Honduras

Country Environmental Profile

A Field Study

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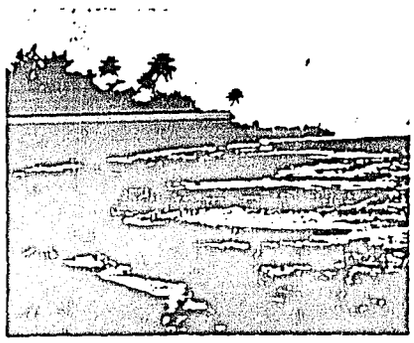

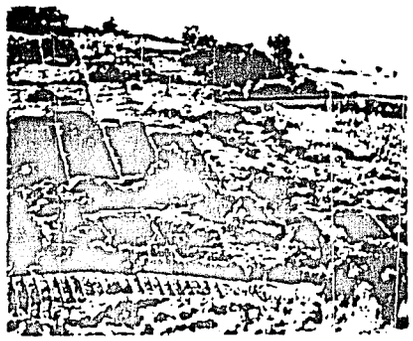

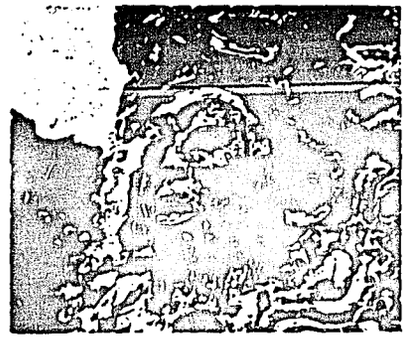

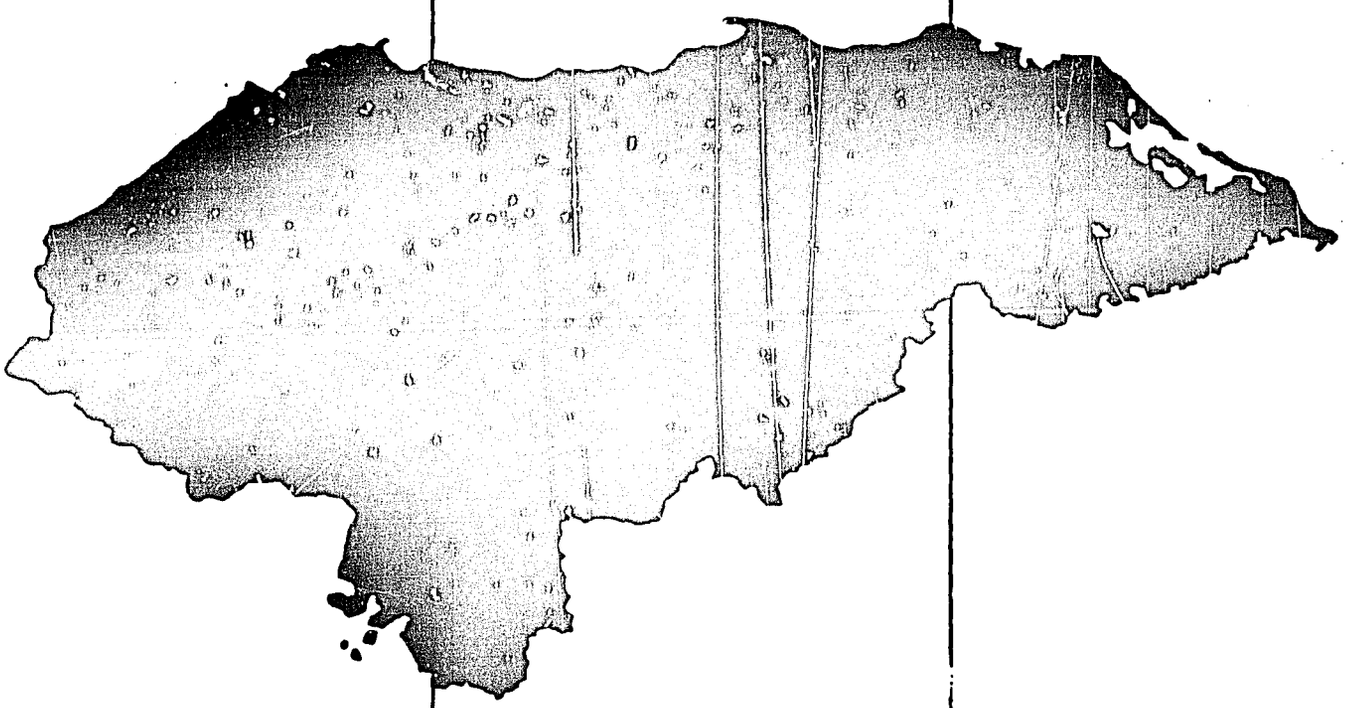

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HONDURAS

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A Field Study

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PREFACE

This environmental profile of Honduras is one of a series of country environmental profiles (CEPs) sponsored by the U.S. Agency for International Development, Bureau for Latin America and the Caribbean (LAC), Office of Development Resources (DR). The scope of work for this in-country study was developed jointly by AID/ROCAP, the AID mission in Honduras and Robert Otto, the environmental officer for LAC. Contractual arrangements for this profile, including publication, were handled by JRB Associates, 8400 Westpark Drive, McLean, Virginia 22102 (IQC: AID/SOD/PDC-C-0247). The following individuals contributed to this field study during July and August 1981 and to the preparation of this CEP:

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LIST OF ACRONYMS AND ABBREVIATIONS

ACNUR	Alto Comisionado para las Naciones Unidas de Refugiados
AHE	Asociación Hondureño de Ecología
ANACH	Asociación Nacional de Campesinos de Honduras
API	American Petroleum Institute
BANADESA	Banco Nacional de Desarrollo Agrícola
BCIE	Banco Centro Americano de Integración Económica
CASISA	Central de Aserrio de Siguatepeque, S.A.
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza
CEDEN	Comité Evangélico de Emergencia
CEPIS	Centro Panamericano de Ingeniería Sanitaria
CEVER	Centro Evangélico de Capacitación Artesanal de Yoro
CIDA	Canadian International Development Agency
CMDC	Consejo Metropolitano del Distrito Central
COHBANA	Corporación Hondureña de Banano
COHDEFOR	Corporación Hondureña de Desarrollo Forestal
CONATRIN	Consejo Nacional de Tribus Indígenas
CONSUPLANE	Consejo Superior de Planificación Económica
CORFINO	Corporación Forestal Industrial de Olancho
CPA	Comisión de Política Agrícola
CURLA	Centro Universitario del Litoral Atlántico
DIFOCOOP	Dirección de Fomento Cooperativo
DMHC	Dirección de Minas e Hidrocarburos
DWER	Department of Wildlife and Environmental Resources
EEC	European Economic Commission

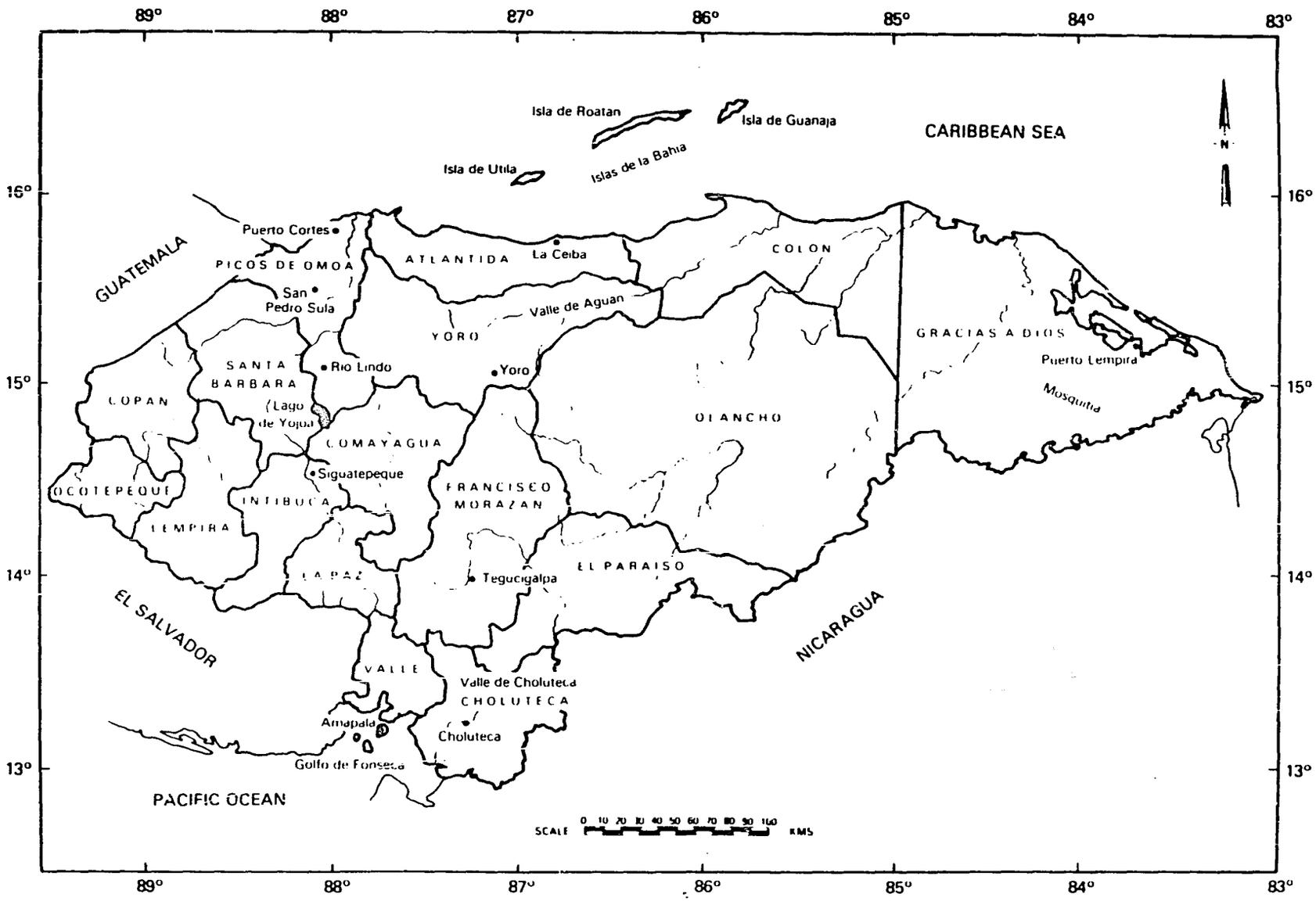
LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

ENEE	Empresa Nacional de Energía Eléctrica
ENP	Empresa Nacional Portuaria
ESNACIFOR	Escuela Nacional de Ciencias Forestales
FAO	Food and Agricultural Organization of the United Nations
FECORAH	Federación de Cooperativas de la Reforma Agraria de Honduras
FENATRILIH	Federación Nacional De Tribus Para La Liberación Del Indio Hondureño
FIAFSA	Forestal Industrial Agua Fria, S.A.
GOH	Government of Honduras
ICAITI	Instituto Centroamericano de Investigación y Tecnología Industrial
IDB	Inter-American Development Bank
IHAH	Instituto Hondureño de Antropología e Historia
IHCAFE	Instituto Hondureño del Café
IHMA	Instituto Hondureño de Mercadeo Agrícola
IHT	Instituto Hondureño de Turismo
INA	Instituto Nacional Agrario
INFONAC	Inventorio Forestal Nacional
IUCN	International Union for the Conservation of Nature and Natural Resources
JICA	Japanese International Cooperation Agency
MAB	Man and Biosphere Programme (UNESCO)
MRN	Ministerio de Recursos Naturales*
MSP	Ministerio de Salud Publica
NMFS	National Marine Fisheries Service

*The official designation is Secretariat of Natural Resources (SRN), but throughout the profile MRN is used.

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

OEA	Organización de los Estados Americanos
PCN	Programa Catastro Nacional
Plan Comayagua	Proyecto de Desarrollo Forestal de Comayagua
PRODERO	Proyecto de Desarrollo de la Región Occidental
RENARE	Dirección General de Recursos Naturales Renovables
RESIHON	Resinas de Honduras, S.A.
ROCAP	Regional Office for Central America and Panama (AID)
SANAA	Servicio Nacional de Acueductos y Alcantarillados
SECOPT	Secretaría de Comunicaciones, Obras Publicas y Transporte
SMN	Servicio Meteorológico Nacional
SRN	Secretaría de Recursos Naturales
SSF	Sistema Social Forestal
UNAH	Universidad Nacional Autónoma de Honduras
UNC	Unión Nacional de Compesinos
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
USAID	U.S. Agency for International Development
USEPA	U.S. Environmental Protection Agency
WECAF	Western Central Atlantic Fishing Commission
WWF	World Wildlife Fund



Geopolitical map of Honduras.

I. EXECUTIVE SUMMARY

Honduras, second largest of the Central American countries, is also one of most geographically and biologically diverse. The national territory harbors representative samples of some of Mesoamerica's most ecologically and economically important natural resources. From pristine coral reefs to lush cloud forests, pine clad savanna to tropical rain forest, the potential for sustained yield development based upon rational utilization of the natural resource base appears to be Honduras' most promising development strategy. Unfortunately, these resources are not being managed effectively. Both hardwood and pine forests are being rapidly depleted, soil erosion is rampant, dozens of plant and animal species are imminently threatened with extinction, hydroelectric power potential is being reduced, potable water supplies threatened and tourist development opportunities limited. However, with a firm national commitment and responsible international assistance, Honduras can achieve the goal of balancing natural resource utilization with natural resource protection. Management of natural resources and initiation of environmental education programs must be an integral component of this effort.

The Honduras Country Environmental Profile (HCEP) has been prepared as an aid to decision makers in planning and implementing development policies and projects. Discussed are a core set of cultural, political and institutional constraints and the environmental problems deriving from them which, in turn, limit social and economic development. The conclusions and recommendations of the HCEP team are intended to provide a broad framework for more effective management and for sustained development of the Honduran environment. The positive contribution that the environmental sciences can make to the development process and the negative consequences of neglecting the environmental factor are both evident in this profile.

GENERAL CONCLUSIONS

The HCEP team believes that certain conclusions of a more general nature should be appropriately highlighted at the beginning of this summary. Such conclusions are pertinent to many, if not all, sectors discussed in the HCEP.

- Environmental Problems are Development Problems. Development problems manifest themselves in three forms:
  - Failure to exploit ecological knowledge to achieve maximum agricultural production: forcing short cycle moncultures in the humid tropics where long cycle mixed cropping systems would be more productive.
  - Destruction of environmental services of economic value allowing port development, road building or salt production to destroy or reduce the productivity of mangrove and coral reef ecosystems upon which commerical fisheries or tourism depend.
  - Devastating impacts of environmental processes on development infrastructure: predictable and avoidable sedimentation and/or eutrophication of hydroelectric and water supply reservoirs due to erosion from unprotected watersheds.

- More Active Involvement in Environmental Matters by GOH and Nongovernmental Organizations. International development assistance institutions, multilateral and bilateral, have not and will not take substantive action on environmentally related issues without strong urging, participation and commitment from the Honduran government. Nongovernmental organizations, such as the Asociacion Hondurena de Ecologia, can play a valuable role as catalysts and consciousness-raising sources to affirm the government commitment. Where assistance institutions have taken unilateral action on environmental matters, the effects have been negligible and transitory.

- Unified Voice for Environmental Consideration in Development. Within the government of Honduras, a single authorative voice must speak for the environmental component in development. This entity, with strong executive backing, would represent the environment both within Honduras and internationally with other countries, aid institutions and multinationals. A first priority would be the channeling of national and international resources toward building an environmental management consciousness and scientific capability within the existing institutional structure of the country.

- Development of Honduran Capabilities in Environmental Sciences. Without a cadre of graduate trained environmental scientists--ecologists, marine biologists, geomorphologists, tropical foresters, and others--no amount of official commitment or outside assistance can have a substantive long-term effect on development. Workshops and short courses can be important stopgap measures until agencies and educational institutions can be adequately staffed.

- Role of Population Growth i Environmental Degradation. Con tinued rapid population growth i the most serious threat to develop ment, both for the present popula tion and for future generations. decisive effort toward stabilizin the population would be cost effec tive and have far reaching social health and economic benefits.

- Cost-Effective Renewable Energ Alternatives. Imports of increas ingly costly petroleum represent mounting drain on scarce developmen capital. The environmental manage ment recommendations outlined i this profile involve lower net con sumption of fossil fuels, as result of more effective use o renewable energy and ecologica processes, and encourage increase exports to earn foreign exchange.

- Recognition of Aesthetic and Scien tific Values of Natural Resources Certain qualitative values of a aesthetic and scientific nature such as the beauty of a reef o cloud forest or the fate of th endangered manatee, are of concer to all people. Aesthetic an scientific values, in this context have much in common since they ar recognized intuitively as bein valuable even though they frequentl cannot be assigned monetary value.

- Periodic Update of the Countr Environmental Profile (CEP). Th environmental profile is a usefu planning tool that could play a important role in guiding devel opment options. However, the CEP i an "extensive" survey evaluatin several sectors (agriculture forestry, fisheries), large geo graphic areas, and numerou development assistance activitie over a relatively short period o time (two months). Therefore, i would be advantageous to the GC and development assistance communit to periodically update the CEP

perhaps as often as every two-three years.

In the following sections issues concerning social and cultural conditions, agriculture, forestry, watershed management, coastal areas, wildlands, and water supply and waste management as they relate to environment and development are summarized.

