personnel, Equipment and Materials Requirements

D. Development Sequence
1. Personnel and Equipment
2. Integrated Development Map
3. Development Calender
4. Budget

(RENARE 1980)

Work on the management plan was distributed in the following manner. Background information on natural and cultural resources of the nation, region and the reserve was gathered principally by RENARE non-technical office staff. Up until this point many of them had not been

working on the effort. Team members and RENARE administrators saw this as an opportunity to involve more personnel in the project. This would not only be educational for them but also a great assistance to the planning team. MAB committee members, because of their affiliation with virtually all government agencies, also assisted with this task.

In the interim, the planning team spent several days discussing management objectives, goals and activities as well as reviewing management documents formulated for other wildland units. It soon became evident that in many ways the envisioned Rio Platano plan was somewhat different from most of the other plans reviewed. This was to be the first management document ever elaborated for a Biosphere Reserve. There were essentially no models from which to draw advice or ideas. Also, the area contained human inhabitants which were to be considered an integral part of the reserve, not an exotic species which would eventually be phased out.

Elaboration of Section IV—The Integral Management Plan—began first by formulating the "General Management Objectives" for the Reserve. These were based upon national conservation strategies, MAB Biosphere Reserve guidelines, national development goals, natural and cultural characteristics of the area, and the development needs and desires of the local populus. These

objectives included:

1. Management of the region's tropical ecosystems in such a manner that they continue to remain self-regulating.
2. Conservation of the ethnological and esthetic conditions represented by the human inhabitants of the area.
3. Protection of the archaeological features of the zone and promotion of their scientific investigation.
4. Assistance in achieving and maintaining a high quality of life for the local populous through ecodevelopment programs.
5. Promotion of educational and scientific tourism opportunities for the local and regional population as well as for national and international visitors. This will only be pursued if it does not detrimentally affect natural and cultural resources.
6. And finally, the reserve will be utilized as a model for the analysis and prediction of man's short and long term impacts on tropical humid forests.

The entire reserve was then divided into management zones determined by resource utilization patterns and trends as well as data on the location of natural and cultural resources. These zones include the natural core zone, a cultural zone, a buffer zone, and a special use zone. Each of these areas was identified, defined and designated objectives which are reviewed later in this chapter.

Management programs were outlined. These programs cover all aspects of the reserves protection and development and relate to both the human and natural components of the region. The major classifications, Environmental Management, Visitor Use Programs, Resident Ecodevelopment, Operations, Construction and Maintenance, are further broken down into more specific subprograms. Each of these includes objectives, activities, management norms and guidelines, resources required and a chronology of implementation and expected results and benefits. An integrated development program and map identify specific development sites within the reserve. They also outline projected activities and services provided in these areas.

After several weeks of discussions and writing, a rough draft was completed. As each planning team member submitted his designated topic or topics, the other team members made revisions and modifications.

The first draft was periodically reviewed for the next several months by RENARE personnel, including the Head of the Department of Environmental Resources and Wildlife, professionals from Honduras' National Planning Board, wildland managers, members of the National MAB Committee and representatives of the indigenous peoples of the reserve. A revised version of the plan was presented to several governmental and non-governmental agencies during a two-day seminar on the Rio Platano

Biosphere Reserve in 1980. Recipients of the document (including community members from the Reserve) will study it and submit their comments and alterations. These will be reviewed and incorporated into the published management plan which is slated to be finished in 1981. Even this document though is not recognized as a final definitive statement but rather a stepping stone in a never-ending process of review and refinement (Glick 1980).

The Rio Platano Management Plan and Its Relation to the Implementation of an Indigenous Technology Transfer Program

The authors of the Rio Platano management plan were cognizant of the importance of the native peoples, their traditions and their knowledge. This is reflected in several aspects of the document which attempted to incorporate cultural considerations into the zoning scheme and the management programs. What follows is a general description of the Integral Management Plan and its relation to projected or potential indigenous technology transfer programs. While only the major objectives of the zoning scheme and management programs have been listed, activities, norms and guidelines, requirements, timing and expected outputs were all elaborated for each management program in the original plan (the exception in this thesis is the environmental education plan for

reserve residents which has included all of the aforementioned data as an example of program design).

Reserve Zoning

In the zoning scheme not only is a cultural zone provided for native inhabitants to live and work, but also a buffer zone has been created. This is where manipulative experimentation which may alter natural ecosystems and could include such indigenous technology practices as agroforestry or swidden agriculture can be carried out. Even the natural "core" zone permits some indigenous utilizations.

The Cultural Zone

The cultural zone as mentioned previously, was determined by conversations with local inhabitants concerning their resource utilization patterns and through observation and aerial photographs. Trends in resource use were considered because agricultural, and hunting and fishing patterns are continually changing.

The cultural zone is defined as a sector which has been altered by the hand of man, but generally in a manner which is in harmony with natural systems. This area will provide protection for the indigenous peoples and opportunities to study cultural characteristics and the archaeological sites of the area. Land use practices

deemed threatening to the maintenance of an acceptable quality of life will be modified using appropriate technologies. While permitting the indigenous cultures to evolve at their own pace, adequate management of this area will also relieve pressure from these groups upon the core zone resources.

Objectives of the Cultural Zone

1. Provide the local population with an adequately sized area to carry out activities necessary to maintain their livelihood.
2. Provide study sites for socio-ecologic investigations on the traditional cultures of the area and their land use practices in order to determine short and long term impacts. These studies could include:
    a. Investigations of minimal levels of soil fertility and ecological diversity needed to maintain sustained yield of products.
    b. Study epidemiological impacts of land use practices on man, domesticated animals and agricultural crops in tropical humid forests.
    c. Study the short and long term impacts of various external influences such as mining, forest harvesting and the lobster and shrimp industries on the stability of local cultures.
    d. Investigate current and potential use of forest products.
3. Improve health and nutritional conditions through environmental education and cooperation with

governmental health agencies.

4. Promote through environmental education the traditional utilization of forest products (i.e., medicinal plants, materials for weaving and artwork, etc.) as well as sponsoring demonstrations and extension programs dealing with appropriate land use (RENARE 1980).

The Buffer Zone

The buffer zone encircles the core area. This swath of forest represents the transition zone between the developed lands outside of the reserve and the primary ecosystems of the natural area. Although for the most part this area is currently uninhabited, it will soon feel the pressure of loggers and peasant farmers from the interior of Honduras as they converge on the tropical woodlands of the Mosquitia.

The buffer zone is defined as an area designed to protect the integrity of the core zone from outside influences. The rational harvesting of buffer zone resources will be permitted in a manner which is compatible with the general objectives of the reserve. Forestry, agricultural and other activities must not drastically alter natural ecosystems except in those areas where severe experimental land use treatments are planned to measure their impact on the environment.

Objectives of the Buffer Zone

1. Protect the integrity of the natural zone.
2. Provide sites appropriate for the experimentation of techniques for better utilization of tropical humid forest resources.
3. Facilitate environmental education activities for the local populous which relates to appropriate techniques for land use.
4. Study the actual land use in this zone with particular emphasis upon its impacts on natural ecosystems. These studies could include:
   a. Investigate floral succession in various types of forest disturbances (i.e., slash and burn agriculture, multiple cropping systems, agroforestry practices and various forest harvesting techniques).
   b. Identify current and potential use of tropical rain forest resources.
   c. Investigate human development patterns in the tropical humid forests and determine their natural and social impacts (RENARE 1980).

The Natural Zone

The natural or "core" zone protects the finest representatives of primary forestland in the reserve. Although made up principally of the upland region of the watershed, a corridor of forest which stretches from the headwaters area to the Caribbean Ocean will

BIOSPHERE RESERVE OF THE PLATANO RIVER
ZONE MAP

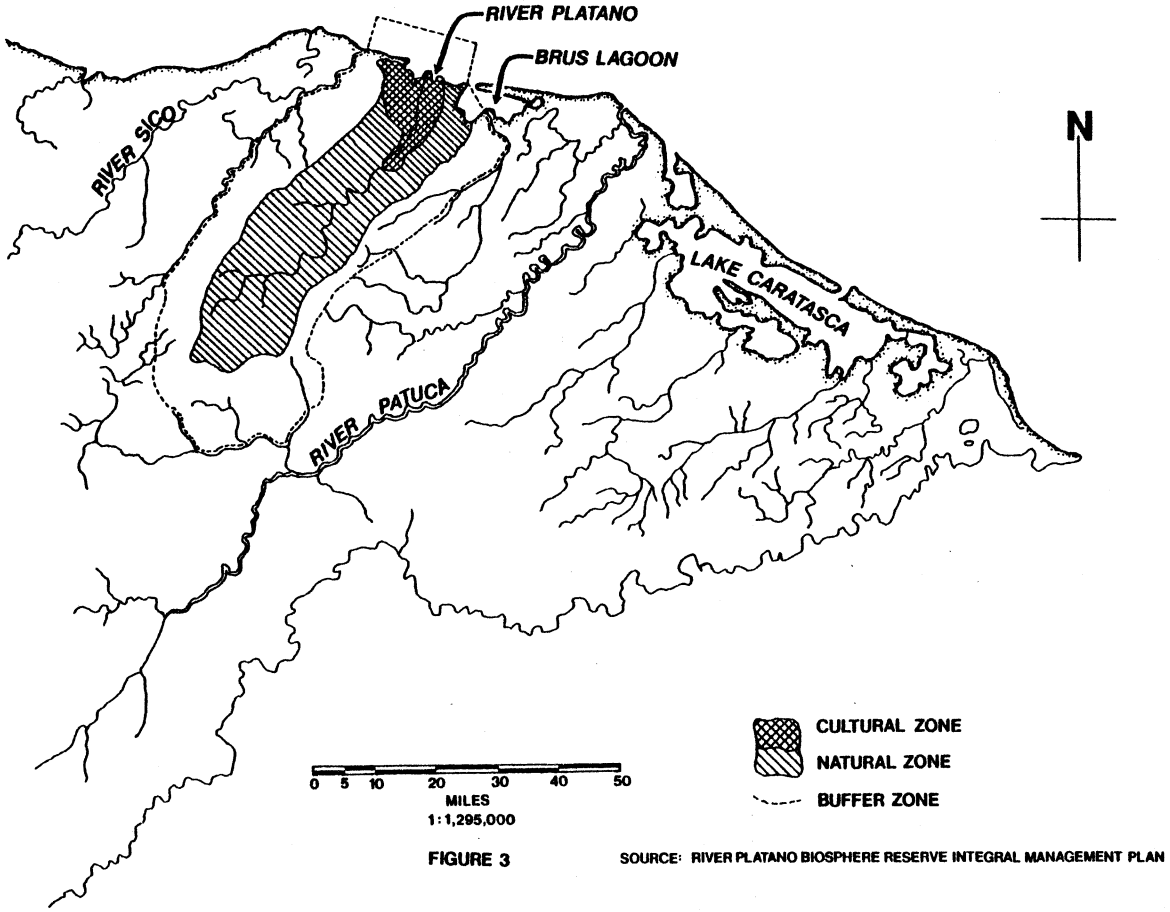


FIGURE 3

SOURCE: RIVER PLATANO BIOSPHERE RESERVE INTEGRAL MANAGEMENT PLAN

ensure protection of a wide array of ecosystem types.

The core zone is defined as an area of sufficient size to function as a self-regulating natural system. It will remain unaltered for the conservation of genetic material. Special uses such as scientific, educational tourism and monitoring activities as well as occasional use by local populations will be permitted but only when closely monitored and of negligible impact.

Objectives of the Natural Zone

1. Conserve the area in a natural and unaltered state through the use of protection and environmental education programs.
2. Study the genetic diversity of the tropical humid forest through ecological investigations such as:
   a. Studies of the floral and faunal composition.
   b. Research on succession and regeneration in natural areas.
   c. Investigations of physical and chemical characteristics of the soil and its micro flora and fauna.
   d. Research to determine possible commercial uses of tree and plant species without current value.
3. Conserve the natural, archaeological and esthetic features of the area for eventual utilization in educational, scientific and scientific tourism programs.

4. Permit the occasional or traditional use of this area (for local consumption) of natural products on a sustained yield basis (RENARE 1980).

Zoning and Indigenous Technology Transfer

The reserve zoning plan lends itself to the incorporation of native technology projects in the following manner. First, the cultural zone serves as protection for the storehouse of indigenous knowledge which can be tapped and recorded by investigators. The core area will provide native peoples with many of the resources needed to maintain their lifestyles and land use practices. Finally, the buffer zone will serve as a staging and monitoring area for experimental plots which demonstrate indigenous technologies to non-native regional inhabitants living adjacent to the reserve.

Management Programs

Management programs which provide reserve administration with the necessary guidelines for successfully meeting goals also contain several activities which provide a framework for investigating native technologies and incorporating them into regional development activities. Relevant management programs and subprograms which contain components important to the realization of indigenous technology transfer are listed and described below.

Environmental Management Programs

In order to achieve the established goals of the Reserve it is essential to develop adequate and appropriate protection and management of natural and cultural resources. Furthermore, to be effective, the implementation of these programs must be based upon sufficient baseline data on the features of the zone and on continual monitoring and evaluation of social and environmental conditions.

One major purpose of the environmental management program is to identify studies and investigations that contribute the basic information needed to formulate management strategies. This data will also assist in defining projects and activities needed to assure the protection, maintenance and development of the natural and cultural resources.

An integral facet of management and protection programs is environmental education. This will be incorporated into the vigilance, control, investigation and monitoring programs.

Coordination between the various institutions involved in these sub-programs is essential. Before the implementation of these projects interinstitutional lines of communication must be established. Furthermore, it is of the utmost importance to achieve the cooperation and participation of the inhabitants of the region who

will, in actuality, receive many of the benefits of appropriate environmental management.