SOCIAL AND CULTURAL ISSUES

Overview

- Population (1980 estimate) - 3,691,000 (62 percent rural)
  - Birth and death rates - 49.3 and 14.6 per 1000
  - Infant mortality rate - 118 per 1000 (128 in rural areas)
  - Population growth rate - 3.3 percent
  - Per capita income - $271 (U.S.)
- Total land area - 112,088 square kilometers (25 percent arable)
- Population density per square kilometer of arable land:
  - Western Highlands 1024
  - Central Region. 196
  - Central-Eastern Highlands 250
  - Lowlands. 49
- Farms less than 5 hectares:
  - 65 percent of farms
  - 9 percent of total farm area
- Farms greater than 50 hectares:
  - 4 percent of all farms
  - 56 percent of total farm area

Population Growth. The rate of population growth far exceeds the capacity of the government to expand and deliver basic services such as health care, education, extension and credit and the distribution of land.

Distribution of People. For historical and ecological reasons the population has tended to concentrate in the highlands, notably in the west, where the Maya influence was greatest. People have also concentrated in highland areas with the best soils, avoiding large areas with poor soils. Degradation of resources, such as soil erosion leading to the improverishment of agricultural soils, gives rise to emigration from these impoverished regions to either agricultural frontiers or to urban areas.

Distribution of Land. The tenure pattern is grossly unequal with the majority of the rural population having either no land (47 percent) or marginally economical units of less than 5 hectares. The best land tends to be occupied by the large holdings. The better two-thirds of the arable land is occupied either by banana plantations or extensive cattle ranches.

Economic Participation. The population inhabiting areas of active forest resource exploitation is largely excluded from participation in the profits and employment opportunities associated with forest usage. The result is a continued poverty and lack of concern for the forest resource expressed by indiscriminate burning and the widespread clearing of broadleaf forest land (See Forestry section for full discussion).

Documentation. Lack of appropriate identification documents excludes many campesinos, both Honduran and immigrant, from participating in government employment and cooperatives, as well as in credit, land distribution and titling programs.

Human and Environmental Problems

The conditions mentioned above are rooted deeply in cultural attitudes towards people and land use brought from Spain and more recently from the developed world. From medieval Spain comes the acceptance of a peasant class

of minifundistas working their eroding hillside patches of corn and beans while cattle graze on valley bottom haciendas. From the developed world has come capital intensive technology for producing rice, cotton, more cattle and bananas--all in the valleys. Neither the developed world in 50 years nor the Iberians in 450 years have fully recognized that tropical forest and crop ecosystems require fundamentally different management than was practiced in Asturias or Ohio. The following problems are considered to be important from a human and environmental perspective.

Unstable Relation of Man to Land. The population density per square kilometer of arable land given above is really an indirect measure of the pressure on non-arable land that should be protecting watersheds, or growing forests and perennial crops. Lack of access to arable land, lack of alternative employment, inappropriate technology and exclusion from participation in the forest economy are part of the cause for the rapid degradation of settled land and clearing of new lands, which are even less suitable for annual crops and pasture. This rapidly growing rural and impoverished population is also a major factor in the rate of increase in urban population which far outstrips the capability of government to extend services and the economy to absorb labor.

The "Indian" Problem. The majority of some 25 ethnic groups identified in the 18th century have disappeared, either as a result of physical annihilation or absorption into the dominant mestizo or ladino (people of Spanish blood) culture. Both processes are still at work on the remaining indigenous groups, with emphasis on the latter. A critical concern of the HCEP team is that some ethnic groups may have more appropriate technology for their environment, more so than any ladino group. Thus, preservation of this base of indigenous knowledge wo merit serious attention.

Although the rights of Indians maintain their culture and their l base are legally recognized, they h had little serious support from National Agrarian Institute (INA). Pan-Indian movement was formed in l in an attempt to organize politica to defend the lands of the 40 to thousand Indians in Honduras. Lad settlement pressure, without governm interference, results in the continu attrition of the Indian land base thus in the ability to maintain coherent cultural unit.

Stress on Environmental and Soc Services. The major concern here that additional people are putti greater pressure on existing envir mental and social services. marginal population of Honduras, b rural and urban, has been swel significantly by the influx of refug from El Savador and Nicaragua. estimate of Salvadorean refugees ran from 18,000 to 30,000. Most of th were initially established in bor encampments, but many have moved el where in search of work. An in terminant number of Nicaraguans cros the border as a result of the civil there. More recently some 14, Misquito Indians have crossed i Gracias a Dios as a result of unr stemming from Sandinista governme efforts to force acculturation.

Archaeological Resources. Hondu is an archaeologically rich transiti zone with evidence of Olmec, Maya Chibchan influences as well as m others. The Honduran Institute Anthropology and History (IHAH) developing a national registry of t most significant sites. Lack of fu and personnel prevent any action preserve and study the known sit For example, the El Cajon hydroelect project will innundate some 140 kn sites. One on the Rio Yunque, Salit Viejo, contains some 392 structur Foreign teams of archaeologists

conducting salvage studies. Only the famous ruins at Copan have been adequately protected as a tourist attraction.

Lack of Documentation/Identity Papers. Many campesinos causing land degradation to marginal lands and forest resources are undocumented Honduran and alien shifting cultivators. This is a problem in the north central coastal areas and inland, and in the Mosquitia. Officially nonexistent, they do not benefit from land reform, credit, technical assistance or any other service which might otherwise bring them down off the steep slopes and improve their well-being.

Recommendations

- Support Family Planning Measures. Given the political dangers and long lead time required for land redistribution and agricultural innovation, respectively, the most cost-effective way to improve human well-being and reduce long term land degradation is through an aggressive program to bring family planning and health care information and materials to the rural population as an integral part of an overall health program.

- Implement New Land Use Technology for Small Farmers. Opening of new lands and better economic and social use of the existing agricultural land should be preceded by land capability mapping and the development of tropical agricultural and forest management technologies appropriate to the small scale farmer. Without such technology the land degradation and poverty now existing will be augmented and spread to new areas.

- Preserve Archeological Resources. Archeological sites identified by IHAH should be preserved for their heritage and touristic values, as yet undocumented by GOH.

- Preserve and Study Ethnic Groups and Their Environmental Management Systems. Indigenous ethnic groups and their patterns of resource utilization should be preserved and studied in order to evaluate and document their potential contribution to more effective utilization and management of Honduran resources.

- Issue Identity Papers to Campesinos. Better participation of the campesinos in resource preservation and the economy could be achieved if certain individuals had identitfy papers. The GOH should issue these as soon as is practicable.

AGRICULTURAL ISSUES

Overview

Agriculture in Honduras is the dominant economic activity. Bananas, coffee, cattle and sugar, along with pine lumber, constitute the principal exports. Corn, beans, yuca and rice are the staple foods produced. More than 60 percent of the population is rural and engaged in agriculture. The character of these activities varies dramatically from the thousands of campesinos practicing the most rudimentary shifting cultivation on a subsistence level to modern "factories in the field" producing crops for a global market.

Constraints to Development

Seven major constraints underlie and are causatively linked to problems of agricultural development. The first constraint, a severe shortage of land suitable for agriculture, is an immutable geographical reality. The remaining six constraints are man-caused and therefore theoretically

amenable to relief through conscious changes in policy and action by the government with support from the international development assistance community.

That the constraints are obvious and could be, but are not, alleviated using technical and capital resources now available to Honduras is at once the cause and the effect of underdevelopment. The roots of this circular phenomenon lie deep in the culture and history of the country and in the uncoordinated, sectorial approach to development assistance by the entire aid-giving community. The interrelated constraints discussed below are particularly intractable because a coordinated, systematic attack is required on all of them at once.

Population Growth. At the current average level of seven live births per woman, the population would grow from the current 3.8 to over seven million in 18 years, and by the year 2025, to a projected 21 million. The present rate of population growth in Honduras precludes future development measured in per capita terms. Growth-related pressures on soil resources and upper watersheds is foreclosing future options for sustained human well-being at any population level.

Maldistribution and Use of Land. More than 50 percent of the farms are of three hectares or less and occupy only five percent of the farmland while farms larger than 50 hectares occupy over 50 percent of the farmland. The statistics do not indicate how much of that land is inappropriate for the current use. Much of the good farmland is occupied by large corporate farms and extensive cattle ranches. Rural population growth more than equals the modest rate of land distribution under the agrarian reform.

Farming Technology. Recent efforts to develop technology adapted to the needs of the small-scale farmer have had to run counter to a long history of development efforts favoring capita and energy intensive technology mo appropriate to large farms on land wi minimal slope. This adoption of bas cally temperate zone technology h been applied to monocultural producti of bananas, cotton, grains and sug cane primarily. The inappropriatene of this technology to hillside farme with limited land and capital has be a major contributing factor in sprea ing land resource depletion, low pr duction and the resultant poverty. narrow focus on single crops i agronomic research rather than up ecologically viable crop and anim production systems for specif tropical conditions has left the sma farm technology programs with a we data base.

Several ongoing and proposed pro ects from AID/Honduras' Offices Agriculture (AG) and Environment a Technology (OET) are designed to assi the GOH in developing appropriate tec nologies for small farmers. In A ongoing projects include: agricultur research (extension and on-farm) a small farmer coffee production improv ment; proposed projects include: sma farmer titling and services, fa service centers, and a livestock i provement project for small farmer In OET, ongoing projects includ rural technologies and natur resources management; proposed projec include: forest resources development

Cattle Production. Cattle produ tion is an appropriate agricultur activity in ecological life zones a under certain site conditions. Unfo tunately, overemphasis on cattle h had serious environmental, economic a social consequences in Honduras. Pro lems include the expansion of catt into areas too steep and too wet f sustained production as well as t persistence of extensive ranches on t best valley land more suitable f intensive crop production. Three re sons are apparent for such expansio the centuries-old prestige of havi cattle, the current attractive expo

market and the relatively low risk when compared to the poorly functioning infrastructure for crop production. The net effect is the degradation of lands more suitable for permanent crop, forest or protective use; the alienation of valley lands economically and socially more suited for crop production; and the neglect of other livestock combinations integrated within a small farm production system.

Agricultural Institutions. The effectiveness of agricultural extension, credit and marketing institutions essential to the productivity of commercial agriculture and the well-being of the rural population is gravely limited by fragmented responsibilities, uncoordinated and duplicative functions and ineffective and poorly supported operations in the field. The fruit companies, the ranchers and the small scale farmers, which together account for the bulk of agricultural production and the majority of the rural population, operate in virtual independence from the support infrastructure. The agrarian reform projects, the cooperative and Honduran-owned farms suffer most from ineffective infrastructural support.

Environmental Problems

The constraints outlined above operate directly to cause such environmental problems as erosion, which affects agricultural production, or indirectly through sedimentation which causes flooding or affects the useful life of reservoirs. These effects in turn create problems in other sectors. It must be clearly understood by the government and the institutions administering foreign assistance that to invest in terracing projects to inhibit erosion around Lake Yojoa or to finance dikes and flood control dams in the Aguan Valley is to treat only isolated symptoms of the effects of rural development constraints. The constraints will continue to operate causing far worse problems in the future. Three major environmental problems, their origins and possible remedial actions are summarized below.

Deforestation. Deforestation by shifting cultivators is a major concern and a serious environmental problem. Shifting agriculturists deforest an estimated 80,000 hectares of broadleaf forests annually. Development problems resulting from this activity include:

- Continued poverty for the farmer and small cattleman because the extensive forest lands on steep slopes are unsuitable for crops or pasture.
- Annual loss of 300 million dollars worth of hardwood timber.
- Decrease in dry season water supply for cities such as Tegucigalpa and hundreds of villages as upper watesheds are cleared of their vegetative tree cover.
- Threat to the operation and useful life of hydroelectric reservoirs downstream of affected watersheds.
- Loss of wildlife, scientific and recreational values, watershed protection functions, and sustained-yield forestry use of the deforested areas.

A common pattern observed has been the purchase by cattlemen of land "improvements", i.e. deforestation and the planting of pasture after exhaustion of the crop production potential. This process unleashes the pressure for additional expansion of shifting agriculture on agriculturally marginal land.

Origins of the deforestation related problems include:

- Accelerated rural population growth due to high birthrate and some migration; existence of a nearly constant arable land base.
- Lack of access to land appropriate for agriculture or access to alternative employment. Disenfranchisement because of lack of

identification papers exacerbates these problems.

- Lack of access to lumber-related employment and markets controlled by the COHDEFOR.
- An unlimited access to the U.S. market for beef, rendering beef production on first class cropland as well as on marginal land economically viable to the producer.
- Failure of service infrastructure on lands designated for agrarian reform and general lack of agricultural technology and extension appropriate to small tropical farms, especially perennial crop orientation for hillside farms.

As is clear in this example, deforestation is best defined as a development problem manifest in the environment. The solution is not simply one of posting more forest guards; rather the solutions recommended require coordinated actions affecting the interests of various sectors. Similarly, the benefits of controlling deforestation accrue to several sectors. Necessary actions have additional social and economic benefits unrelated to those resulting from control of deforestation, such as increased agricultural production. Other environmental or development issues addressed in this profile such as fishery production, forest fires and waterborne disease are equally complex and multisectorial in scope.

Declining Productivity. Deforestation by the shifting cultivator clearing high forest in Yoro and Olancho is dramatic and well publicized. The human tragedy is even more serious for the many thousands of campesino families living on degrading lands in the Choluteca Valley and the western departments bordering El Savador. The forest cover has been peeled back leaving a threadbare patchwork of grazed bush fallow and cultivated plots.

Increased population pressure and the resultant shortened fallow period interrupt the process of regeneration in soil fertitlity, introduce erosion hazard, and result in energy inefficiency since soil productivity declines.

Without relief from population pressure, appropriate agricultural technology, and conscientious infrastructural support, human well-being and the productivity of the land will continue to decline.

Given existing technology, this mountainous land is not likely to be a major source of products for national and export markets. Therefore, the tendency is to abandon this land and its campesinos, and invest existing resources in improving agricultural production among more sophisticated farmers on the better valley soils. Such a course of action will have serious social, economic and environmental effects.

Pesticides. Insufficient baseline data are available on overall pesticide use and effects on the environment. However, based on observations and interviews, a qualitative view of pesticide-related issues has been gained. Existing restrictions on pesticide importations and use are not enforced. Producers of cotton employ massive applications of pesticides to sustain production. It is probable that pesticide use on cotton in the watersheds feeding into the Gulf of Fonseca is creating a build-up of toxic residues in fish and other organisms of importance to man. Among less sophisticated farmers, salesmen for the distributors of agricultural chemicals are the major sources of extension information on pest control. Their primary concerns are sales volume and chemical control. They have neither the interest in nor access to information on integrated pest management.

The effects of persistent and highly toxic pesticides on human health, fisheries and wildlife is unknown. The effects are not being monitored or mitigated by any formal government

program. Without effective enforcement of existing regulations concerning pesticide use, it can be assumed that any major increase in credit and extension for annual crop production will result in a commensurate increase in pesticide-related problems.

Recommendations

- Design and Develop a Land Capability Mapping System. Such a system would be suitable for the location of areas appropriate for agricultural, forestry and protective functions and as a tool in location of major infrastructural projects such as reservoirs, roads and urban expansion. Such a capability system is being developed by the National Cadaster Program (PCN). Use of such a system should be legally binding on all institutions with land management functions. Capability mapping should be consistently linked in a hierarchy ranging from the regional scale through the watershed to the individual land management unit.

- Provide Additional Support to National Cadaster Program. Increased technical and financial assistance is needed by PCN to carry out its responsibilities and complete the mapping system.

- Support Small Farm Sector. Establishment of an integrated program among government, agricultural institutions, universities and agricultural schools and the international aid institutions for the support of the small farm sector. Such a program should combine the ecological approach developed at CATIE with the technological advances developed by the AID Rural Technologies Project and the economics and organizational contribution of the Small Farm Systems Project of the MRN. Programs of research applicable to small farms should be implemented whenever possible on cooperating farms, not at an experiment station or model farm.

- Use Environmental Management Criteria in Agricultural Projects. Agricultural development projects should incorporate environmental management criteria in their design and implementation. "Criteria" refer specifically to land capability, cropping systems appropriate to the tropics, and soil and water conservation strategies.

- Promote IPM Strategies. Establish an authority to regulate the importation and use of pesticides combined with an active research and extension program in integrated pest management (IPM) aimed especially at cotton and vegetables where misuse of pesticides is most serious.

- Address Land Use and Tenure Issues. Recognize that maldistribution and inappropriate use of good agricultural land is more than an exciting political issue; it is a fundamental problem limiting human and economic development. To be effective, land reform programs will have to give new emphasis to the coordinated functioning of the service institutions and to agricultural technology appropriate to the farmer and the environment in which he works.

- Promote Family Planning. The national government and the development assistance community should explicitly acknowledge that the development potential of Honduras is ultimately constrained by population pressure. A vigorously implemented family planning program should be initiated to relieve pressure on the land resource and permit agricultural development programs to realize actual advances in the well-being of the rural population and increases in surplus production.

- Develop Operational Institutional Models. Evaluate the underlying reasons for success of IHCAFE, the Honduran Coffee Institute. This institution has done an effective job of providing credit, extension and marketing services to coffee producers including campesions with and without identification papers. IHCAFE could perhaps provide a model for other agricultural service institutions with problems of organization, morale and sense of mission which limit their effectiveness.