Protection Sub-Program Objectives

1. Protect the genetic resources of the Reserve for their preservation and sustained use (in accordance with their management zone guidelines).
2. Protect archaeological features of the region from human and natural degradation.
3. Avoid negative impacts from unorganized or unplanned development.
4. Assure a sustained production of benefits from the natural resources of the reserve for utilization by area and regional inhabitants.

Investigation Sub-Program Objectives

1. Develop a deeper understanding of the natural and cultural resources of the area including information on species composition and anthropogenic and natural impacts upon these resources.
2. Determine the structure and function of the major ecosystems of the region.
3. Carry out thorough resource inventories in the different zones of the reserve.
4. Determine the environmental quality and condition of the reserve and its influence upon regional and global ecologic conditions.

Resource Management Sub-Program Objectives

1. Maintain an unaltered form of natural ecological processes of the reserve.
2. Recuperate ecosystems or plant and animal populations that have been degraded by the actions of man.
3. Assure a sustained yield of natural resources from the reserve for the utilization by local inhabitants.
4. Manage the cultural resource in such a manner that it is protected and can support limited scientific tourism activities.

Monitoring and Scientific Cooperation Sub-Program Objectives

1. Periodically evaluate the state of the natural renewable resources of the reserve.
2. Monitor impacts of agricultural activities within the reserve.
3. Determine climatic variations within the reserve.
4. Establish interinstitutional and international monitoring programs (RENARE 1980).

Environmental Management Programs and Indigenous Technology Transfer

The planners of the biosphere reserve stressed the need for scientific management of the area based upon a solid understanding of the resources. This is why the study and monitoring of human and natural resources is

a common theme in most of the sub-programs. A thorough comprehension of the dynamics of the region's ecosystems is a prerequisite for indentifying the limitations and opportunities for indigenous technology transfer. This is true especially for activities which may not be currently practiced within the zone but could be introduced (the domestication of certain wildlife species, for example). Assessment of human impacts upon resources will be useful in quantifying the appropriateness of certain indigenous exploitive practices. Certainly some development characteristics of local inhabitants which outwardly appear unsound may prove to be appropriate and vice versa. Not only will study of the present day inhabitants prove enlightening to ecologists, but the archaeological studies which have been projected should also provide additional information concerning development opportunities in the region. For example, the pejibaye palm (*Guilielma gasipacs*) which produces a nutritious fruit as well as a palm cabbage (Budowski 1978) is not grown by the people of the region. However, in several archaeological sites deep within the interior of the reserve abandoned plantations of pejibaye have been found. Undoubtedly, archaeological studies will uncover other pre-Colombian land use practices that could be economically and ecologically viable today.

The environmental management program stresses education as a means of protection. In this case it may not be so much a matter of RENARE personnel teaching Platano peoples about ecology, as the inhabitants sharing their knowledge of the area with reserve staff. In either case, it should be a mutual exchange of information. Some indigenous inhabitants will be trained in environmental education skills as they would be most adept at taking this message to their own people.

Active vigilance of the reserve is also stressed. An integrated team of forest guards representing both indigenous inhabitants of the zone and members of the non-Indian society should be trained not only to police the forest but also to be educators and extentionists. As mentioned, efforts have been made to not only involve locals in the planning of the area but also in the actual administration and management of the zone.

Public Use Programs

Owing to the diversity of the natural and cultural features, the reserve offers many educational and recreational opportunities to the public. This program defines environmental education, public relations and tourism programs for visitors to the zone. They are designed to minimize tourism impact upon the social and ecological features of the area.

It should be emphasized that at least in the beginning, public use of the reserve will be minimal. This will allow adequate development of the protection and environmental management activities. Although tourism development will not be of high priority in the early years, the reserve administration must attempt to disseminate information related to the reserve in all parts of the country.

These extension programs will be directed at priority target groups (i.e., decision makers, politicians, businessmen, etc.). The general public will receive information on the project by means of media articles and pamphlets, presentations and films.

When tourist development does begin in the area, all of its associated environmental and cultural impacts must be minimized. Tourism in the reserve will be limited to "scientific tourism" with visitors required to travel in small, well controlled groups. The majority of visitor activities will be of an educative nature although the many esthetic features of the reserve; the beaches, rivers, lagoons, etc., lend themselves well to recreation activities and will be incorporated into these programs when appropriate.

Tourist development will involve local inhabitants in all stages of planning and implementation. The

principal purpose of tourism will be to increase local income and improve living standards.

Visitors Environmental Education and Interpretation Sub-Program Objectives

1. Provide an agreeable and safe experience for visitors which is also compatible with the management objectives of the reserve.
2. Reduce negative impacts on natural and cultural resources caused by visitor use.
3. Promote the creation of an "environmental consciousness" on the part of reserve visitors with special emphasis on the importance of fragility of tropical ecosystems.
4. Develop the idea of rational protection and management of wild areas and natural resources in general, specifically obtaining government and public support for the creation of a complete wildlands system.
5. Stimulate public interest and pride in the rich cultural and natural heritage of the country.

Tourism Sub-Program Objectives

1. Facilitate tourism development with emphasis on scientific tourism.
2. Develop sources of income for local inhabitants through the installation of community operated tourist facilities.
3. Demonstrate that the conservation of natural resources can be economically productive, in this case as a base for a small scale tourist industry.

Public Relations Sub-Program Objectives

1. Disseminate basic information on the Reserve and its regional and global importance.
2. Establish lines of communication and the interchange of information between national and international institutions involved or interested in the global network of Biosphere Reserves.
3. Serve as a catalyst for the development of public and private interests in the many examples of natural and cultural treasures represented in the reserve, including the flora, fauna, geology, indigenous communities and archaeological ruins (RENARE 1980).

Public Use Programs and Indigenous Technology Transfer

Native technology transfer not only benefits the general public but it also could elevate the social status of indigenous groups. Currently native peoples generally occupy the bottom rung of the third world social ladder. Public empathy and respect needed to force governments to actively protect and conserve native people's rights and culture is usually non-existent. In Central America, there seems to be a social identity crisis where historical roots and cultural heritage have been forsaken by the general public for the social manifestations of what they perceive to be the signs of prosperity and sophistication--often of North American origin (D. Cruz, pers. comm.). Almost

the entire middle and upper class is trying to disassociate themselves with the indigenous peoples, despite their close blood relation in many cases. Local tourism in the Platano and similar reserves could provide non-indigenous citizens with a new view of native peoples--one which stresses their attributes and wisdom rather than their non-conformity and peculiarities. Native skills and technology would be emphasized and could demonstrate that not only do these people deserve equal rights but also that they have an important contribution to make to society.

This is one of the major themes behind the Rio Platano public use programs. Native peoples will administer many of these activities and will thus be telling their own story in their own manner.

Another important aspect of this set of programs are the objectives related to the establishment of national and international lines of communications, including a link-up with the global network of biosphere reserves. Through this information network knowledge obtained from this reserve will be available to those persons, institutions or bioshpere reserves that are involved in similar endeavors. Also, results of indigenous technology transfer projects in other areas can be relayed to Platano staff for possible implementation in Honduras.