FORESTRY ISSUES

Overview

Honduras is the only Latin American country in which forestry is one of the principal economic ativities. Lumber exports rank in value among the top five exports of the country. The principal factor contributing to the importance of forestry is the presence of some three million hectares of pine and 4.4 million hectares of hardwoods. As an export, pine has distinct advantages: it is known and accepted on the world market; technology for processing can be transferred directly from the midlatitude industry of the U.S. and Europe; and it occurs in nearly pure stands that are relatively simple and inexpensive to exploit. In addition, extremely poor soil and broken topography have limited competition for land from agriculture and to some extent from cattle grazing.

While mahogany and cedar are esteemed abroad, little effort has been made to create markets for other hardwoods with valuable properties because of the ease of exploiting and marketing pine. Consequently pine constitutes 97 percent of the value of all lumber exported. Hardwoods remain an underutilized resource rapidly disappearing as forests are burned and converted directly for agriculture and grazing.

Constraints to Development

Unlike agriculture which is limited by a scarcity of appropriate land, there is an abundance of land suitable for pine and hardwood production. The contribution of forest products to the export economy and to well-being of the rural population is limited by the interaction of four broad constraints operating within the institutional and cultural structure of Honduras. Again, environmental problems, such as uncontrolled fire, deforestation and erosion, affect the productivity of the forest sector as well as the agriculture, energy and fisheries sectors.

Economic Participation of the Campesino. While nearly 2000 people are employed permanently by COHDEFOR and over 30,000 are employed on contract, an estimated 200,000 familes live within the limits of the forest areas managed by COHDEFOR. These people receive minimal benefit from the exploitation of the forest that surrounds them. The reasons are first, the State, not the individual campesino or his village, is the owner of the timber and second, most campesinos lack proper identification papers and therefore are not even employed by COHDEFOR. COHDEFOR sells the standing timber to an outside concessionaire who cuts the wood and then resells the lumber back for export.

Logging Practices. Logging is marked by waste and inefficiency at every step from the stump to the mill. In the broadleaf forests only about 10 percent of a given stand is logged, the focus being on only a few particularly valuable species such as mahogany. In both pine and broadleaf areas logs with any defects are abandoned, variable lengths result in wasteful trimming, and poor sawing practices and poorly maintained equipment contribute to the loss of as much as 50 percent of the potentially marketable wood. Lower grade wood with a potential local

market is left in the forest or burned at the mill. There is a lack of operational standards and procedures governing what slopes and soils can be logged without incurring site degradation, or where and how logging roads should be constructed.

Forestry Knowledge. Forest exploitation in Honduras is unbalanced. The fact that only three percent of the lumber exported comes from the broadleaf forests and only 10 percent of a given stand is logged indicate a lack of appropriate knowledge and technology for effective utilization of this resource. Failure to valuate the resource has led to its destruction by competing activities of relatively low value, namely shifting agriculture and grazing. Sustained-yield forestry in the broadleaf areas cannot be even considered without personnel trained in the management of forest succession combined with reforstation using a variety of species. The incentive to actually effectively use the broadleaf forest will come from more aggressive marketing abroad and the manufacture of secondary products from hardwoods such as paneling, furniture, laminates and short fiber paper products.

Institutional Functioning. Honduras has centralized under State control not only such traditional functions of a forest service as protection and extension, but the ownership and management of all forests and the domestic and export commercialization of forest products as well. The objective of taking over most private sector functions is to generate funds directly for the public treasury through rational management of the total resource. In reality, a powerful but unwieldy bureaucracy has arisen with neither the business sense of a corporation nor the esprit de corps of a national forest service. COHDEFOR has been plagued by problems of essential coordination among departments such as production and commercialization. Social forestry, an official concern for the large population living in or peripheral to the forest, has not been taken seriously. For example, the volume of firewood cut by campesinos is five times the volume of wood exported, yet this major forest use and contribution to the economy is given low priority by COHDEFOR.

Environmental Problems

Fire. The high incidence of uncontrolled forest fires limits the benefits that could accrue to campesinos from utilization of pine forest resources. Since those who live in the pine forests do not benefit from its optimum management, they tend to use fire inappropriately. Fire is used to prepare a new field for cultivation and often escapes to surrounding pineland. Similarly, cattle operations burn pastures annually to maintain palatability of grass for the cattle. Some fires are set out of spite because the campesino belives COHDEFOR has usurped his forest. Between 1977 and 1981, illegal fires burned on the average 65,000 hectares per year, with an estimated timber loss of 448,000 cubic meters per year. The total effect of ill-timed and frequent fire is a loss of standing timber and a great loss in pine regeneration that in turn, affect future timber harvests. Efforts have been made to improve fire detection and control. However, the underlying issue of full participaton by the campesino in the forest economy has not been addressed effectively.

Erosion. While erosion caused by logging operations is not of the same magnitude as that due to shifting agriculture, it is significant. The two causes are inseparable where logging is carried out in the broadleaf forest. Skid trails and roads that are poorly designed or situated trigger serious erosion. Where the logging is extended into steeply sloping marginal areas in upper watersheds, the inevitable invasion of

campesino farmers using the forest roads and trails greatly exacerbates the problems of erosion and downstream sedimentation. Lack of a social forestry program to involve the campesion in forest product exploitation, disinterest in sustained yield broadleaf forestry, and total neglect of the small, hillside farmer by the agricultural sector guarantee an unstable situation characterized by serious erosion, forest degradation and institutionalized poverty. In the Aguan Valley, erosion and accelerated runoff are causing serious problems of sedimentation and flooding downstream.

Loss of the Forest Resource. The basic institutional failures by the forestery and agricultural sectors to recognize the survival needs of the campesino and particularly his need to benefit from the management of the forest around him, underlie the precipitous loss of forest resources in Honduras. The pine forests are not decreasing markedly in area, but the volume dropped from 48 to 28 million cubic meters between 1964 and 1980. Much of this drop in volume is due to poor regeneration caused by uncontrolled burning. If the human problems underlying burning are not resolved, commercial forestry based on cutting the remaining old growth pine will virtually stop in 18 years.

The broadleaf forests are shrinking in area by four percent in area each year. Some 80,000 hectares are cut, burned and converted into poor cropland and pasture. The estimated $320 million dollar value of the lumber lost annually is hypothetical; the technology, infrastructure and motivation to effectively utilize the resource needs to be improved.

Recommendations

- Develop a Land Use Capability System. The design and development of a land capability mapping system would enable the GOH to locate areas appropriate for agricultural, forestry and protective uses (see Agricultural Section). Criteria should be established and implemented for distinguishing between exploitable forests and land suitable for watershed protection or reserves. Such mapping should give the location and design of forest penetration and wood extraction roads.

- Integrate Social Considerations in Forest Development. While in some highly urbanized countries, forest management may be a purely technical endeavor, in Honduras, two-thirds of the population lives in rural areas, making social considerations in forestry essential. Concern is not only for the well-being of the people, but for the productivity of the forest as well. The law creating COHDEFOR provides guidelines for incorporating the campesino into the forest industry. The letter and spirit of the appropriate articles should be implemented.

- Initiate Training Programs. Include in programs of university training in foresty a specialization in tropical broadleaf management, agroforestry, watershed management and social forestry in addition to traditional training in pine production.

- Improve the Utilization of Forest Resources. Increase the efficiency of forest operations from the stump to the market. This involves full utilization of the trees on a given site, efficient sawmill operation and creation of markets for woods of different species and qualities. Favorable results would reduce pressure on the forests for a given quantity of products actually marketed.

- Manage Some Forests for Energy Production. Given the dependence of Honduras on imported fuel COHDEFOR should establish a major program to

assure a sustained supply of firewood and charcoal for the low income population, ceramic and lime slaking industry, and for new uses such as substituting fuelwood for petroleum. Better ways should be found to manage production and distribution of firewood and charcoal-making so that they are incorporated into programs that opt for full utilization of forests as noted in the preceding recommendation.

WATERSHED MANAGEMENT ISSUES

Overview

A watershed provides a useful natural framework for evaluation and management of such interrelated activities as agriculture, fisheries, forestry, natural area protection, hydroelectric power generation and urban water supply and waste disposal. Ecological processes operating in Honduras have resulted in highly dissected watersheds with extensive areas of steeply sloping land. The relatively high density of people in upper watersheds has resulted in the degradation of the various productive and protective functions. This has accentuated downstream problems of sedimentation, flooding and dry season water deficiency. Shifting agriculture and uncontrolled grazing and forest exploitation are the principal causes of watershed degradation. The constraints which operate to prevent effective resolution of these problems within the agricultural and forestry sectors have already been discussed. In this section, the broader issues of watershed management are explored.

Constraints on Management

The constraints limiting the effectiveness of watershed management in Honduras are formidable due to the dissected landscape, the array of institutions involved and the complexity of the underlying social problems. Various constraints and resultant environmental problems mentioned in previous sections on agriculture and forestry are intimately related to watershed management. These have not been repeated in this section.

Institutional Priorities. The law creating COHDEFOR gave it a mandate to protect forests against destruction by overgrazing, to prevent accelerated erosion and to carry out watershed protection activities either directly or in collaboration with other institutions. In practice this is an inoperative mandate, since COHDEFOR is, in part, in the pine forest exploitation business. Within this reality it is unprofitable to invest in watershed management in broadleaf forest areas where the most serious degradation occurs. Similarly, degradation of upper watersheds and the associated involvement by campesinos in this process are of only marginal concern to the agricultural and agrarian reform institutions. Institutions responsible for hydroelectric development and urban water supply are the most directly affected by downstream sedimentation and changes in hydroperiod, yet effective collaboration with COHDEFOR is lacking.

Land Use Policy. Although land use laws and policies exist, there is ambiguity among institutional mandates. Enforcement has been virtually nonexistent for lack of specific procedures for implementation and there is no national watershed management policy or plan. A serious concern is the lack of a land-use capability classification system and a land ownership system for guiding coherent management decisions by all institutions concerned. Such tools are essential to integrated watershed management.

Inadequate Data Management. Lacking is a structure for orderly gathering,

maintenance and productive use of data. Soils and forests are being degraded at a rapid rate by processes outside official control, such as shifting agriculture and grazing. As a result, forest inventories are obsolete by the time they are completed and industry development plans are based upon nonexistent or depleted resources. Sectorial projects in road building or agrarian reform often fail or negatively affect other sectors for several reasons:

- Lack of basic data
- Inability to use existing information held by other institutions
- Failure to conduct field surveys to gather data.

For example, agrarian reform settlements are often located on poor soils, and bridges are lost due to lack of hydrologic data or input from local observers regarding flood stage of rivers.

Training in Watershed Management. Lack of institutional capability in watershed management can be traced back to the training received at the schools providing personnel for COHDEFOR. Programs tend to be production oriented. The forestry school at Siguatepeque has proposed a curriculum in watershed management but has not as yet found funding to implement it. Similarly, those agricultural schools which should be training administrators and extensionists versed in alternatives to existing destructive practices in upper watersheds are almost exclusively concerned with commercial cattle and crop production.

Environmental Problems

Environmental problems such as flooding, erosion, and water deficits associated with inadequate watershed management are outgrowths of many concerns discussed up to this point. Unlike the forestry sector where improper management of resources results in direct observable economic losses, watershed degradation indirectly affects those responsible for impro land use, namely the campesino, t rancher and COHDEFOR. The campesi and rancher lose valuable so resources; COHDEFOR loses credibili in ineffectively coordinating watersh management activities. The negati effects of mismanagement are displac in distance and time; for exampl flooding and siltation are increas long after the penetration of the fi logging road. Furthermore, instit tions are ineffective in preventi such degradation; for example, t affected sectors lack the legal bas as well as the foresight to act defense of vital urban water suppli and reservoir capacity.

Flooding. Flooding is a natur phenomenon in the floodplain of river. However, increased runoff fr deforested lands can cause more than tenfold increase in peak flow followi a heavy rain in a flood plain are Erosion rates of 100 to 500 tons soil per hectare per year have be recorded in Honduras, filling stre channels and increasing further t potential for flooding. Some 85 pe cent of Honduras drains to the Cari bean, with the Sula and Aguan valle alone receiving the runoff from mo than 30 percent of the national terr tory. In the heavily developed Su Valley, damage from flooding is est mated at 33 million dollars per yea In the Aguan and neighboring littor valleys where both upper watersh disturbance and downstream developme are incipient, annual damages are we in excess of 4.5 million dollars p year.

Deficiency of Water. The inevitab companion of culturally-caused floodi is water deficiency. This problem particularly acute in the more dense populated dry forest Life Zones of t Pacific drainage. Only 15 percent the land area drains to the Pacific a this area receives an even lower pr portion of the annual rainfall. T situation is typified by Tegucigal

with its more than 350,000 inhabitants which often suffers from a scarcity of water during seven months of the year. The limited extent of an upstream forested watershed capable of receiving and storing the abundant rainfall is being rapidly degraded with resultant accentuation of flood and water scarcity. A common response to the ravages of a culturally induced change in hydroperiod is to advocate massive investment in flood control and water supply dams coupled, as in the Aguan Valley, with diking and channelization. Such expensive measures treat only the symptoms of poor watershed management.

El Cajon Watershed. The El Cajon hydroelectric project represents a 650 million dollar investment (current estimate) with a watershed area of 8,320 square kilometers. Interaction between IDB and the government resulted initially in a comprehensive program of watershed management studies. The institutional constraints such as lack of training, conflicting priorities, etc., will have a major impact on effective management of the El Cajon watershed. Failure to recognize the human role in arresting watershed degradation has led COHDEFOR and IDB to accept a 40,000 hectare pine reforestation and logging project as a substitute to the original integrated program.

Recommendations

Recognize the Relationship Between Watershed Protection and Environmental Quality. The GOH should recognize that shifting agriculture, grazing and improper forestry practices in upper watersheds represent the de-capitalization of development resources. This degradation of watersheds threatens the viability of the economy and the well-being of the people. An executive order should mandate that institutions responsible for watershed management prepare specific procedures and action plans to effectively implement the intent of existing laws.

- Emphasize Social Forestry Approach. The GOH should promote those programs in the agriculture and forestry sectors which will provide viable alternatives to the large marginal population now causing watershed degradation. Programs should have the dual focus of increasing small farmer access to better lands currently underutilized and, recognizing the limited extent of good agricultural land, facilitate campesino involvement in forestry and perennial crop production. With COHDEFOR, the diverse social action programs should be coordinated and strengthened. Infrastructural support is needed by campesinos living in forested areas in order that they may engage in activities less damaging to watershed protective functions.

- Improve Range Management. COHDEFOR should initiate a controlled fee-grazing and range management program, as provided or under Decree 103 in order to insure the sustained productivity of forest range lands.

- Initiate Program in Broadleaf Forest Management. COHDEFOR should initiate a major program in broadleaf forest management and exploitation integrating the campesino population now destroying both protective and timber-producing forests.

- Strengthen Education and Training in Watershed Management. Education and training in watershed management should be strengthened in the following major areas:
  - At the university level as an option for professionals in training for positions with COHDEFOR and other institutions
  - For upper and middle level decision makers in government agencies where a sectorial

perspective and lack of understanding of the economic importance of watershed management have limited support for and participation in such programs.

- In public education programs designed to reach both school children and the citizen as a means of gaining immediate and long-term support for watershed management activities.

FRESHWATER AND MARINE RESOURCE ISSUES

Overview

Honduras is blessed with rich and diverse coastal resources including extensive areas of mangroves and lagoons, coral reefs and sandy beaches. Off the 680 kilometer long Caribbean coastline extends a continental shelf ranging from 19 to 240 kilometers in width. Shrimp and fish which reproduce in the coastal lagoons provide the basis for the major fishing on the offshore banks. The Pacific coast around the Gulf of Fonseca is shared with El Salvador and Nicaragua. The estimated 50,000 hectares of mangroves in the Gulf serve as a major nursery area for the offshore fisheries. The configuration of the coast and national boundaries leaves Honduras with only right of transit to the open Pacific through the territorial waters of her neighbors.

Environmental issues of particular significance in the optimum development of the coastal zone include:

- Sustained yield management of near shore marine fisheries, notably lobster, shrimp and conch
- Mitigation of conflict between the vital nursery functions of coastal estuaries and such activities as salt production, shrimp farming, port and tourism development and upstream agriculture.
- Management of tourism development in the Bay Islands and along the Caribbean beaches to maintain coral reef productivity and the aesthetic qualities of the coastal landscape from which its economic potential derives.

Constraints To Management

Soil erosion, overgrazing and uncontrolled fire have locally visible negative effects on agricultural and forest production. Appropriate land management yields obvious rewards to the landowner or institution controlling the land. The fundamentally different nature of coastal and marine ecosystems and the more complex management required to derive optimum economic benefit from them imposes constraints which will challenge environmental management institutions. These and more conventional constraints are discussed below.

Ecological Complexity. Management of many marine resources is complicated because nursery areas such as estuaries are often distant from where the resource is exploited; shrimp, many fish and sea turtles are examples. A number of issues must be addressed by the GOH in order to improve its ability to effectively manage fishery resources in a sustainable fashion:

- Lack of basic knowledge about fish nursery grounds and their role in productivity of the resource
- Problems of jurisdiction of the fishery sector institutions in habitats critical to the productivity of the fisheries
- Overfishing pressures on offshore fishing grounds.

Often cooperation between two or more countries is required as in the case of the Gulf of Fonseca where Honduras controls only the fish reproduction area and not the fishing grounds.

Sectorial Interests. Given that the estuarine environment of lagoons, mangroves and tidal flats is essential to the fishing industry, conflicts arise

because other sectors control and have conflicting uses for these areas. Salt production results in the removal of mangroves from large areas with additional use of mangrove wood for fuel in some operations. Shrimp farmers dike off large areas and remove mangroves. Infrastructural development (ports, roads, industries and urban expansion) in the coastal zone may adversely affect estuarine productivity as does upstream dam construction and use of agricultural chemicals. These sectors derive no benefit from restrictions on their activities which benefit a distant fishing industry.

Lack of a Fisheries Control Management Plan. Any boat licensed to fish in Honduran waters may exploit the fishery resource. Control is difficult, as the catch may be taken directly to foreign ports for processing. Even in the face of a declining resource, it benefits a fleet owner to send out boats as long the value of the catch exceeds the of operation. Expanding fisheries more distant and deeper waters as is occurring on the Caribbean coast, results in an escalation of energy costs and only puts off the necessity of taking firm management action.

Institutional Limitations. While marine resources were abundant and the coastal zone undeveloped, fishery related institutions had either no pressing concerns about the resource or were primarily engaged in promoting expansion of production and collecting tax revenues. This situation prevailed until as recently as 1978. Since that year shrimp and lobster catches have dropped off. Institutional responsibilities are fragmented and none has the personnel, budget or mandate to fulfill an integrated fishery resource management function.

Environmental Problems

Overfishing. As in the case of the agricultural sector, the fishery sector is driven by the export market. Because of the luxury nature of the market, energy and monetary costs of exploitation can be far higher than could be borne by a fishery oriented to supply basic dietary needs. Limited purchasing power of those Hondurans who could use fish protein coupled with a specialized export market have resulted in a differential pressure on populations of shrimp, lobster and a few fish. Not only are shrimp populations stressed by overfishing, but large quantities of non-target fish including juveniles are killed and dumped into the sea. In 1979, the shrimp catch fell dramatically, and the lobster catch has fallen by 50 percent per year since 1978. In 1979, a moratorium was set on new entries into the fishing fleet and a March to June closed season was established.

Estuarine Destruction. Estuarine functions are being impaired or destroyed by several types of activities. Most obvious is the destruction of the habitat itself by diking areas, particularly mangrove swamps, with complete removal of vegetation (as in the case of salt ponds and shrimp farms in the Gulf of Fonseca). Dredging and spoil disposal associated with port development at San Lorenzo have had an undocumented effect on shallow water habitats. Heavy use of agricultural chemicals in the Pacific coastal plain is detrimental to estuarine organisms and can affect human health through biomagnification in food chains leading to man. A similar problem has been identified on the Caribbean coast at the Laguna de los Micos where contaminants from banana and oil palm plantations enter the lagoon as runoff. Deforestation and erosion in upstream watersheds result in changes in the timing, quality and quantity of the water reaching the estuary, adversely affecting productivity. Changes are occurring subtly on both coasts as watersheds are deforested and runoff patterns are changed. Particularly affected are marine fishes that

spend part of their life cycle in the rivers. If major dams are built in the piedmont the problem could be accentuated.

Uncontrolled Development. The Bay Islands, Roatan, Utila and Guanaja are bounded by coral reefs of exceptional beauty and productivity. These reefs serve the multiple functions of providing habitats for fishes of economic importance, offering a major attraction for tourism and protecting the coastline from the direct impact of storm waves. The value of the reefs, which are a major element in the economic viability of the islands, are threatened by a combination of activities. Uncontrolled land clearing and burning in upper watersheds is an increasing source of sediments reaching the sea during the torrential rains of the wet season. Road construction with little attention to the effects of runoff represents another contribution to the sedimentation problem. Lack of stringent construction and waste treatment standards for expanding urban areas, second homes and hotels represent a future threat to the reefs from nutrient inputs which cause pollution and reduce the diversity of marine life in affected areas.

Recommendations

- Strengthen RENARE. Personnel and financial resources should be provided to carry out effective fisheries management. The RENARE has a broad mandate to manage living aquatic resources. This would increase production and revenues well in excess of the cost.

- Support an Aquatic Resources Management Program. An integrated program involving government agencies, universities, industry and international expertise should be funded to confront problems of highest priority. Implementation of an aquatic resources management program will require basic inventory data and applied research. Establishing a sustained yield shrimp and lobster fishery would be of immediate value.

- Develop and Implement a Coastal Zone Management Plan. Coastal zone management authorities should be established to provide interinstitutional coordination and leadership to address the unique management issues represented by the Bay Islands, the coastal lagoons of the mainland and the mangrove areas in the Gulf of Fonseca. The AID-funded Choluteca watershed project should be expanded to include the estuarine zone of the lower watershed affected by upstream management.

- Support Training Programs. A comprehensive training program should be developed including formal graduate training, in-service courses, workshops and technician/enforcement personnel training. Sufficient human resources to implement programs in fisheries and coastal zone management do not exist in Honduras.

WILDLANDS MANAGEMENT ISSUES

Overview

Varied topography, soils and rainfall give Honduras some of America's most ecologically diverse and economically valuable natural areas. From pristine coral reefs to lush cloud forests, open pine savannas to dense rainforests, the potential exists for sustained development based on rational management of these natural resources. Unfortunately, these natural areas are being destroyed to support ephemeral shifting agriculture and cattle raising on poor pasture. In addition to the loss of timber and watershed values mentioned in previous sections, this expanding frontier of shifting cultivation and cattle farms is threatening

the survival of various endangered animal and plant species, decimating economically valuable animal populations and foreclosing such future development options as forestry or scientific and general tourism in natural areas. The extremely limited extent of good agricultural land coupled with the absence of fossil fuel resources in Honduras makes it imperative that natural areas be effectively managed to optimize their contribution to the economy and the well-being of the population. Such contributions include wood products, fuel, protein from game and fish, medicinal plants, watershed protection, waste treatment, tourist attractions and recreation.

Constraints

The perception that natural areas have little intrinsic value except in terms of their agricultural potential seriously constrains institutions with wildlife and wildlands management responsibilities. Low status coupled with a limited overall budget and the pressures to serve the immediate needs of the rural and urban poor make it extremely difficult to justify the funds needed to carry out an adequate management program. Low status is exemplified by the following quote:

> "In the uninhabited regions of Honduras, wildlife has long been almost extinct except for iguanas and snakes, both adaptable to changing conditions. There is no evidence that additional farming units in the uninhabited areas will affect wildlife either adversely or favorably." (AID Project Paper Honduras - Small Farmer Technologies, 1976)

Institutional Constraints. The Department of Wildlife and Environmental Resources (DWER) in RENARE is the lead natural area management agency. Their total budget for 1980 including international inputs was only 39,000 dollars. More than half the nationally budgeted funds designated for DWER are spent for caging and stuffing animals for the zoo and museum rather than for managing wildlife habitat. With only a few trained biologists complemented by Peace Corps volunteers, the agency has embarked on an ambitious program of wildland management. The fisheries department, also under RENARE, overshadows DWER because of the recognized value of fisheries to the economy from taxes on seafood exports.

Development Relevance. Despite the significant advances in identifying management needs, and the establishment of cooperation with other agencies and nongovernmental organizations, the DWER has not yet organized its available resources to effectively sell the need for integrated natural area management. DWER has made the strategic error in over-emphasizing a wildlife and parks orientation. A focus on preserving wildlands and saving endangered species is indeed valuable and needed, but marginally important to a government facing desperate social and political problems of underdevelopment. Missing is a pragmatic emphasis on the essential contribution of natural ecosystems to development. Well-managed natural forests and waters are in many instances more energy efficient in producing wood products, fuel and food, in controlling flooding and sedimentation and in treating wastes than the fossil fuel subsidized plantations and infrastructure that is required to replace degraded natural system functions. An upper watershed supplying water to a city or protecting a hydroelectric investment and an estuary providing a nursery area vital to commercial fisheries both provide wildlife habitats at no additional cost.

Marginality. The population groups causing greatest damage to natural areas are politically and geographically outside the influence of any government programs. They are not reached by education, health, credit, agrarian

reform or law enforcement and much less by DWER. Education, extension or enforcement programs are virtually impossible to carry out in the absence of any institutional infrastructure or even roads.

Environmental Problems

Natural Area Degradation. By far the greatest threat to natural area functions and wildlife is the indiscriminate destruction of all natural vegetation by shifting agriculturists and cattlemen regardless of the inappropriateness of the sites for such uses. Extreme steepness and, even more important, isolation from the settlement frontier remain the major factors in the continued existence of extensive natural areas in Honduras. Presently, there are functioning programs for managing critical upper watersheds, particularly cloud forests, providing water to cities such as Tegucigalpa or protecting reservoirs from sedimentation, and protecting valuable wildlife habitat.

Over-Exploitation. While habitat destruction continues to be the major threat to both endangered and economically important wildlife, over-exploitation has a notable effect on the following animals: jaguar, river otter, manatee, tapir, crocodile, macaw and sea turtles. Freshwater fish populations cannot be maintained in areas where nets, poisons (including pesticides) and dynamite are used routinely.

Urban-Industrial Expansion. The threat to mangroves and coral reefs from tourism development, salt making and shrimp farms is treated in the section on "Uncontrolled Development" in the Freshwater and Marine Resources Section, page 18.

Recommendations

- Develop and Implement a Land-Use Capability System. As mentioned in previous sections, high priority should be given to establishing a legally mandated land capability classification system. If implemented, such a classification would immediately identify large areas of the country to be zoned as protective because of such limitations as steep slope, poor soils or poor drainage. In these areas there would be no use conflict with wildland management. Where forestry is a potential use, sustained yield management can be combined with wildlife management and recreational uses. The classification would tend to concentrate agricultural development projects on appropriate lands and minimize competition with wildland uses.

- Valuate Natural Resources in a Development Context. A clear distinction should be made between those natural system attributes that clearly have economic value as protein resources, for sustainable sport hunting (white winged dove) and as a tourism attraction (coral reefs) and those which appeal to aesthetic and scientific values. The cost effectiveness of managing the former resources should be vigorously promoted. The qualitative values associated with rare and endangered species, aesthetically and ecologically unique areas and biosphere reserves represent universal concerns of mankind and should be partially financed on a permanent basis by international organizations with infrastructural support from Honduras.

- Improve Institutional Planning and Cooperation. Given limited financial and personnel resources as a permanent state of affairs, DWER should establish priorities to guide resource allocation. Those areas not immediately threatened by spontaneous settlement and those already overrun can be forgotten temporarily. Those areas where the threat

of deterioration can be countered by concerned effort should receive priority attention. Where other more powerful agencies have a mandate, such as COHDEFOR with its watershed management responsibilities, those agencies should be pressured to function as required by law in protecting areas also having natural area values.

- Strengthen Institutional Capabilities. A restructured department of parks and wildlife should be established as an independent entity or as an integral part of COHDEFOR, the forestry development agency. In the latter case, parks and wildlife could be combined with existing watershed management, social forestry and extension programs. For example, a comprehensive wildlands inventory should be conducted as the basis establishing priorities for future management programs.

- Develop an Environmental Education Program. A national environmental education strategy should be defined focused on four target groups--decision makers, students, the general public and the rural population.

WATER SUPPLY AND WASTE MANAGEMENT

Characteristics of the Water Resource

Society has the following uses for the water resource:

Human use -	drinking, washing and waste removal
Industrial -	cooling, a process solvent and waste removal
Agricultural -	stock water irrigation and food processing
Ecological -	fish habitat and waste filtering and treatment
Energy -	hydroelectric power generation
Navigation -	boat and barge movement
Recreational -	swimming, boating, hunting and fishing

Constraints To Multiple Use of Water Resources

Watershed Management. The seven uses of the water resource listed above are all seriously threatened by the deterioration of such watershed functions as flow regulation, aquifer recharge and erosion control. All of Honduras experiences wet and dry seasons. The Pacific drainage has the least total rainfall, the longest dry season and the highest population density. Unfortunately, those upper watersheds receiving the most rainfall are rapidly losing their capacity to hold water for slow release in the dry season due to rampant deforestation.

Tegucigalpa Water Supply. The threat to water supply is most obvious around Tegucigalpa with more than a quarter million population growing at a rate in excess of six percent per year. Water supply is still seen as simply an engineering problem of dams and aqueducts. A number of institutions are involved in Tegucigalpa's water supply problem:

- The Ministry of Public Health (MSP) and the Autonomous Aqueduct and Sewer Service (SANAA) have not evidenced concern for watershed management which is basic to solving the water supply problem.
- COHDEFOR is legally responsible for watershed management but has little vested interest in exercising control.
- RENARE manages of La Tigra National Park, which protects a vital part of Tegucigalpa's water supply. Its budget for guards is not adequate to prevent rapid encroachment by squatters clearing the cloud forest and destroying

the protective function of the park.

Agricultural Water Use. Most of Honduras has rainfall of adequate quantity and reliability to produce perennial crops and at least one annual crop harvest per year. Of the 54,450 hectares under irrigation, 36,000 hectares belong to banana and sugar companies. The technological level of agriculture in most areas of the country does not yet justify major investment in irrigation. A drop in base flow due to watershed deterioration can be critical to the success of expensive irrigation schemes.

Aquatic Ecosystems. The lagoons and mangrove swamps of the Honduran coast serve as nurseries for shrimp and other economically valuable species. Few decision makers are aware of the linkage between a functioning estuary and the multimillion dollar shrimp industry off the coast. Neither is it realized that a functioning stream ecosystem effectively traps and treats wastes entering from the land rendering the water useful for fish production or human use downstream. This lack of recognition of the economic value of these ecosystems makes it difficult to justify the budget and personnel needed for effective management.

Energy. Hydroelectric energy production is an important water use today with the Yojoa-Rio Lindo plant generating 108 MW. To this capacity will be added El Cajon (202 MW) and El Nispero (22 NW). Lacking fossil fuel resources, Honduras is placing great emphasis on developing its hydroelectric energy potential. However, virtually no attention is being given to maintenance of the quantity and quality of water required to optimize long-term return on investment in dams and generating equipment. This lack of effective concern is evident in the management programs for the El Cajon and El Nispero projects. Hydroelectric projects are viewed by governments and lenders as an engineering sector activity; thus critical ecological and human elements of watershed management are neglected.

Navigation and Recreation. Navigational and recreational uses of water are minimal. Potential for these uses will decline as variations in seasonal water levels in streams become more pronounced due to continuing watershed degradation.

Waste Management Constraints

MSP and SANAA are responsible separately and jointly for water supply and waste disposal (liquid and solid).

Urban Areas. Urban areas concentrate population for more efficient delivery of services such as water and collection of wastes. However, new settlements chaotically located and often on difficult terrain at the city's fringe make access difficult and costly. Migrants lack knowledge of sanitation, particularly under crowded urban conditions. Water and sewer programs are not keeping pace with urban growth, estimated at 6.2 percent per annum.

Rural Areas. Extension of water and waste control services to rural communities is a problem. For example, over 20,000 dispersed communities only connected to major centers often by seasonally passable roads have created difficulties in extending any services. The offering of materials for building latrines and aqueducts or wells must be accompanied by ongoing training and technical assistance. In many small isolated communities, the infrastructure for such follow-through is lacking.

Environmental Problems

Human Health. The disposal of human waste is the most serious waste

management problem of Honduras. In 1978 approximately 44 percent of the urban population was served by sanitary sewers. An additional six percent had latrines, leaving half the urban population apparently without acceptable facilities. In rural areas some 18 percent of the population had latrines with 75 percent drawing water from wells or streams. The magnitude of the public health problem due to waterborne diseases is best evidenced by infant mortality levels of 85.6 per 1,000 urban areas and 127.2 in rural areas.

Sewage and Pollution. Where latrines or septic tanks are properly used, contamination of water supplies and transmission of disease is held to a minimum. The more than 30 sewer systems operating in Honduras concentrate human excrement and other wastes and discharge them into the nearest stream. Health hazards are reduced for large populations in the areas served by the collector lines, while increasing the probability of contracting waterborne diseases for those drawing water downstream. The magnitude of the problem is determined by a number of factors, including water use practices downstream and the magnitude of the contaminant load in relation to the assimilative capacity of the stream ecosystem during the course of a year. Also of importance is the effect of stream pollution on livestock, fish, wildlife and recreation.

Solid Waste. While not as serious a health problem as in the case of liquid waste, solid waste volume tends to increase along with population. Per capita waste generation is relatively low (2.2 kilograms per day) due to the low level of material consumption and the scarcity of non-returnable containers and excess packaging. The poor migrants settling at the urban fringe generate less solid waste than the average. Collection coverage is 70 percent for Tegucigalpa, 95 percent for San Pedro Sula and 100 percent for eight smaller cities. Disposal is by open burning, except in Tegucigalpa where there is a landfill.

Industrial Pollution. In San Pedro Sula, the industrial center of Honduras, wastes are not treated. However, waste streams have yet to be characterized and the effects on receiving waters analyzed. Coffee processing plants (beneficios) number some 45,000 and are located in 13 of the 18 departments of the country. The organic matter output creates a high chemical and biological oxygen demand which can become a serious problem during dry season low flow periods. Deaths of cattle have been attributed to their drinking water downstream from beneficios.