Resident Ecodevelopment Programs

Recognizing as the general definition of ecodevelopment, "the sound utilization of natural resources for meeting the needs of a population in such a manner as to assure a high quality of life for this and future generations", these programs are oriented toward improving living conditions through the appropriate management of the natural resources of the reserve.

Introduced technologies and land use practices (if implemented) must not clash with traditional lifestyles and customs. This relates to a primary objective of ecodevelopment--the incorporation of the local population into the management of their social, natural and cultural environment. All of these programs are oriented toward local residents of the reserve. These, in conjunction with other management sub-programs, should insure local participation in all facets of Reserve development.

Health Sub-Program Objectives

1. Assist in improving health and nutrition conditions of the residents of the reserve.
2. Investigate and implement a health program utilizing traditional health care practices which are effective.

Agricultural Sub-Program Objectives

1. Investigate traditional farming and animal raising techniques and assess their impact upon the tropical rain forest.
2. Carry out an inventory of current land use and compare this with the potential and appropriate uses.
3. Investigate forest succession in natural areas which have been disturbed.
4. Investigate possibilities for utilizing floral species for medicinal and nutritional uses.
5. Establish an extension program to introduce new farming techniques (if deemed necessary).

Forest Management Sub-Program Objectives

1. Identify and minimize the impact of traditional forest exploitation methods on the natural ecosystems of the reserve.
2. Determine non-conventional uses of primary tropical rain forests including medicinal plants, new energy sources, materials for construction, and wild foods.
3. Improve the knowledge base on natural forest habitats of the area and their ecology.
4. Provide educational opportunities for local, national and international students in the field of tropical humid forest protection and management.
5. Initiate reforestation projects in areas which have been degraded.

Wildlife Sub-Program Objectives

1. Organize a research agenda for the floral and faunal components of the reserve.
2. Identify the ecology and population dynamics of important plant and animal species.
3. Establish comprehensive protection programs for rare or endangered species.

Environmental Education Sub-Program Objectives[1]

1. Develop in the reserve habitants a knowledge and appreciation of the importance of sound management of wild areas and tropical humid forest and of their own cultural heritage.
2. Incorporate environmental education methods into the education system of the region.
3. Train teachers in the region in interpretation and environmental education techniques.
4. Inform reserve inhabitants of the management activities being realized in the reserve and of the general management concept itself (RENARE 1980).

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[1] The entire design used for each management sub-program in the management document (RENARE 1980) including Program Description, Objectives, Activities and Chronology, Norms, Requirements and Results, and Expected Benefits has been included for this sub-program as an example of the activities planned to realize program objectives. The reader desiring this information for all of the sub-programs is referred to the "Rio Platano Biosphere Reserve Management Plan" (RENARE 1980).

Description of the Resident Environmental Education Sub-Program

Environmental education for reserve residents serves to coordinate and interpret other sub-programs. Environmental education is the program that explains what is occurring management-wise in the reserve and helps to promote an "environmental consciousness" among the Reserve populous. Environmental education is formally applied in schools and informally by means of trained local individuals working in civic education programs. Methods used in these programs include materials written in Miskito and Spanish, seminars, courses, audio-visual programs, photographs and drawings, demonstrations, etc. These activities should promote the conservation of resources by inhabitants and will guide their participation in the development of the area. The Environmental Education Program for Residents differs from the Environmental Education and Interpretation Program for the Public in that the first program focuses its efforts on local populations within or adjacent to the reserve while the second program is basically for tourists visiting the area or for the entire nation.

Activities and Chronology for Resident Environmental Education

- Write a detailed environmental education plan (Year:(1)).

- Realize seminars, workshops and courses for the Reserve population. (2,3,4)

- Develop environmental education materials stressing active participation for use by teachers in schools. (2)

- Organize training courses for teachers in the schools. (2,3,4)

- Establish environmental study sites near each school. (1,2)

- Develop mobile environmental education exhibits to carry to different schools. (2,3)

- Elaborate programs in environmental education for adults in local communities. (2,3,4)

- Train resident forest guards in the art of environmental education. Utilize this personnel in community education programs. (1,2,3,4)

- Collect information (using students of the zone) on the history, art, technology, folklore, etc., of the local populous and utilize this information for the Environmental Education and Interpretation Sub-Program for Visitors. (2,3,4)

- Collect and disseminate information on the other sub-program activities. (1,2,3,4)

- Establish an environmental education center in Kuri. (1,2)

- Periodically evaluate program results. (1,2,3,4)

Norms for Resident Environmental Education

- Programs for students, teachers and communities must be coordinated with the Ministry of Education, the Forest Service (COHDEFOR), the National Agrarian Institute and the local Community Committees.

- All programs must be periodically and systematically monitored and evaluated.

- All educational materials must be written in Spanish and Miskito.

- Education activities should be documented with photographs, recordings, and brief accounts.

- Environmental education activities should be coordinated and in many cases incorporated into other management sub-programs.

Requirements for Resident Environmental Education

- A translator versed in Spanish and Miskito.

- A small team of trained environmental educators.

- Coordination with the local school system and the Ministry of Education.

- Cooperation of other relevant institutions as well as the local communities.

- Educational materials relevant to local attitudes and lifestyles.

- Local transportation (boat, mule, small plane).

- Cooperation of other sub-program facilitators.

- Building materials for the environmental education center in Kuri.

- Periodic evaluation of environmental education activities.

Results and Expected Benefits of Resident Environmental Education

- Improve the environmental knowledge base and awareness of local students and inhabitants of the reserve region.

- Establish firm lines of communication between the reserve management and the reserve populous and assure their participation in the development of the area.

- Assure that local inhabitants actively support management goals of protecting and conserving the Reserve's natural and cultural features.

- Utilize the resource knowledge of reserve inhabitants in educational programs for non-native visitors and reserve neighbors. (RENARE 1980)

Resident Ecodevelopment Programs and Indigenous Technology Transfer

Ecodevelopment is defined in this thesis as development at the local level which is consistent with the natural and cultural potentials of an area. In ecodevelopment adequate attention is given to the rational use of resources. The application of technologies and organizational strategies that respect the natural ecosystems and local sociocultural patterns is encouraged (UNEP 1976).

Specialists and government officials meeting in Cocoyoc, Mexico in 1974 listed the following points as integral components of the ecodevelopment concept:

1. The basic unit for development is the ecosystem or geographical region (watershed).
2. Natural resources and humans are to be treated on an integral basis as elements of one total system.
3. Mechanisms must be created which will provide for the active participation of all humans involved in, or to be affected by, the development process.
4. Development should give primary attention to meeting the basic necessities of the human population, such as food, water, shelter, health, education and fundamental human rights.
5. Those technologies should be utilized in the development process which incorporate and enhance local

culture and experience. Local initiative and self-reliance are to be respected and promoted, and imported technologies are to be screened to insure their adequate adaptation prior to implementation.

6. Human activities should be designed and operated to maintain and enhance the productivity of the biosphere--the surface layers of the Planet Earth where all terrestrial and aquatic ecosystems operate and upon which all life depends.