Mining Pollution. A single but important instance of pollution from mining was found at Lake Yojoa where the Rosario Resources Corporation mines nonferrous metals and discharges mining and refining wastes into Lake Yojoa. The importance of the waste stream indicates the need for sampling to assess the potential dangers to human health. Since 1948 the mine has been discharging cyanide, copper, lead, zinc and other metals into a nine kilometer long creek leading to the lake. Biomagnification of some toxic materials may be occurring even though the organisms which concentrate the contaminants remain healthy.

Agricultural Pollution. There is no control of pesticide use in Honduras. It can be assumed that cost effective pest control is the primary consideration in selection of chemicals to be used on cotton, bananas and other commercial crops. Danger to spray equipment operators and laborers, persistence and mobility in ecosystems and fish and wildlife mortality are secondary considerations in the absence of enforced regulations and an aware public. No data is available on the magnitude of the problem.

ecommendations

Improve Institutional Collaboration. Adequately funded collaboration between COHDEFOR and the agencies responsible for water supply, MSP and SANAA, is essential in order to give water management a more prominent role in the development and maintenance of water supply systems. The role of La Tigra National Park should be evaluated in terms of its function in maintaining the Tegucigalpa water supply and its funding adjusted in accord with the value of this function.

Conduct Feasibility Studies of Waste Management Practices. Existing and proposed sewer systems should be evaluated in terms of the health impact and the assimilative capacity of the receiving waters. The feasibility of waste treatment using natural swamps and marshes or a man-made system of linked pastures and settling ponds should be considered as an alternative to expensive treatment plants or river contamination. For example, the proposed Tegucigalpa wastewater treatment plants should be completely reevaluated before any money is invested in their actual construction and operation.

Develop Training and Education Programs. The National Autonomous University should establish a short course capability in all areas of environmental engineering, with particular priority given to waste treatment plant operation and alternative methods, and solid waste management. This can be done as a joint venture with Centro Panamericano de Ingeneria Sanitaria in Lima, Peru, or a foreign university.

- Improve Pest and Pesticide Programs. The enforcement of new pesticide import and use regulations should be closely coordinated with an active program to apply integrated pest management techniques. For example, cotton on the Pacific Littoral should receive highest priority.

- Establish Water Quality Standards and Enforcement Program. At the present time there are no water quality standards for Honduras. Any future water pollution control program must rest on such standar . It is recommended that as a first step, CONSUPLANE should establish a list of designated water uses for each major river. The next step would be the development of broad water quality criteria for each designated use (most likely by RENARE). Finally, the implementation of an enforcement program by either RENARE or the Ministry of Public Health is needed. A discharge permit system, or any alternative control program, should include both municipal and industrial dischargers.

II. INTRODUCTION

OBJECTIVES AND ORGANIZATION OF THE PROFILE

The primary objectives of the HCEP are:

- To identify major existing and potential problems and areas of concern for natural resources and environmental management.
- To conduct an analysis of the impact of these issues and problems on the Honduran society and economy.
- To provide, in the context of selected sectors such as agriculture, forestry, etc., an overview of local institutions, policies and resources that are related to natural resource conservation and environmental management.

As such, the HCEP is a planning document that outlines trends and patterns that affect the natural resource base and identifies constraints to development in certain sectors. In addition, the HCEP documents the development consequences of not applying environmental management principles and offers positive recommendations for more effective and sustained development action.

In the HCEP, the authors attempt to provide an overview of key issues, problems and recommendations associated with development (Chapter I), and to treat in detail selected sectors that illustrate the effects of development on the environment and natural resource base of Honduras (Chapters III-IX).

The issues and problems selected for further analysis are associated with: social and cultural conditions (Chapter III), agriculture (Chapter IV), forest resources (Chapter V), watershed management (Chapter VI), freshwater and marine resources (Chapter VII), wildland management (Chapter VIII), and water supply and waste management (Chapter IX). A bibliography of secondary sources used to support the information presented in each chapter is included at the end of the report. A number of maps, photographs and tabular data are used throughout the profile to highlight for the reader the major issues and problems.

PRINCIPAL ENVIRONMENTAL CHARACTERISTICS

Topography and Land Forms

Honduras is the second largest most mountainous country in Central America. More than 75 percent of the land has slopes greater than 25 percent. The landforms can easily be distinguished as the interior highlands and valleys, the Caribbean lowlands, and the Pacific lowlands (Figure II-1).

The Caribbean lowlands account for 16.4 percent of the national territory and along with the 20 major river valleys that connect to the 3 coastal plains represent the best soils of Honduras. The more important of these valleys are:

- Valles de Sula y Lean in the north;
- Valle de Aguan in the northeast;
- Valle de Guayape-Patuca in the east central part of the country;
- and the Valle de Nacaome-Choluteca in the south.

Highlands of the interior represent 81.7 percent of Honduran territory. They are characterized by mountains of more than 600 meters in height (78.9 percent), hills between 150 and 600 meters (14.9 percent), and plains at or near sea level (6.2 percent).

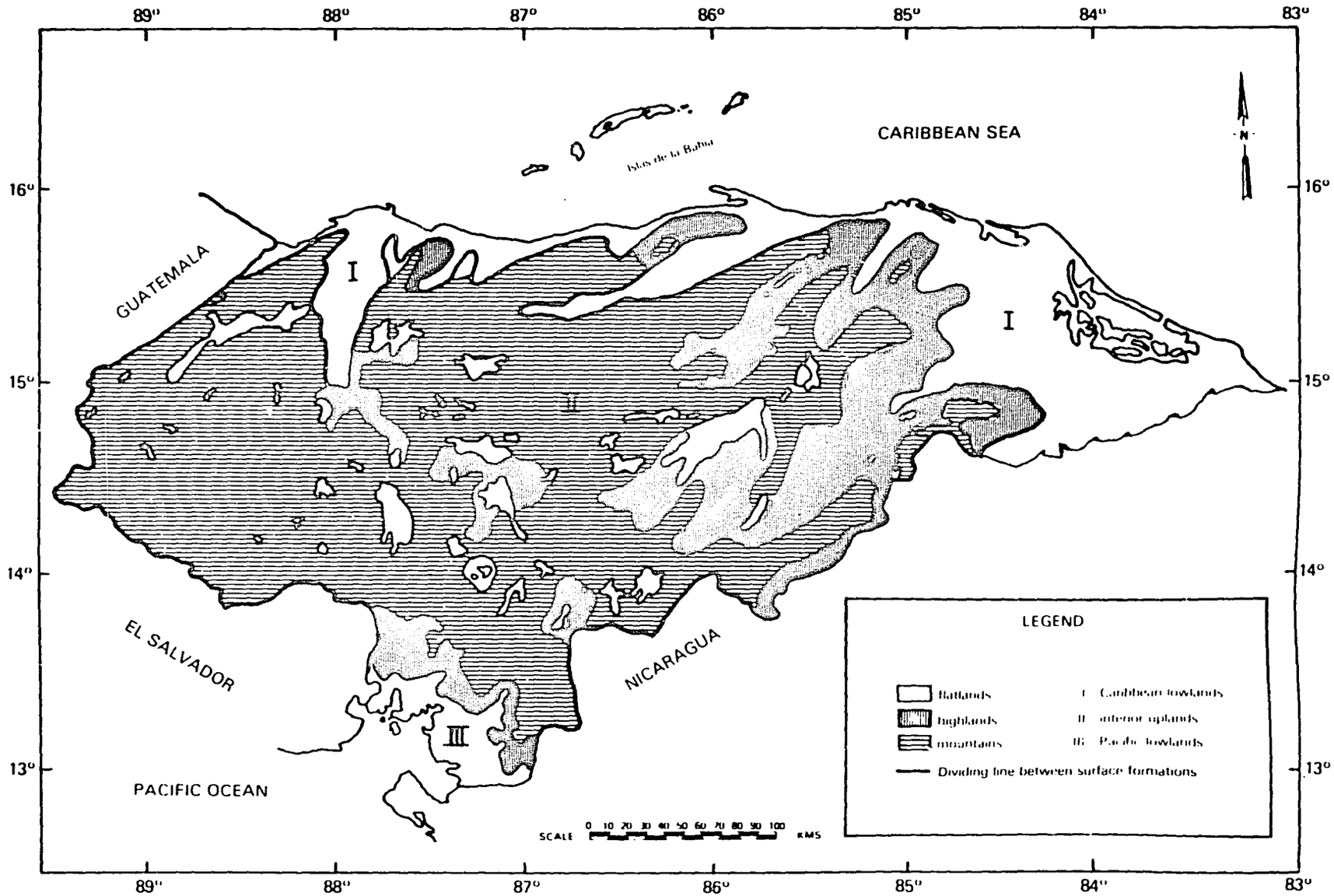


Figure II-1. Surface configuration of Honduras depicting flatlands, highlands, mountains, the Caribbean lowlands (I), interior uplands (II), and the Pacific lowlands (III).

The Pacific lowlands account for 1.9 percent of the national territory.

Interior Highlands and Valleys. The thin, rocky, eroded acidic soils of the interior highlands are dominated by pine forests and are regarded by farmers as poor for agriculture. Since the colonial era the raising of livestock has been a leading activity on the best lands of the Comayagua, Catacamas, and Yoro valleys. Until recently, little has been done to improve the quality of livestock or pasture. As a result the pastures have a low carrying capacity and are burned periodically to prevent invasion of thorny scrub and other weed species.

Tobacco, coffee, grains, and some fruit tree crops are grown on the better soils of the interior highlands whereas more intensive production of vegetables and sugar cane is found in valleys such as Comayagua and Zamorano.

Caribbean Lowlands. This region is characterized by narrow river flood plains extending like fingers far inland following depressions between mountain ranges. The fertile alluvial soils of the valleys and adjacent coastal plains, cultivated since precolombian times, now are marked by large banana plantations and some African oil palm. Of these productive wlands, the Ulua River is the most tensively developed. The Caribbean wlands, especially the area surrounding San Pedro Sula and La Ceiba have w surpassed the interior highlands in onomic production, rate of population owth and rapidity of landscape ange.

In the far northeast lies the Mosltia which for all practical purposes nains outside the scope of national velopment. The Mosquitia is characrized by pine savannas on highly ithered quartz sand soil. Population nsities are extremely low with infrent signs of shifting agriculture be- practiced only on more recent allum with broadleaf forest along rivers ting through the pine savannas.

Pacific Lowlands. The Pacific lowlands encompass the mangrove flood plains, the most extensive of which is the Choluteca River plain. This area is well known for its sparsely wooded savannas and livestock as well as cotton, melon and some vegetable production.

Climate

The Caribbean climatic regimen is dominated by the location of the Bermuda High resulting in prevailing easterly and southeasterly trade winds. These winds may shift as winter cold fronts move across the coast resulting in north and westerly winds accompanied by rainfall. The wet season extends approximately from mid-April to October with an average rainfall of 1800-2500 millimeters per year.

The Caribbean coast receives more than 2,400 millimeters of rain annually due to the prevailing easterly trade winds. A pocket of equally high rainfall occurs in the valley just north of Lake Yojoa. Precipitation decreases in the interior highlands with less than 1,000 millimeters annual rainfall reported in a dry area near Tegucigalpa. The Pacific lowlands, while wetter than the central highlands, are drier than the eastern lowlands. Rainfall ranges from 400 to 2,200 millimeters annually depending on local topographic conditions.

Temperatures are determined primarily by elevation. Coastal lowlands below 500 meters have mean annual temperatures from 26-28 degrees Celsius whereas mountain basins between 500 and 2000 meters range from 16-24 degrees Celsius. Zones above 2100 meters have annual means as low as 14-15 degrees Celsius.

Though the southwest Caribbean Sea is not known for a high incidence of hurricanes, in the last century the north coast and Bay Islands have been hit by 13 hurricanes and eight tropical storms. In 1974, Hurricane Fifi caused

widespread loss of life and property damage.

High winds and heavy rainfall cause erosion and landslides and crop losses, most notably to banana plantations which provide 40 percent of the export income.

Major Habitats

Marine influence, rugged topography and varying soil types have resulted in a wide array of ecosystems. According to the original life zone mapping there are eight Life Zones represented in Honduras (Figure IV-2, page 55).

The prevailing moisture-ladened easterlies from the Caribbean drench the hot and humid Atlantic watershed with between 1750 and 2500 millimeters of rainfall annually, resulting in moist and wet Life Zones on the Atlantic slopes which cover more than 75 percent of the land area. The dominant vegetation of the Atlantic area is broadleaf forest except where fire and edaphic conditions or disturbance favor pine forest. Lagoons and sheltered coastal bays are fringed with mangroves. Mangroves follow the tidal influence inland along major rivers entering the sea. Coral barrier reefs surrounding the Bay Islands and other isolated keys on the Caribbean are some of the best developed in this hemisphere.

The western intermont basins, valleys and mountains which are not exposed to these moist winds are occupied mostly by mixed stands of oak and pine. On slopes and plateaus above 1,200 meters hardwood cloud forest communities often occur. Several valleys to the north and east of Tegucigalpa, are desert-like in appearance and offer a striking contrast to the cool, green cloud forest above them. The southern coast is characterized by large expanses of mangrove and further inland, remnants of tropical dry forest.

Of equal importance to habitat diversity is the fact that Honduras represents an important link in the transition between neoarctic and neotropical plants and animals. The lowland tropical rainforests of southern Central America become constricted and discontinuous in northern and eastern Honduras and form the first natural filter to northern expansion of rain forest biota north of Panama. Tropical plant and animal species are often found in juxtaposition with those of more temperate climates.

Utilizing Monroe's 1968 classification for natural habitats in Honduras, several distinct communities can be identified and described (Figure II-2). These are based upon climatological data, soils and other variables such as fire and floods, and include: tropical lowland rain forest, tropical deciduous forest (monsoon forest), cloud (montane rain) forest, highland pine (ocotal) and pine-oak associations, lowland pine savanna and coastal and reef ecosystems. Coastal and reef ecosystems are described in Chapter VII.

Tropical Lowland Rain Forest.

Tropical rainforest as discussed here generally corresponds to Holdridge's tropical moist forest (see Figure IV-2) which is confined to the Caribbean drainage and reaches its greatest extent in the eastern sector of the country known as La Mosquitia (Figure II-3). It is limited to regions with more than 2000 millimeters (80 inches) of rainfall, and no extended dry season, and found in elevations up to 750 meters. Climax forests are composed of mostly broadleaf evergreens and occasionally a few deciduous species. The upper canopy and emergents often exceed 60 meters in height. Under climax conditions these forests are relatively open underneath the dense canopy. Natural and manmade disturbances are quickly invaded by dense successional vegetation. Lowland rain forest grades into cloud forest (lower montane forests of the Holdridge Life Zone System) at about 750 meters.

Rainforests represent some of the biologically richest ecosystems on the

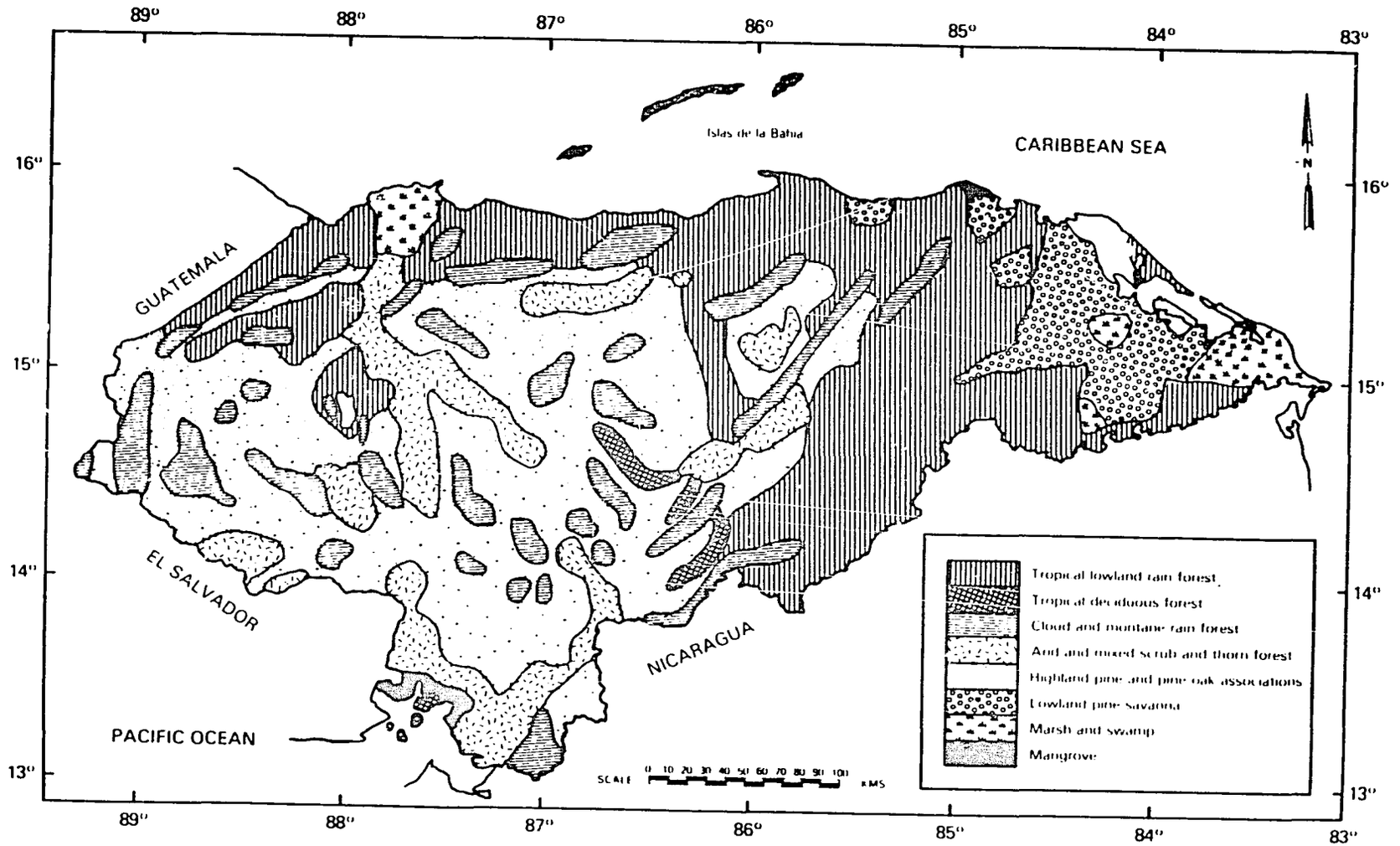


Figure II-2. Distribution of major habitats in Honduras.