7. Human activities should also be designed and operated to use wisely (conserve), the energy and materials of Earth and to respect, maintain and enhance the natural processes which produce and recycle energy and materials.

8. And finally, development should respect, maintain and enhance the diversity of natural life and human cultures to maintain and expand the availability of options for this and future generations of humans. This requires that homogenization of land use and human lifestyles be avoided. (The Cocoyoc Declaration 1974)

Many elements of a comprehensive indigenous technology transfer program are also components of the eco-development strategy. Involvement and respect for cultural characteristics, utilization of appropriate technologies which mitigate detrimental social and economic impacts and resource utilization practices which provide a sustained yield of goods are basic goals of both programs.

Platano Reserve administration has stressed eco-development in the management plan for several reasons. Of paramount importance is the fact that unless human utilization of the resource is adequately managed, the integrity of the natural systems of the region will be jeopardized. In addition, if RENARE can demonstrate to the financially strapped government of Honduras that conservation programs can not only maintain esthetic beauty but also more importantly improve the social and economic welfare of the people, they will be much more apt to receive support from decision makers and the general public.

The Ecodevelopment Programs contain many of the preparatory activities needed to realize native technology activities. Much of the basic collection of baseline data needed to assess the value of indigenous land use practices is proposed in these sub-programs. This includes investigation of indigenous medical practices, traditional farming practices and their impact upon the environment, utilization of forest products including fish and game and identifying the levels of environmental awareness among the local peoples. This understanding of attitudes toward the environment is especially important if new technologies are to be introduced into the area (see discussion in Major Obstacles in Realizing Indigenous Technology Transfer Programs).

The environmental education programs are important for the successful collection and transplanting of native technologies. Not only will they assure the perpetuity of native knowledge but they will also interpret to locals what management is attempting to do in the zone and conversely how the indigenous peoples are reacting to reserve policies. If properly carried out, educational programs can serve as an important communications link between reserve administration and the peoples of the zone. For this reason environmental educators in areas such as the Rio Platano are looking upon their roles as part teacher, part student, always keeping a two-way communications line open.

Operations Program

The operations program is primarily oriented toward achieving the efficient integrated management of the reserve through the coordination and support of the management sub-programs.

Administration Sub-Program Objectives

1. Coordinate the execution and administration of the different management sub-programs.
2. Apply the technical and administrative responsibilities of RENARE.
3. Coordinate the support of other institutions involved in the management of the Reserve.

4. Maintain solid relations with local and national authorities.
5. Obtain and train personnel appropriate for administrative functions, management of resources and ecodevelopment and public use programs.

This sub-program also includes job descriptions for various Reserve personnel including Project Coordinator, Reserve Administrator, Chief Ranger, Chief Naturalist, Rangers, Head of Public Works and Head of Investigations. An organigram of administrative organization is also detailed.

National Cooperation and Coordination
Sub-Program Objectives

1. Establish mechanisms to develop interinstitutional cooperation within the reserve.
2. Promote integrated management of the Reserve resources.
3. Coordinate the participation of the National MAB Committee into the reserve management programs.
4. Solicit and obtain the involvement of relevant governmental institutions into the execution of management programs.

Construction and Maintenance
Sub-Program Objectives

1. Maintain in good condition all equipment and facilities of the reserve to assure the adequate functioning of all management sub-programs.

2. Construct and maintain the public works necessary to develop an adequate infrastructure for the operation of the Reserve. This includes structures, landing fields, trails, guard stations and other facilities.
3. Maintain the human habitations of the Reserve in a clean and hygenic state. (RENARE 1980).

Operations Program and Indigenous Technology Transfer

Although most of the elements necessary to facilitate native technology transfer occur naturally in the area (i.e., indigenous peoples, pristine and managed resources, areas slated for national development by non-indigenous peoples, etc.) the success of the endeavor is dependent upon the coordinating body for the project. The reserve administration, with the support of a multitude of other agencies and individuals including the inhabitants themselves, is responsible for overseeing and initiating the entire process. This includes initial planning and collection of data to the transfer and initiation of appropriate technologies in designated areas. Maintaining communication between all relevant agencies is necessary and has been given high priority in this management plan.

The actual physical development of needed infrastructure such as trails, experimental plots, education centers, etc., is another responsibility of administration. Overseeing the implementation of native technology

projects in the buffer and cultural zone will demand much attention to assure minimal impact upon the environment. Most certainly other agencies will be involved in the project, including the Honduran Forest Service, the Agricultural Service, the Institutes of Anthropology and Tourism, the University and others, but all of their actions must be coordinated and monitored. Finally, the administration must retain close relations with the inhabitants of the zone. Every effort should be made to facilitate their active role in the operation of the reserve.

Integrative Development Program

The Integrative Development Program identifies specific development sites within the Reserve and outlines projected activities and services provided in these areas. All of these sites are related to some aspect of the management sub-programs and provide the necessary infrastructure for their realization.

This section also includes a complete description of personnel needs for all aspects of reserve development. Equipment for these employees is listed as well as training programs (RENARE 1980).

This program will integrate and coordinate all activities related to the indigenous technology efforts. Project sites are identified as well as needed improvements or services in these areas.

Development Sequence

The final chapter of the management plan presents a four-year development program, divided into one-year blocks. Personnel, equipment, and construction is indicated on a development sequence map. The plan concludes with a projected yearly budget for the four-year period (RENARE 1980).

The Development Sequence will ensure that native technology transfer programs are implemented in a logical order with all preparatory steps taken in the proper sequence. A budget is included which will be useful for reserve managers in projecting their financial needs for the future.

A Summary of Key Elements of the Rio Platano Biosphere Reserve and Its Management Plan which Relate to Indigenous Technology Transfer Programs

To summarize the preceding chapter, the following elements of the Rio Platano Biosphere Reserve make it appropriate to the successful initiation of a program of indigenous technology transfer:

I. Physical Features

   A. A large expanse of undeveloped land containing a variety of undisturbed ecosystems.

   B. A zone of generally undeveloped land surrounding this core zone which is open to development.

C. Indigenous peoples residing in or near the region which demonstrate generally environmentally sound land use patterns.

II. Institutional Features

A. Governmental and non-governmental agencies with the legal mandate and institutional capability to plan and carry out wildland management and ecodevelopment activities.

B. A national wildland management strategy which stresses ecodevelopment and recognizes the importance and value of indigenous peoples and technologies.

C. A coordinating body which represents all relevant agencies and individuals involved in the indigenous technology project, e.g., the MAB committee.

D. An international network for information and assistance related to the development of such a program. In this case UNESCO and other international organizations have provided valuable assistance to the Honduran government.

E. A management structure which can facilitate native technology transfer, e.g., the Biosphere Reserve Concept.

III. Management Features

A. A management plan which receives support and input from all relevant entities, especially the inhabitants of the zone.

B. An integrated plan which effectively coordinates all necessary activities.

C. A plan that addresses the necessary activities for realizing indigenous programs in the logical order which they should be carried out. These include:

1. Elaboration of general management objectives which specifically address the realization of native technology projects.

2. Development of mangement zones which provide areas for cultural protection and study, physical manipulation and experimentation, and complete protection of other zones.

3. Formulation of management programs which detail the step-by-step activities for carrying out projects of this nature. Relevant programs and sub-programs including:

   a. Environmental Management Programs

      - Protection Sub-program
      - Resource Management Sub-program
      - Investigation Sub-program
      - Monitoring and Scientific Cooperation Sub-program

   b. Public Use Programs

      - Recreation and Tourism Sub-program
      - Interpretation and Environmental Education Sub-program
      - Public Relations Sub-program

   c. Ecodevelopment Programs

      - Environmental Education Sub-program
      - Agricultural Sub-program
      - Wildlife Sub-program
      - Forest Management Sub-program

   d. Operations Program

      - Administrative Sub-program
      - Construction and Maintenance Sub-program

- National Cooperation and Coordination Sub-program

4. Formulation of an Integrative Development plan which identifies development sites within the reserve and outlines projected activities including training of personnel.

5. Elaboration of a sequential development program, map and budget.

D. A plan which calls for perpetual monitoring and evaluation of native technology projects to assess their effectiveness and, if deemed necessary, flexible enough to restructure programs.

E. Development of a communications network to transfer knowledge obtained from these projects to those persons and agencies that can most benefit from it. This includes both on a national and international scale.

In conclusion, this chapter has dealt with the methodology used for developing a management plan for a Biosphere Reserve as well as the results of these efforts--the Rio Platano management document. The opportunities for implementing indigenous technology transfer programs have been stressed as has the suitability of this planning method for incorporating efforts of this nature.

The following chapter will extrapolate experience gained in Honduras for introduction of native technology programs into the global network of Biosphere Reserves. A development sequence is suggested for implementing these activities in areas with similar natural and cultural features.

CHAPTER V

SUGGESTED GUIDELINES FOR IMPLEMENTATION AND OPERATION OF INDIGENOUS TECHNOLOGY TRANSFER PROGRAMS IN BIOSPHERE RESERVES

Based upon the case study of the biosphere reserve project in the Rio Platano, a strategy and sequence of development for native technology transfer programs can be suggested for this and similar areas. Although no two biosphere reserves will be identical in their physical, cultural and administrative make-up, there are some basic guidelines which can be offered to assure the effective incorporation and maintenance of these projects. In approximate order of execution they are:

1. Formation of Government and Non-government Agencies with Legal Status and Infrastructure Capable of Efficiently Managing an Indigenous Technology Project.

This necessitates not only the appropriate staffing and management of individual agencies but also the formation of a coordinating body representing all relevant agencies and parties. National MAB committees can serve this function.

Necessary legislation related to management of natural and cultural resources must be passed and a

national wildlands and ecodevelopment strategy conceived. These agencies are also charged with the dissemination of educational materials and the promotion of an environmentally aware public and decision making body.

2. Selection and Establishment of Biosphere Reserves.

National wildland surveys should be undertaken which not only identify priority areas for conservation but also select the most appropriate management strategy for each area.[1] Biosphere reserves must meet criteria and official ratification of a reserve site is carried out by the MAB International Secretariat only after its nomination by the National MAB committee (UNESCO 1974).

Management plans should be developed for all reserves. Suggested guidelines for the elaboration of these programs can be obtained by consulting: Miller 1978; Moseley et al., 1974; Spangle et al., 1974; Deshler 1973; Hendee et al., 1978, and several others.

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[1] Management strategies vary according to natural and cultural features of a wildland unit. Choosing the most appropriate management classification involves identifying the objectives for conservation and development in the zone after the area has been studied to assess its natural and cultural characteristics. Management categories coincide to certain management objectives. These categories include: National Parks, Natural Monuments, Scientific or Biological Reserves, Wildlife Sanctuary, Resource Reserve, National Forest, Game Reserves, Protected Zones, Recreation Areas, Scenic Easements, Cultural Monuments and Biosphere Reserves (Miller 1978).

3. Involvement of Local Inhabitants in the Management Process.

Interest and participation on the part of local inhabitants of the reserve should be facilitated from the onset. This is especially related to the native peoples that will be involved in the technology transfer projects. Reserve planners and administration should include members of local tribes and communities and frequent meetings held with residents of the area. Environmental education and interpretation programs should be initiated and used as a communications link between area residents and reserve administrators.

4. Carry out Baseline Studies.

Thorough baseline studies on both the natural and cultural features of the reserve should be realized. Special attention would be placed on indigenous uses of resources and the value and impact of these activities. Extensive ethnographic studies are initiated which include the identification of environmental perceptions of the local inhabitants. Long term monitoring programs must be set up to record changing environmental and cultural conditions.

Archaeological studies with emphasis placed upon archaic land use and development practices will be carried out. These too should be assessed for their contemporary usefulness.

Possible sites for the establishment of experimental plots and model projects, especially in the buffer zone, are identified. Research must be carried out to explore indigenous practices from other similar zones and their appropriateness for this reserve determined.

5. Formulation of Reserve Objectives

Most management strategies begin by identifying general goals and objectives for the reserve. Future management decisions and subsequent planning activities are based upon these parameters (Miller 1978). Consequently, the inclusion of objectives related to the collection, study and distribution of indigenous skills is important in developing a native technology program. These objectives are often included in the legislation which legally establishes the protected wildland unit and would thus give reserve administration legal status to carry out these activities.

6. Design Reserve Zoning

Zoning plans for wildland units vary but the MAB Task Force on Biosphere Reserves recommends the following formula: 1) a natural or "core" area which will remain essentially intangible; 2) a cultural zone that corresponds to the area and resources utilized by local inhabitants; 3) a buffer zone protecting the core area and may be utilized, altered or manipulated under the auspices of reserve management and; 4) the restoration

zone which includes degraded areas in need of rehabilitation (UNESCO 1976). To this may be added 5) special use zones where administrative infrastructure will be established (Miller 1978).

Although core areas are generally determined by ecological characteristics, their importance to the indigenous peoples should also be taken into account. Limited use of these areas by native peoples can be permitted if their ecological impact is negligible and the practice is necessary to provide some vital resource.

The cultural zone should encompass those resources that are integral to the normal functioning of the indigenous society. Living sites, ceremonial areas, agricultural plots, hunting and fishing grounds and similar areas should be zoned cultural. Resource utilization trends must be determined and if considered to be healthy and not threatening to the integrity of the reserve, these areas too should be zoned cultural. In the case of large expanses of primary forest which are used only periodically for exploitive purposes (i.e., hunting, collection of medicinal plants, etc.) these regions can be zoned "core" areas with such sporadic use allowed yet closely monitored and controlled.

Buffer zones will be the site of transfer and dissemination of indigenous technologies except in those cultural zone areas where the native peoples themselves

adopt new development skills (preferably indigenous technologies or modified indigenous technologies). Buffer zones should be adjacent to inhabited areas outside of the reserve and can be under pressure from development. However, all exploitive activities in this zone will follow guidelines set by the reserve administration and the MAB committee and will be closely monitored. Demonstration plots and manipulative experimentation dealing with native technologies will be established here. Extension programs working with regional "neighbors" of the reserve will concentrate their efforts in this zone.