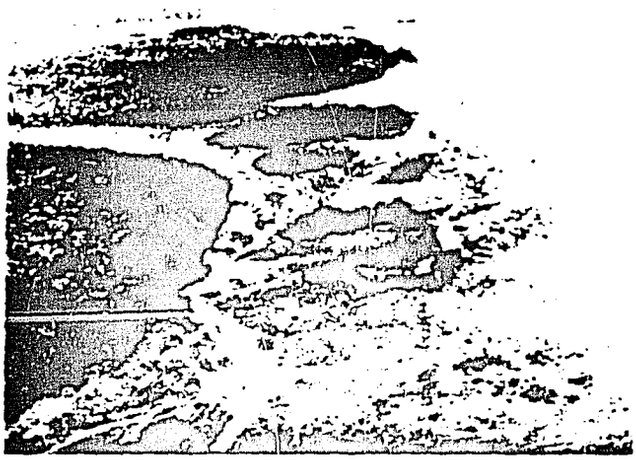


Figure II-3. Tropical lowland rainforest such as shown in this photograph from the vicinity of Puerto Lempira grades into savanna in certain places due to wet conditions and clayey soils.

planet. They are storehouses of genetic diversity that are unmatched by any other ecosystem. Unfortunately they are being destroyed at an unprecedented rate by shifting agriculture, cattle ranching, agroindustries and forest industries. Upon removal of rainforest vegetation, many of these sites are subject to serious erosion and depletion of soil nutrients. If permitted to occur, regeneration seldom resembles the original forest composition. As development accelerates in these regions, future options will rapidly decline for sustained utilization of these forests for timber and other materials, firewood, watershed protection, medicinal plants, genetic reservoirs, wildlife and tourism.

Tropical Deciduous (Monsoon) Forest. The tropical deciduous forest replaces the rainforest where marked seasonality of precipitation is the predominant climatic pattern. During the extended dry season most of the trees lose their leaves. Although deciduous forest potentially represents the dominant vegetation type in the lowlands of the Pacific coastal region, it has been almost completely eliminated by agriculturalists and cattle ranchers. Only a few small remnants remain, mostly as scattered gallery forests along streams and rivers.

Cloud (Montane Rain) Forest. These highland broadleaf forests are typically found in the southern mountains of Honduras at elevations ranging from 1,350 - 2,300 meters and in the Caribbean watershed from about 900 - 2,800 meters. In each of these regions the cloud forest results from different climatic factors although the resultant habitats are very similar. In the southern cordillera almost daily cloud buildup and lower evaporation rates on mountain peaks provide moisture for the lush plant growth. These forests are generally surrounded at lower elevation by oak and pine forest. Heavy rains and cloud buildup in the northern mountain ranges create a similar cloud forest habitat although these areas are often contiguous with lowland rainforests. Species diversity (number of species and their relative abundance) in these forests is usually less than that of the lowland rainforests.

Cloud forests are important in the regulation of surface and ground water supplies for drinking, irrigation and hydroelectric power production. The role of intact forests in maintaining water supplies is especially evident in cloud forests as condensation on leaves and trunks is the source of much of the precipitation. Tegucigalpa and other cities in Honduras get a large percentage of their drinking water from cloud forests. Hydroelectric energy generated at Lago Yojoa is dependent, in part, on the sound management of cloud forests and montane rain forests. Since these forests are situated on extremely steep slopes they aid significantly in reducing erosion and siltation of streams and lakes, factors which appreciably shorten the useful life of hydroelectric power projects.

Because of their humid climate and rugged terrain, many of the cloud forests have, until recently, remained fairly intact. However, these forests are being seriously degraded with increased coffee cultivation and the spread of slash and burn agriculture into formerly inaccessible areas.

Highland Pine and Pine-Oak Associations. The pine and oak associations correspond to Holdridge's sub-tropical moist forest Life Zone. They cover much of western Honduras at altitudes ranging from 600 to 1,800 meters. Predominant species are oak (Quercus) and Pinus oocarpa at lower elevations and Pinus psuedostrobus in the upper reaches of the pine zone. Understory varies from park-like grassy cover where fire is common, to almost impenetrable low shrubs and tall grasses. Pines seem well adapted to the thin, poor soils of much of this region but are oftentimes replaced by oaks where there are pockets of deeper soils. Grazing, some agriculture, cutting of oak for firewood and exportoriented logging of pine have greatly modified this habitat.

This is a region whose resources are being rapidly depleted. For example, in 1978 alone 261 million board feet of pine were cut; in 1980 54,000 hectares were burned, representing a loss of 44 million dollars worth of wood. Recent immigration from El Salvador and Nicaragua as well as population growth within Honduras is putting increasing pressure upon these and other forest ecosystems. Although natural regeneration of the oak-pine forests occurs, grazing, farming and fire are preventing adequate replacement of harvested stocks. It is becoming obvious that if current trends continue, Honduras may soon be facing serious economic problems in its forest industry.

Lowland Pine Savanna. The lowland pine forests of the Mosquitia are composed of Caribbean pine (Pinus caribaea) with some fingers of hardwood gallery forests following major streams. Geographically, this area corresponds to Holdridge's tropical humid forest life zone, a region dominated by the broadleaf rain forest which almost surrounds these pine savannas. Presence of pine is generally attributed to highly leached, sandy soils and frequent fire.

Although not as extensively exploited as the interior pine regions, this zone has been identified by foresters as an area of high potential for pine production. Poor conditions for agriculture favor sustained forest use. Poor fire management is currently a limiting factor on productivity.

Demographic Profile

Honduras has a population, as of 1974, of approximately 2,808,171 people. This figure was expected to increase to 3,691,030 people by 1980 given the 2.7 percent annual rate of population growth calculated between 1961 and 1974 according to United Nations figures. Nearly two-thirds of the population is rural; the remaining one-third is urban. Most of the population is concentrated in western Honduras.

ENVIRONMENTAL MANAGEMENT APPROACH

Land use and land tenure affect the resource base of Honduras. Deforestation by shifting cultivation and conversion of forested lands to cattle pasture leads to a loss of forest products, erosion, sedimentation of reservoirs, flooding, and water scarcity. Erosion of poorly managed croplands and pastures reduces the agricultural productivity of the land and contributes to downstream sedimentation and hydroperiod changes. Reduced productivity of the land ensures the poverty of the campesino.

As is apparent from this example, the development problems which manifest themselves as negative impacts in the environment of Honduras are closely linked. Such conflicts are intra- and intersectorial in nature. For example, the shifting cultivators (agricultural sector) are destroying 80,000 hectares of forest per year valued at more than

$300 million dollars (forestry sector). Poorly designed logging roads and inappropriate management of agricultural lands cause watershed degradation with resultant erosion, sedimentation and greater variability in river flows. These, in turn, affect hydroelectric production (energy sector) and the seasonal water supply for cities (urban sector). Table II-1 presents further examples of such conflicts.

Another common development problem is inappropriate use and management of natural resources. Some examples of immediate economic importance include:

- Failure to use the rich diversity of tree species to maximize forest production by using only a handful of woods in the market system.
- Waste of wood resources in the logging and milling process.
- Uncontrolled use of fire in pine-forested lands for maintenance of pastures, causing unnecessary loss of the ability of these lands to regenerate pine forests.
- Heavy and uncontrolled use of pesticides on crops such as cotton.
- Failure to use tropical ecological knowledge, much of which is retained by indigenous ethnic groups, in integrated pest management and design of adaptive cropping systems.

To implement the recommendations presented in this Profile requires an environmental management approach in development project conceptualization and execution. The management process involves a systematic, interdisciplinary effort incorporating the contribution of the biological, physical, applied and social sciences, and a structure for administration and control.

For example, energy efficiency is a major development concern to which the environmental sciences can contribute. In almost every recommendation included in this Profile are implicit strategies to minimize the consumption of imported fossil fuels. Among these are:

- Relatively small, labor intensive farms employing cropping systems ecologically adapted to a particular Life Zone.
- Use of alternative livestock species and some managed wildlife appropriate to a particular ecological situation rather than being overwhelmingly dependent on cattle.
- Sustained yield management of both pine and broadleaf forests rather than depending on plantations.
- Careful management of estuarine ecosystems including mangroves to sustain a productive inshore fishery.
- Use of natural systems such as swamps for the treatment of urban and organic agricultural wastes.

An environmental management approach enhances the legally mandated Initial Environmental Evaluation (IEE) process of USAID and the impact evaluation procedures of other donor institutions. The IEE identifies potentially negative and controversial impacts. Should the evaluation indicate no significant impact, further input from the environmental sciences is not required. When a negative impact is identified, an environmental assessment is dedicated to documentation and mitigation of the identified impact. In either case, the positive contribution of the environmental sciences to project design is not contemplated.

The environmental management approach includes not only the mitigation measures, but also a strong positive emphasis on effective use of environmental sciences to enhance project productivity. Examples include design of ecologically adapted cropping systems, use of natural areas for waste treatment, and protection of investments in hydroelectric power-generating facilities in upper watersheds, and in irrigation infrastructure through watershed management.

TABLE II-1

SECTORIAL ACTIVITIES AND POTENTIAL ENVIRONMENTAL MANAGEMENT PROBLEMS

Sector	Activity	In Sector	Other Sectors	Solution Strategies
Agriculture	Heavy Biocide Use	Loss of pest predators Loss of pollinators. Resistant pests requiring more costly control. Intoxification of livestock.	Fisheries - direct and Indirect effects on food fish populations. Water - contamination of water supplies. Health - intoxification of farm labor and consumers. Wildlife - loss of higher animals from biological magnification of biocides.	Adaptive research on integrated pest management. Establishment of biocide use regulations with accompanying extension and enforcement program. Evaluation of mixed cropping systems for weed and pest reduction.
	Monocultural cropping systems midlatitude crops	Heavy dependence on mechanization and chemical inputs. Vulnerability to costly pest and weed problems. High energy costs of production.	Social marginalization of small scale farmers. Some problems associated with heavy biocide and fertilizer use.	Evaluation of combination of crops and cropping systems adapted to the using tropical environment using ecological as well as agronomic criteria.
	Agriculture in upper watersheds, traditional annual cropping systems.	Rapid declines in production due to erosion and nutrient leaching.	Social - Rapid marginalization of farmers in new areas and limited development potential in occupied areas. Water - accentuated peaks in flow with quality affected by rapid runoff and reduced filtration. Infrastructure - accelerated sedimentation of water management structures.	Analysis of management alternatives compatible with downstreams water quality and quantity objectives. Evaluation of educational, incentive and coercive strategies, legal structures and operational programs necessary to achieve management objectives.
Transportation	Road construction in mountainous terrain	High maintenance costs when routing fails to consider geologic, geomorphic or climatic factors.	Hydroelectric - Major source of sediments affecting useful life of reservoirs. Indirect effect on sedimentation by providing access for spontaneous settlement of fragile areas. Agriculture - Opening of areas of marginal potential with resultant high cost of delivering services and low benefit in terms of agricultural production.	Regional scale evaluation of highway routing in terms of maintenance costs and indirect effects on settlement patterns, agriculture, forestry and aquatic system functions.

TABLE II-1 (CONTINUED)

SECTORIAL ACTIVITIES AND POTENTIAL ENVIRONMENTAL MANAGEMENT PROBLEMS

Sector	Activity	In Sector	Other Sectors	Solution Strategies
Industry	Discharge of wastes to water	Water quality reduced below standards required by downstream industries.	Health - Heavy metals and toxic chemicals render downstream water unpotable for people and livestock. Social - Loss of recreational potential downstream and on beaches. Fisheries - Contamination reducing yield of commercial and sport fisheries.	Establishment of discharge control criteria appropriate to the real costs and benefits to society and control technology available. Evaluation of potential for resource recovery.
Tourism	Facilities located in or near fragile ecosystems such as coral reefs, dunes, cloud forests, etc.	Degradation of attractions which orginally justified the promotion of tourism. Loss of site attractiveness due to changed cultural patterns and secondary development.	Social - Change from modestly productive and sustained land and water use to exploitive use or dependency. Natural systems - loss of diversity and productivity. Agriculture - Diversion of agricultural land into speculative and non-productive uses.	Ecological assessment of potential or actual site for tourism to establish carrying capacity and use restriction. Prohibition of attractions with no relevance to natural systems such as casinos, tennis, free ports, etc. Establish land use zoning, buffers, and incentives to reduce loss of attractiveness and loss of production due to secondary development and cultural change.

The lack of an environmental science perspective coupled with political expediency leads to a bias toward highly visible infrastructural projects such as flood control dams and dikes rather than watershed protection and floodplain zoning. Neither the GOH nor the development assistance community is prepared to implement the environmental management concept in project design. However, the Inter-American Development Bank has taken a major step in this direction by publishing, in 1981, loan application guidelines for environmental management. Through loans and technical cooperation Honduras can implement watershed management to protect infrastructural investments and develop institutional capabilities in environmental management, among other activities. By actively pressuring the international development-assistance community, the GOH can take the lead in adopting environmental management criteria into project design and implementation.

III. SOCIAL AND CULTURAL ISSUES

INTRODUCTION

This chapter provides basic information on the following topics: demographic and land use patterns, agrarian reform and campesino groups, and archeological resources. A listing of major ethnic groups of Honduras is found in Appendix 3. Issues of concern that arise from conflicts between social factors and use of natural resources such as land or forests are also discussed. Some of the social/cultural factors that affect resource depletion include:

- Stress on social and environmental services caused by land conflicts, refugees, absolute limits on the amount of agricultural land, gross maldistribution of land, and rapid population growth.
- Inappropriate land use practices including placement of row crops on steep slopes and cattle on alluvial valleys.
- Failure to perceive the cause and effect relationship between poor land use and resource degradation, as evidenced by small farmer attitudes toward the natural resource base.

DEMOGRAPHIC AND LAND USE PATTERNS

More than two-thirds of the total population is rural, living in 22,798 centers which account for 99.7 percent of all the settlements in the country. The socioeconomic condition of the rural population is a complex problem generated by historical, economic, and cultural antecedents which are directly related to the topography of the country. This situation is characterized by a grossly unequal distribution of agriculturally productive land in the rural sector where there is a preponderance of minifundistas occupying an average of 3.4 to 6 hectares. Campesinos are barely capable of a subsistence existence. In 1976 there were 120,441 minifundias of this size comprising a total of 196,219 hectares. On the other hand there were 667 properties of more than 340 hectares each totaling 626,300 hectares. Sixty percent of Honduras' population lives in the western part of the country on lands which contain only 14 percent of the country's total land area deemed suitable for intensive agriculture. The northern and eastern zones of the country have a much lower population density yet a greater agricultural potential (Figure III-1).

Approximately one-third of the total population is urban and of this number two-thirds are largely a result of immigration from the rural sector (Figure III-2). This has been more a factor of economic explusion, resulting from a lack of available land, than from an attraction to the cities. In 1974, almost two-thirds of all migrants were less than 24 years of age. In the urban sector these people represented 65.2 percent of the migrants to the area. In the rural sector they represented 59.6 percent of the migrant population. Most migrants to the cities face a difficult time once they arrive, and in many cases the reality of city life proves to be as difficult as the situation left behind in the country. Men arrive basically ill-adapted to perform any work other than manual labor, and as a result are absorbed with difficulty into the work force. Women leave the rural sector

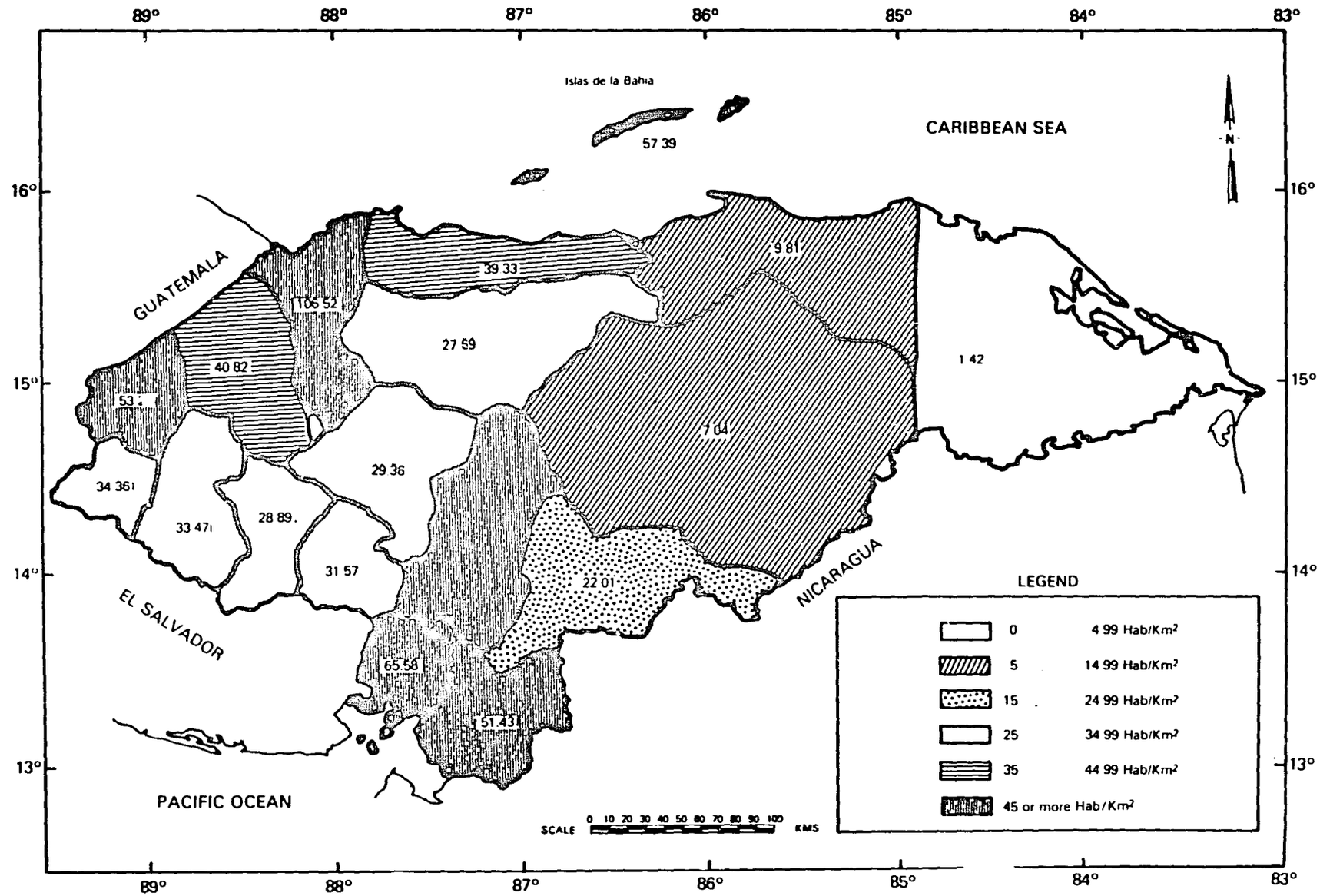


Figure III-1. Population density of Honduras by department.

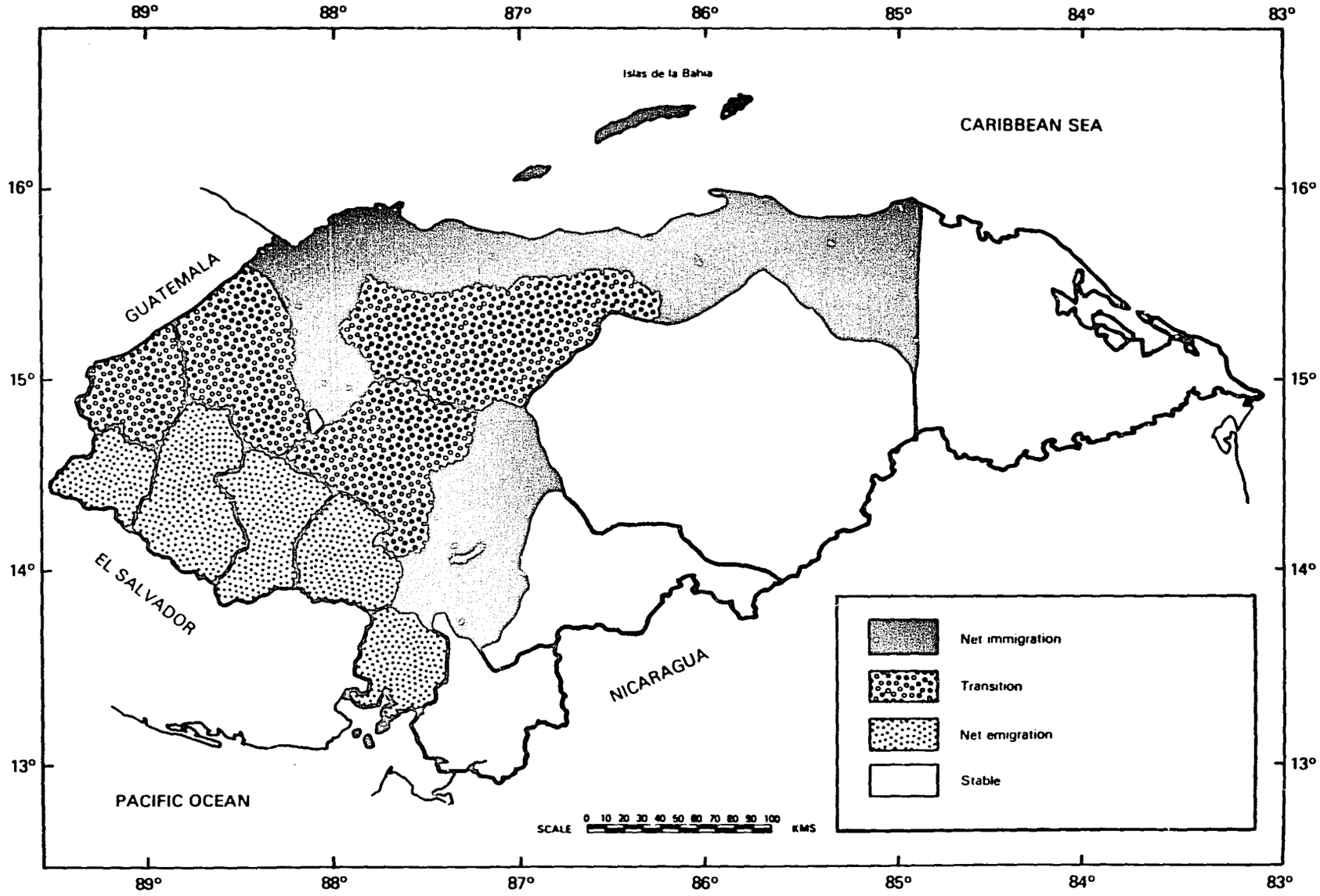


Figure III-2. Type of migration in Honduras by department, indicating net immigration and emigration, and departments in transition or stable, with little activity.

for the same reasons as men but arrive in the city with a different set of handicaps. The place of work for women is generally considered to be in the home--although it is recognized, if only tacitly, that in the rural sector she makes a valuable and essential contribution to many of the agricultural activities undertaken. This domestic stereotype is carried with them to the city. They find it difficult obtaining employment other than in marginal activities. The myriad of squatter settlements found surrounding the outskirts of Tegucigalpa and San Pedro Sula (as well as other urban areas) gives testimony to the condition of life sustained by many of the migrants from the rural sector (See Figure IX-1).

TABLE III-1. POPULATION OF HONDURAS: 1980*

Department	Population
Atlantida	214,080
Colon	114,052
Comayagua	191,195
Copan	201,161
Cortes	542,581
Choluteca	264,278
El Paraiso	189,350
Francisco Morazan	656,633
Gracias a Dios	31,005
Intibuca	104,828
Islas de La Bahia	17,348
La Paz	82,679
Lempira	164,251
Ocotepeque	62,009
Olancho	206,698
Santa Barbara	259,848
Valle	117,744
Yoro	271,290
Total	3,691,030

*CONSUPLANE Projection from 1974 Census

AGRARIAN REFORM AND CAMPESINO GROUPS

During the period 1951-1961, the government of Honduras distributed an estimated 35,000 - 40,000 hectares of land, principally in the form of individual plots, to approximately 2,300 - 2,500 families. In 1961-1962 the Instituto Nacional Agrario (INA) was established with the enactment of the country's first agrarian reform law. During its early years the INA focused much of its energy on the colonization project of the Bajo Aguan. This was due in part to heavy resistance encountered in efforts to expropriate latifundia lands. In 1972, after a strong campesino reaction including waves of land invasions, and a campesino march on Tegucigalpa, there was a military takeover of the government. In 1974 President Lopez announced his intention of distributing 600,000 hectares of land over the next five years to 120,000 campesino families organized into groups. The results of agrarian reform are discussed in the agricultural chapter which follows.

Campesino Organizations

The three largest peasant organizations of Honduras are: 1) the National Association of Campesinos of Honduras (ANACH); 2) the National Union of Campesinos (UNC); 3) and the Federation of Cooperatives of the Agrarian Reform (FECORAH). ANACH is the oldest and largest of the three, formed in 1962. UNC, which first went by the name of Ligas Campesinas, was organized in 1963 by the Christian Democrat Labor Union Federation. FECORAH was formed in the early 1970's and differs from ANACH and UNC primarily in that it focuses attention on organizing groups which have a reasonable chance of securing land from INA. An emphasis is placed on practical organization rather than on political mobilization.

All of the agrarian reform groups are organized as cooperatives or quasi-cooperatives and take the following

form: subseccionales of ANACH; ligas campesinas of UNC and the National Union of Authentic Campesinos (UNCA); cooperatives of FECORAH; empresas asociativas de campesinos (under the agrarian reform law of 1975); and independent asentamientos. In 1981 there were 1,292 of these reformed groups with a total of 33,381 members holding 209,403 hectares of land.

Empresas asociativas de campesinos evolved as a result of Decree No. 170 of 1975 and were automatically conferred with the status of personeria juridica. This is the same status given to cooperatives which makes it possible for them to deal with financial institutions in order to obtain credit. None of the groups affilitated with ANACH or UNC has legal standing. ANACH, UNC, nor FECORAH, favor the concept of these Empresas because they are considered to be an instrument of INA used to retain governmental control over reform groups.

·ooperatives

The Direccion de Fomento Cooperativo (DIFOCOOP) showed a total of 790 cooperatives as having been registered by 1980, and 68 percent of this number were formed between 1970 and 1979. In actuality only 711 were still operating at this time, representing a 10 percent attrition. There were a total of 73,667 cooperative members of whom 60,558 were considered active and 13,109 inactive. Directly dependent upon these people were an additional 365,208 people, approximately 10 percent of the population of Honduras.

Although a sizeable portion of the country's population is both directly and indirectly involved with cooperatives, the cooperatives in general suffer from a lack of cohesion and a functioning organizational structure. Very few have any form of management and those that do operate without adequate technical knowledge. The exceptions to this would be the handful of model cooperatives such as Guanchias, Casmul, Caraol, Caral, and others which operate on a much more efficient level. But for the most part the cooperatives have a poorly defined organizational and management structure. Only slightly more than half (383) of the cooperatives employ an accounting system. Many are in debt and cannot or do not pay their bills. The majority of cooperative members are unfamiliar with the laws that govern the operation of cooperatives in Honduras, and those who are familiar with them are of the opinion that they should be rewritten to reflect the reality of today. The participation of DIFOCOOP as a guiding force has been less than adequate as a result of budgetary limitations and lack of autonomy.

Analysis of Reforms

In 1978 agrarian reform farms represented 0.5 percent of all the farms in Honduras and accounted for 6.0 percent of the total farmed area. Traditional small scale farms (those outside of the reformed areas) represented 93.6 percent of all the farms in the country and accounted for 36.8 percent of the total farmed area. The rest of the farmed area (57.2 percent) was owned by commercial private farms (including transnationals) with holdings of 35 hectares or more each. This group accounted for 5.9 percent of all the farms in Honduras. In the same year approximately 33,774 families lived on farms with less than 1 hectare of land, and 124,000 families on land more than 1 hectare, but less than 35 hectares in size. In addition, it is estimated that there were approximately 119,433 families within the rural labor force who had no land at all.

Small scale agriculturalists of the traditional sector are for the most part neglected by the government. The majority of these independent farmers do not belong to cooperatives and receive no technical assistance or support of any kind. The fact that

many of these individuals do not belong out of choice is quite possibly a reaction to negative experiences with cooperatives in the past.

The rate of abandonment of agrarian reform lands is high. Past history has shown this to be particularly true of the colonization project of Bajo Aguan. Other parts of the country are similarly affected. In a recent study, INA indicated that there was as high as a 42 percent attrition rate among groups in the Region Sur, an area that encompasses the Departments of Choluteca and Valle, and parts of La Paz. This was a reduction of 414 members from the original 982 members belonging to 30 different groups.

Reasons for this loss are many. Primary among them is lack of economic success. In many instances the original membership was beyond the carrying capacity of the land, given the lack of resources with which to work. Other problems include poor soils and heavy erosion. Indeed, the land distributed by INA since the enactment of Decree No. 8 in 1972 has been described as predominantly marginal land, characterized by steep grades and susceptibility to erosion. A general complaint is that these people are not well served by INA, that they lack technical assistance and that their pleas for additional land are ignored.

With regard to land distribution, INA is barely able to keep up with the annual increase in rural families which was estimated in 1978 to be 5,500 per year. Most of the reform groups are not eligible for credit. In 1978, INA spent approximately 73 percent of its budget on the seven Concentrated Rural Development Projects (Bajo Aguan, La Masica, San Miguel, Guaymas, Puerto Artuor, San Bernardo, and Ola Monjares). These projects represented only 25 percent of the people settled under the agrarian reform. Since that time two more concentrated projects have been undertaken (Tabaco and Jamastran).

ARCHAEOLOGICAL RESOURCES

Honduras is an archaeologically rich country covered with sites representing many diverse cultures (Figure III-3).

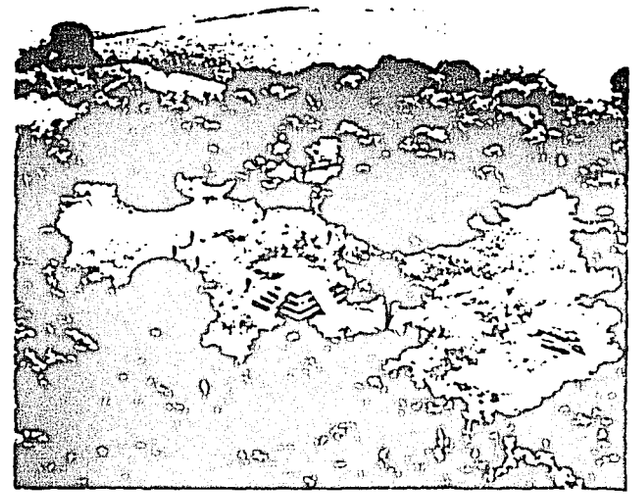


Figure III-3. Archaeological resources such as the ruins at Copan offer considerable heritage value to the people of Honduras *(Courtesy of R. DuBois).*

Many of these sites have been recorded by the Instituto Hondureno de Antropologia e Historia (IHAH) for the national registry, but it is all they can do to just note the existence of such sites for lack of money and manpower. Ideally archaeological sites are considered a national treasure and as such are protected by law. The reality is that archaeology in Honduras receives low priority at best and many sites are in danger of being lost. According to IHAH the archaeological zones most in danger are the following:

- Valle de Sula: evidence of a mixture of cultures including Maya, Jicaque, Lenca, and Mexican groups.
- Olancho: evidence of Paya culture.

- Valle de Aguan: evidence of Paya culture.
- Comayagua: evidence of Lenca culture.
- Quimistan: evidence of Maya culture. This zone is located in the Department of Santa Barbara.
- La Entrada: evidence of Maya culture. This zone is located in the Department of Copan.
- Zona Sur: evidence of Cholutega culture from Nicaragua.
- El Paraiso: evidence of Cholutega and Paya cultures but not much is known.
- Islas de Bahia: evidence of Paya culture.
- Valle de Otoro: evidence of sites but little is known about the culture they represent. This zone is located in the department of Intibuca.
- Lago de Yojoa: evidence of Lenca and Olmec culture.
- La Mosquitia: evidence of Paya and Misquito culture as well as other influences from Nicaragua, Costa Rica and further south.

The one area most in danger of being lost is not included on this list. The archaeological zone which will be inundated by 1985 with the completion of the hydroelectric project El Cajon has already been written off by the IHAH for obvious reasons. Foreign archaeologists have been brought in to help perform salvage work in a rush against time.

To date a total of 141 sites have been found of which 75 are located along the Rio Humuya and its tributaries, and the other 66 along the Rio Sulaco and its tributaries. The three most important sites are Salitron Viejo, Guarabuqui, and La Ceiba. Salitron Viejo, located on the Rio Yunque, a tributary of the Sulaco, has proven to be the most significant of these. Excavations of this site have already uncovered more than 392 structures, one of which is particularly elaborate. This structure, called La Iglesia, probably represents a religious ceremonial ground.

The Copan ruins, situated in the Department of Copan near the Guatemala border, is the best known archaeological monument in Honduras (Figure III-3). On July 25, 1981 President Policarpo Paz Garcia officially inaugurated the Proyecto Arqueologico y Turistico de Copan which will invest more than $13 million for development of the area. The project is financed by the BCIE. One of the first priorities is to construct a paved highway 62 kilometers long between the municipios of La Entrada and Copan which will provide greater access for tourism. One of the more serious problems that remains with the area is flooding from the Rio Copan which in the past has seriously eroded the eastern part of the monument. The river has been sandbagged in places along the banks, but precariously so. Other problems include: people still manage to break into the fenced compound at night in order to cut firewood from the surrounding forest, and the dirt airstrip located in front of the monument area brings planes perilously close to the structures impairing overall visual quality.