The special use zones should respect traditional uses of resources and not interfere with native social patterns and customs. Adequate input from local inhabitants in the design of the management plan should prevent confrontations between reserve construction crews and local inhabitants. In relation to physical infrastructure, local architectural styles and materials can be utilized for reserve structures in order to more harmoniously blend in with the cultural and natural environment.

7. Develop Management Programs and Sub-Programs

Possibilities for management programs are endless but it is possible to identify several major elements that should be addressed if a program of indigenous

technology transfer is envisioned. These major themes and their components include:

a. Natural Resource Management

Management programs in this category include all activities and programs related to the adequate protection, study and utilization of a reserve's natural resources. Initial baseline data collection and continued monitoring and study of resources should be stressed in this aspect of the plan. Included is assessment of human impacts upon the reserve environment, i.e., indigenous utilization of resources as well as experimental manipulation of ecosystems (in the buffer zone). Baseline studies would give adequate attention to identifying forest resources of actual or potential value to the inhabitants of the zone. Much of this work is done by integrated teams of scientists and native peoples. Management guidelines for threatened species or ecosystems should be elaborated and these will to some degree determine which native exploitive practices can be continued and which should be curtailed or modified.

Protection of resources is another important aspect of this program. Major emphasis should be placed upon education as a tool for protection. Extensive environmental education activities for reserve inhabitants, regional populations adjacent to the reserve and the public in general will be initiated early on in the

development of the reserve. Active vigilance is also necessary and both area residents and non-partial outside individuals should be integrated into the guard-force. Training in educational techniques can be incorporated into their instruction. These Resource Management Programs in general protect and properly manage those natural resources which will be utilized for the realization of the Ecodevelopment Programs.

b. Ecodevelopment Programs

Initiation of native technology transfer will essentially be carried out by the ecodevelopment programs. These programs must be based upon thorough understanding of all cultural aspects of the indigenous inhabitants of the area. Also those persons in outlying regions that have been targeted as the recipients of this information are studied and their cultural features and resource utilization characteristics documented.

Using this data as well as relevant information gathered from other regions and reserves, pilot indigenous technology projects should be established in the cultural zone (directed principally toward the native peoples) and in the buffer zone (for and with the non-reserve inhabitants living in the adjacent area). If possible, the indigenous peoples themselves should be involved in establishing the demonstration plots in the cultural as well as the buffer zone.

An important aspect of these programs is the development of good public relations between native peoples and outside visitors or regional inhabitants. This will be instrumental in adding credibility to land use practices of these people and assist in the acceptance of their ideas. The elements of visitation, tourism and public relations are addressed in these programs.

Education activities related to inhabitants of the reserve and the region as well as visitors to the area are once again an integral component of a successful indigenous technology project. Both reserve peoples and regional inhabitants must understand the reasoning behind these efforts and how programs will be managed. In many cases an educational foundation must be built before certain activities can be initiated. This includes a basic understanding of some ecological and conservation concepts and of appropriate land use practices. The Biosphere Reserve Program must be presented in such a manner as to make it relevant to their needs and problems.

Reserve administration needs to understand that the social well being of area inhabitants should be a major goal of the Biosphere Reserve project. Peoples that are exploited by unjust economic and social systems will probably not treat the land with any more respect or care than they themselves have been treated (Eckholm 1976).

c. Administration Programs

Coordination and implementation of all native technology activities is dependent upon the reserve administration. Although much of the effort will be carried out by inhabitants of the region themselves, it is the administration's job to provide the initiative, direction, infrastructure and financial and technical support needed to facilitate these projects. An administration that has adequately integrated local peoples into its structure and operation will probably not be looked upon as an external force but rather an important and constructive decision making body of and for the community. Thus, it is important that reserve administration include regional inhabitants on its staff and at all times work closely with reserve peoples.

The effective operation of the reserve and these projects requires not only adequate pre-planning but also constant monitoring, evaluation and at times modification of management programs. Actions needed to achieve all of these aspects of program development must be built into the administrative system.

Communication and transfer of knowledge is one of the major goals of Biosphere Reserves and of indigenous technology efforts. The formation and utilization of the MAB global communications network is a chief responsibility of administration. This also includes national

and regional communication and coordination of all of the diverse agencies and organizations involved in the reserve programs.

8. Secure Long-Term National and International Support.

Projects for which funding or technical assistance wanes before it reaches a level of self-perpetuation will seldom be reactivated regardless of renewed support. This is owing to the fact that reserve administration could lose credibility and local peoples may believe that once again government has misled them. Thus, it is of extreme importance that before and during these programs adequate long-term support and funding are assured.

International aid agencies must take a similar approach to indigenous technology transfer projects and conservation efforts in general. Too many wildland protection programs including Biosphere Reserves have been encouraged and sometimes prematurely initiated at the insistence of global conservation associations without providing the necessary financial and technical backstopping.

Major Obstacles Facing Indigenous Technology Transfer Programs

An important factor which has weighed heavily into the frequent failure of North/South technology exchange and which could be just as relevant to indigenous

TABLE 3

SUGGESTED DEVELOPMENT SEQUENCE FOR IMPLEMENTATION OF INDIGENOUS TECHNOLOGY TRANSFER (I.T.T) IN BIOSPHERE RESERVES

Activity	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8
1. Formation of governmental and non-governmental agencies with the mandate and infrastructure capable of efficiently managing an I.T.T. project.	X							
2. Selection and establishment of Biosphere Reserves.		X						
3. Involvement of local inhabitants in the management process.		X	X	X	X	X	X	X
4. Carry out baseline studies.				X				
5. Formulation of reserve and I.T.T. objectives.					X			
6. Design Reserve zoning, identify sites for I.T.T.						X		
7. Develop and implement management programs and I.T.T projects. Continually assess these programs.							X	X
8. Securing long-term national and international technical and financial support until the projects are self-supporting.	X	X	X	X	X	X	X	X

technology transfer, is that oftentimes a well adapted, appropriately structured social organization is needed to adequately realize development goals. Many indigenous cultural practices depend upon these specialized social systems for their maintenance (Spencer 1966, Freeman 1955, Conklin 1975, Nietschmann 1973). For example, communal efforts are often needed to harvest crops or wildlife resources (Hutterer, pers. comm.). Imposing communal development strategies in capitalistic systems may be strongly opposed.

There may also be opposition to a perceived "devolution" in resource harvesting techniques. Third world societies striving to erase their image of backwardness will not easily sacrifice the supposed advancement of modern technological development practices regardless of whether there is an advantage over more traditional ones.

The general attitude discussed earlier of prejudice against indigenous peoples may inhibit many from adopting land use practices which natives are known to have perfected. Consequently, information gleaned from indigenous peoples will have to be interpreted and presented in such a manner as to make it easy for non-Indians to assimilate. An adequate environmental knowledge base will have to be established in the minds of recipients of these skills before it will be intelligable.

Possible ecological problems relate principally to the adoption of very specialized resource utilization techniques which have been developed in other regions. Ecological similarity must be studied before indigenous technologies can be transplanted into new areas. However, the fact that most Biosphere Reserves contain representative samples of global ecosystems should assure that development methods perfected in one reserve will be appropriate to other sites.

Because this program links the anthropological sciences with the field of natural resources, it will need professionals and technicians that are versed in both of these disciplines. They must be able to integrate the wide range of needed expertise into their approach to regional development and be able to communicate this information to others. Universities and training institutions will in many cases have to broaden the scope of the material presented to students to include this new orientation. Currently, adequately trained personnel needed for native technology activities are few in number and many of them appear to be concentrating on theoretical rather than "on-site" efforts.

In relation to the MAB program, the future management orientation of these reserves still remains clouded. After initial establishment, development of many sites has stagnated due to a lack of direction and in some

cases initiative and financing. There has been little evidence that the "network" concept for international communication and cooperation between reserves is occurring with notable success. Clearly further clarification of the MAB program and assistance for the oftentimes financially and technically deprived third world reserves is needed if the program is to become firmly established.

Reserve administrators will undoubtedly be burdened with insufficient funding and staffing and may be tempted to consider these projects of secondary importance. However, a thorough analysis of benefits accrued from these activities should warrant their high priority in most cases.

Perhaps the greatest and most tragic obstacle is the fact that the originators and propagators of these techniques are rapidly being either physically or culturally exterminated. Their exploitive systems which have evolved for thousands of years and are still evolving, face imminent obliteration if nothing is done immediately to protect these peoples and their knowledge.

> Entiendan estudiosos que no puede haber un intermediario que conozca nuestra region mejor que nosotros mismos. Los que deseen estudiar nuestras costumbres, pueden hacer lo, pero nosotros tambien debemos aprender de ustedes las leyes y los mecanismos utiles para cursar adecuadamente nuestras quejas y formular nuestras peticiones ante las autoridades oficiales. En la medida que ustedes nos ayuden nosotros les ayudaremos.
>
> Simeon Jimenez Turon
> Yeicuana, Venezuela
> (AMARU IV 1980)

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

This thesis has outlined a program of indigenous technology transfer which, if implemented, could play an important role in halting ecosystem and cultural deterioration in developing nations. The amenities of these projects are both ecological and social. First, natural and man-manipulated ecosystems should benefit from sound management programs. Resource utilization could become more efficient, imparting minimal adverse environmental impacts. Secondly, these time-tested sustained yield harvesting methods can relieve development pressures on the remaining pristine ecosystems. In respect to human populations, the quality of life for indigenous peoples and the recipients of their technology should improve. Cultural wisdom will be respected and utilized for the betterment of the general rural populous. Improved social standing for natives in non-indigenous societies may also be an indirect result of these activities.

Much of the information and organizational structure needed to carry out indigenous technology transfer programs is presently available. Extensive anthropological

data related to native resource utilization has already been gathered although its analysis in relation to this project is still deficient. Institutional organization needed to coordinate these efforts exists in the form of UNESCO's Man and the Biosphere Program. MAB Project 8--Biosphere Reserves, provides the managerial framework to facilitate the collection, assessment, dissemination and implementation of native skills and knowledge.

Although several barriers to the successful realization of these activities do exist, the critical need for such a program and its projected benefits appear to warrant a global effort to launch a project of this nature. If, in fact, the predictions for the massive loss of tropical ecosystems and native peoples are true, the immediate initiation of this project is not only encouraged but perhaps essential for the survival of both of these resources.

The following general recommendations are made in relation to this program. They are directed to a wide array of agencies and institutions as the development of native technology activities will necessitate an interdisciplinary effort on the part of many entities.

Recommendations to UNESCO MAB

- Under the direction of MAB 8--The Biosphere Reserve Program--UNESCO should investigate the possibilities

for initiating pilot indigenous technology transfer programs within a selected group of biosphere reserves.

- MAB 8 should develop and distribute educational materials focusing upon this concept to national MAB committees (this could include formation of an "Expert Panel on Indigenous Technology" and subsequent production of a document similar in format to their other "Expert Panel" publications).

- Other related MAB projects such as MAB 1--Tropical Forests, MAB 2--Demographic Change, MAB 13--Perception of Environmental Quality, as well as other U.N. programs such as the United Nations Development Program (UNDP), the United Nations Environmental Fund (UNEF), and the Food and Agricultural Organization of the United Nations (FAO) should be integrated into indigenous technology transfer efforts and tapped for their human and financial resources.

Recommendations to National MAB Committees

- National MAB committees should assess the feasibility and desirability of incorporating this project into their Biosphere Reserve programs.

- Utilizing the global MAB communications network, National committees should collect and exchange

indigenous land use data with other reserves and nations with similar programs.

- Together with biosphere reserve personnel and members of indigenous and peasant communities, national committees should map out strategies for initiating such projects.

Recommendations to Biosphere Reserve Managers

- Biosphere Reserve managers should begin exploring opportunities for the inclusion of native technology programs. Resource inventories should pay special attention to indigenous uses of resources (with native peoples integrated into all levels of park administration and operation).

- Managerial components needed to facilitate these projects must be written into the reserve management strategy and plans.

- In cooperation with other governmental and related agencies, reserve administrators can initiate small pilot projects.

Recommendations to Native Peoples and Organizations Involved in their Protection

- Native peoples and agencies involved in cultural conservation should begin to record and document land use practices which seem to be especially relevant to regional development.

- These groups could establish an active dialogue between themselves and national MAB representatives and begin developing comprehensive indigenous technology transfer programs.

Recommendations to Universities and Institutions of Higher Learning and Research

- Future studies in anthropological fields can adopt a more ecological orientation in field research with special emphasis on data on indigenous resource utilization transferable to similar biomes.

- Field anthropologists and archaeologists should become familiar with relevant natural resource and ecology concepts. Conversely natural resource managers working in the tropics and other developing regions should be exposed to anthropological research on contemporary and past inhabitants of these areas.

- Research institutes working to solve resource utilization problems in fragile ecosystems such as the tropical rain forests, should be acquainted with native uses of these ecosystems.

- Native technology workshops and training programs should be facilitated for resource managers and regional developers in third world nations.

Recommendations to International Conservation and Aid Agencies

- International development and conservation organizations should promote and assist such efforts in developing nations. These organizations can provide funding and technical assistance needed to implement these programs.

Recommendations to Environmental Education Efforts in Developing Nations

- Environmental education efforts in third world nations should not only publicize environmental problems but also present feasible solutions including the use of native technologies.

- Environmental education programs should emphasize the value of the cultural as well as the national heritage of a nation.

- These programs are to be oriented towards supporting the national and regional goals set for conservation. On a macro scale, this would include securing citizen support for the nationwide establishment of wildland management and ecodevelopment efforts. On a more micro scale, it could mean insuring participation by the local populous in developing a biosphere reserve or indigenous technology programs.

- These educators must thoroughly understand their targeted audience in order to present environmental information in an appropriate manner. Concepts should be understandable and relevant to the needs and problems of developing countries.

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