FACTORS IN RESOURCE DEPLETION

Land Conflicts in Yoro

Whereas the HCEP team was not able to identify all conflicts and impacts between ladinos and Indians, one case study of land tenure and use in a tribal area in Yoro is presented to provide the reader with some insight into the problem.

In 1979 the Sistema Social Forestal (SSF) of COHDEFOR initiated a sociological study of the Jicaque people of Yoro (Appendix 3). The pilot study, Proyecto Cooperacion al Desarrollo Indigena de Yoro (Grupo Turrupan x Xicaque), dealt with five of twenty-one tribes in the area--Subirana, Lagunitas, Santa Marta, El Pate, and El Tablon--and produced interesting data with regard to land use and land tenure. One immediate and shared problem faced by these people is the rapidly increasing loss of traditional lands to the encroaching ladino sector. Jicaque tribes were individually granted varying amounts of titled land in 1864 by the Government of Honduras (19 of the 21 tribes today claim title).

The Jicaque of the Subirana tribe were originally granted an area equivalent to 3,243 hectares. Today there are 596 ladinos (73 families) on 97.5 percent of this land in contrast to 224 tribal members (33 familes) who control 2.25 percent of the same area. The best lands for farming are tied up by the ladino sector who have approximately 3,020 hectares reserved for cattle grazing; 2,114 hectares are maintained as guamil, which represents 65 percent of the area; and six of the ladino farms represent a total of 1,573 hectares. The Jicaque of this area have traditionally used their land for subsistence farming in contrast to the ladino sector which ties up large areas for cattle. It may be argued that some land is best suited for cattle use, but that does not help to mollify the resentment felt by the Indian. This is especially true in the Subirana area where there are 25 tribal members who have no land at all and find it necessary to rent lands elsewhere. Those who continue to farm on traditional land find it necessary to hire themselves out for at least five to six months a year. They then work for ladinos who maintain coffee or other types of cultivation.

Some Jicaque have lost their land by selling it to ladinos, but for the most part it has been taken from them by means of invasion or force, and in some instances with the approval of municipal or higher authorities. In the latter case, this is often done with the understanding that the property is designated as ejidal land, or if failing that, national land. There is a great deal of animosity between the Jicaque and ladino sectors which has erupted into violence in the past. On June 24, 1977 the Jicaque of the Subirana tribe petitioned the INA to formally demarcate their tribal land and to immediately recuperate the lands lost to ladinos. INA claims that there are problems in the interpretation of the old standards (caballerias) used in measuring the land. To date nothing has been done.

The Lagunitas tribe has had a similar experience with land loss. These people originally claimed title to 2,502 hectares of land, but this figure was reduced to 446 hectares by INA. Of this figure over 332 hectares (about 7[illegible] percent of the total land) are now controlled by 44 ladinos in contrast to 227 Jicaque who have 114 hectares.

Due to loss of land, 44 percent of the Santa Marta tribe (23 families with 153 people) have found it necessary in recent years to leave behind their traditional territory and immigrate to surrounding areas. The 195 Jicaque who still remain occupy 112 hectares of land (12.6 percent of the traditional area) as opposed to 769 hectares controlled by 318 ladinos (130 families). This is a case where ladino farmers have come in from other areas principally to establish cafetales. Of the

land controlled by them, 81.6 percent is devoted to this activity.

The El Pate tribe now has a problem with the appearance of a campesino settlement of 30 ladinos on their land. The ladinos were apportioned 191 hectares of land by INA, representing over 37 percent of the tribal land.

The El Tablon tribe (126 members) controls 123 hectares of land (13.5 percent of the traditional area) in contrast to 794 hectares controlled by 53 ladinos. Fifty-one percent of the ladino controlled land is reserved for cattle, while 48.5 percent is used for coffee cultivation.

Pan-Indian Movement

As mentioned above, the Paya and Jicaque groups claim title to land that was granted to them in 1864 by the Government of Honduras. Since 1971, members of these two groups have joined in a common struggle to regain land that has been taken from them over the years in piecemeal fashion by ladinos. Their case was originally placed before INA, whereupon it was relegated to the jurisdiction of a special division within INA (Division Indigenista). That division was shortly phased out and the role of dealing with the Indians was passed directly to COHDEFOR by way of the Sistema Social Forestal under the Gerencia de Bosques. This poses an interesting situation as COHDEFOR has no jurisdiction over the land of these people, only over the forest which is on their land. The question of land tenure quite properly belongs to the domain of INA.

It appears ironic that while INA drags its feet and stalls the Indians with regard to recognizing tribal territory, COHDEFOR de facto recognizes their claim in the form of payment made for timber harvested on their land. The general manager of COHDEFOR is authorized to return up to 40 percent of the stumpage value of harvested timber to the landowner, in this case the Indians.

To date, neither the Paya nor the Jicaque have been successful in regaining land. In fact, they remain in danger of losing even more. One Jicaque tribe, El Pate from the Department of Yoro, is presently engaged in a dispute with a campesino settlement that has legally claimed their land with the sanction of INA. The campesinos are affiliated with UNC and were apportioned the land by INA.

In 1977, the various tribes of Yoro joined the Consejo Nacional de Tribus Indigenas (CONATRIN) at the suggestion of ANACH, and in 1978 joined the Federacion Nacional de Tribus para La Liberacion del Indio Hondureno (FENATRILIH), the same year the organization was formed. Much in the same way that the combined effort of ANACH and UNC is primarily directed towards acquiring land for the campesinos' use, FENATRILIH's principal goal is to regain lost land from the ladino sector. Additionally there is the goal of obtaining technical assistance and credit in order to increase food productivity, as well as the desire to improve the overall social, economic, and political condition of all the Indian groups in Honduras. What appears to be an incipient pan-Indian movement in Honduras is at this stage very weak and fragmented with no internal organization nor control. With financial and organizational assistance FENATRILIH could become an effective political organ for the Indian.

Stress on Social and Environmental Services Caused by Refugees

The recent influx of refugees from El Salvador and Nicaragua, not to mention the presence of the so-called Somocista community, has placed an additional strain on the resources of Honduras. This is reflected by the competition for land and employment, especially graphic in the southern part of the country where a significant number of refugees have been absorbed into the countryside.

Reports vary as to how many refugees from El Salvador there are in Honduras. The number ranges from 18,000 to as high as 30,000. In July, 1981 an estimated 3,000 refugees arrived in the area of La Virtud-Valladolid-Guarita in the Department of Lempira where there were already some 12,000 refugees located. The Department of Chalatenango (El Salvador), immediately over the border from Lempira, has been the scene of intensive military operations and fighting. Approximately 7,000 of the refugees are children, among whom it is reported that the mortality rate is high due to malnutrition and diseases. As can be imagined, the general atmosphere is tense among both the Hondurans and refugees. Salvadorean militia have crossed over the border and refugees as well as Hondurans have been killed. The principal relief organizations involved are, Caritas, Alto Comisionado para las Naciones Unidas de Refugiados (ACNUR), and the Comite Evangelico de Emergencia (CEDEN).

Since the time of the recent civil war in Nicaragua many refugees (Somocistas as they are called) have crossed into Honduras. They are now widely dispersed. Many Salvadorean refugees have moved up to the north coast area (San Pedro Sula) where there is a greater opportunity for work. Refugees from both countries are to be found working in rural areas in exchange for food and shelter. The newly arrived refugees are first located in centers which are under military supervision. But control is loose and many leave to search for work or to become shifting cultivators.

Another recently arrived group of refugees are the 2,400 - 3,700 Misquito Indians from Nicaragua who are now in the Department of Gracias a Dios near Puerto Lempira. These people have been quartered in two authorized camps: Mistruck, which is about 45 kilometers from Puerto Lempira, and Mocoron, located 88 kilometers from Puerto Lempira. These are nominally supervised by the Honduran military. However, the number is uncertain as refugees come and go through the border, which is essentially open. Some refugees have found temporary shelter among the Honduran Misquito communities in Gracias a Dios. Most of these Misquito are young males with an average age of 22, but also include nearly 300 women with children. The refugees as a whole are in bad shape physically, suffering from malaria and intestinal parasites as well as other diseases. The current situation is that these people are in desperate need of help. World Relief of Akron, Ohio recently began supplying them with 40,000 pounds a month of rice, beans, and corn. But they are lacking other essentials such as milk for the children, medical attention, and clothing.

The Misquito refugees first appeared on the Honduran side in April, 1981 and have been coming ever since. Their organization, Misurasata (which represents the Nicaraguan Misquito through a Council of Elders), has placed itself in direct opposition to the Sandinista Government. During the civil war in Nicaragua, Misurasata maintained a pro-Sandinista position, if in spirit only, but they now feel betrayed. The Misquito cultural identity has not been respected with the FSLN's attempt to work them into a homogeneous society. Under the new agrarian reform they no longer have direct usufruct rights to their land. Sandinista troops as well as Misquito Indians have been killed and now the Misquito fear retaliation.

Lack of Identification Papers

Lack of identification papers is common among the campesinos in some areas who, as a result, are excluded from colonization projects, government employment and credit and extension services. In the Bajo Aguan project campesinos already practicing agriculture were displaced for lack of identification papers needed to qualify campesinos as project beneficiaries.

These people cannot receive the benefits of land settlements or redistribution and are actually displaced by and forced to move ahead of government services. People without papers form the vanguard of destruction in the broadleaf forest. In the pine forest these people feel that they are not allowed to gain from the use of the forest. These rural poor cannot become members of resination cooperatives, become employed by COHDEFOR except for short-term (less than 25 days) pick-up labor, or participate in any other scheme to their benefit. The resentment they feel is real and serious. One concrete example of the problem is in Rio Chiquito in Colon. When COHDEFOR needs short-term labor they hire in Tocoa and transport workers over 40 kilometers to work around villages where men are unemployed but do not have papers. These men are understandably upset and refuse to give cooperation to the programs of COHDEFOR.

Inappropriate Land Use

Maldistribution of good land spurs migration to the city and movement to the frontier of slash and burn farming in forest areas or acceptance of low yields where land rotation is limited. Shifting agriculture itself has been faulted as a primary cause of soil depletion, but that problem can be shown to be more a function of the overuse of land as a result of its scarcity. The slash and burn technique as it is now employed does contribute to the erosion problem, given the type of traditional crops such as maize and beans that are farmed on the slopes (Figure III-4). But the traditional technique as it was practiced before 1950 in the highlands of southern Honduras, for example, allowed for a 3-5 year fallow period which kept the ground covered and permitted the natural restoration of soil fertility. When fallow time is reduced yields drop. Often land is allowed to go into poor pasture and is then burned every year. The main problem in situations of intensive cultivation is not the burning but the lack of sufficient fallow time needed for the return of diverse plant growth so that future burns create a nutrient ash for the crops that follow. A recent study about attitudes of farmers towards agriculturally caused erosion in the

Figure III-4. The rapid spread of shifting agriculture into forested lands and steep-sloped areas, as seen in this photograph from near San Esteban, is accelerating environmental and social problems in Honduras *(Courtesy of J. Dickinson).*

Choluteca River Basin showed that in general these people were less concerned with the problems of erosion than they were with the absolute lack of land. In trying to effectively deal with the problem of erosion and soil depletion in Honduras it would seem necessary to place more emphasis than has been done in the past on the prevailing socioeconomic forces which operate to produce the imbalance in the distribution of land rather than faulting the campesino and his practice of slash and burn agriculture. This would entail shifting attention to the current underutilization of the potentially most agriculturally productive lands found on the north coast and elsewhere, as well as a thorough examination of the expanding cattle export industry in Honduras. Certainly many

cultural practices found among the peasantry of Honduras contribute to the problem of erosion and soil depletion but to single out the campesino as the prime culprit, as the media has done so often, is to treat the symptom rather than the problem. Studies in the Choluteca basin have shown that campesinos who own their land are more inclined to practice conservation measures than those who must rent or share crop the land.

Small Farmer Attitudes

Very few of the farmers in the Choluteca River Basin own flat lands. As a result staple crops such as maize and beans are planted on slopes. The combination of sloping land and use of these particular crops has been shown to be very condusive to erosion. It has also been shown that maize production in this area is a losing proposition in terms of man-hours and monetary value of the crop produced. Even though armed with this information, it would prove extremely difficult to convince the farmer to stop growing these crops in favor of substitutes that would be better suited for sloping terrain. The cultivation of maize and beans is an integral part of campesino culture, dating from the earliest cultures of Mesoamerica. Such a strategy should be viewed more as a risk-averting measure than as an irrational continuation of an agricultural practice that has proven to be a major cause of erosion. The campesino living at subsistence levels has little room for error, and accordingly, acts in a pragmatic way relying on tried and true practices. The campesino's present-time orientation results in plans being made on a day-to-day basis, and problems are tackled as they occur. As such, emphasis is placed on what can be expected within the immediate future, based upon past experience, and not on the effects of his actions on degradation of land resources in the long term.

Another of these value systems is the belief in "good and divine intervention" which functions as a mechanism to explain or rationalize the occurrence of natural events. Natural resource problems, such as the erosion and leaching of soils and diminishing water supplies, are seen as natural and uncontrollable phenomena belonging to the province of supernatural influence. In this way the peasant does not see himself as responsible. The peasant is aware of the deteriorated quality of land that has come about with generations of use but poorly understands the relationship between his activities and the environment. The campesino does not associate low crop yields with soil erosion but attributes it to exhausted soils or the lack of rain (or inconsistent rains), all of which are events beyond his control.

One particular example should illustrate this problem on a large scale. The Lago de Yojoa watershed covers approximately 34,000 hectares and is situated in the Departments of Cortes, Comayagua and Santa Barbara. For some time now, the environmental quality of the watershed has been in a state of decline. The government issued a special law (Decree No. 71) 10 years ago which declared the watershed to be a protected zone (Zona Protegida No. 5). Since that time nothing more has been done to ameliorate the deteriorating situation. The present population has been estimated at 21,656 people. More than 70 percent of them are small scale agriculturalists who supplement their income with fishing.

The people of the area regard the watershed as a resource to be exploited--i.e., when asked for what purpose they would use the forest, if they could, a common reply was for the extraction of timber to be processed in small scale saw-mills. Others said they would clear areas for sugar cane. As such, when asked why there was so much soil erosion in the area the majority responded that it was due to heavy rains--not making the connection between deforestation and subsequent

rains, but simply heavy rains. Others put the blame on Hurricane Fifi of 1974 for having carried the soil away. A small number (7.1 percent) saw deforestation as the cause.

Social Forestry: An Alternative?

COHDEFOR has established a social forestry program to provide incentives for the campesino not to burn the forest but rather, to take care of it. In part, this action program stemmed from an attempt to deal with the tremendous loss of timber resulting from illegally set fires over the past seven years (Table III-2). The program in general has been unsuccessful for many reasons.

The SSF was legally established with Decree No. 103 on January 10, 1974 and fully implemented as a Department within the COHDEFOR structure by November of the same year. The intent at this time was to develop a program whereby the campesino population living in and around the forests were to be fully integrated into a system that would conserve the natural resources of the forest and at the same time mutually benefit the campesino by giving him access to a share of the profit to be made from the forest. In 1976, the status of the SSF as a Department was reduced to that of a Section under the Department of Forests, and with this, much of its former strength was lost. In 1980, the SSF received $425,000--which represented approximately 5 percent of the Forest Division's budget ($8,000,000)--and only one half of this sum was designated for use at the district level.

The main emphasis of the social forestry program has been the establishment of resin cooperatives. Other activites such as the collection of liquidambar, latex de tuno, and pine seeds have been initated as well, but it is the resin cooperative that is the mainstay of the program. The reality is however, that only a tiny fraction of the campesino population is served by the cooperatives, and a great deal of envy and resentment on behalf of those not participating has been generated since the inception of the program. In the first years of operation money and materials were loaned to

TABLE III-2. TIMBER LOSS AND ASSOCIATED VALUE DUE TO ILLEGALLY SET FIRES

YEARS	NUMBER OF ILLEGALLY SET FIRES	SURFACE BURNED (HECTARES)	CUBIC METERS OF LOST TIMBER	VALUE LOST (DOLLARS)
1975	1,026	4,504	455,040	22,752,000
1976	872	10,166	101,660	5,083,000
1977	2,326	66,983	669,830	33,491,500
1978	2,203	113,525	1,135,250	56,762,500
1979	2,135	28,593	285,930	14,296,500
1980	3,581	85,021	850,210	42,510,500
1981	3,200	30,000	300,000	15,000,000

Source: COHDEFOR

cooperatives. Later, after financial failures, largely as a result of disorganization and unfamiliarity with basic accounting procedures, loans were curtailed.

Cooperatives that have managed to survive face additional problems. One of the most prominent is the extremely low value they receive for the collected resin, in which they have no voice in determining the price. Another is the uncertainity of having the primary resource dry up should COHDEFOR authorize someone to cut the trees. Personnel from COHDEFOR and DIFOCOOP who come to assist as extensionists or trouble-shooters have been accused of being ill-prepared in understanding the campesino culture and the special problems encountered in living in the forest. The net effect is that their efforts to solve some of the basic problems are thwarted by their lack of sensitivity.

Campesinos see a great deal of waste going on in the saw-mills and resentment is created at the sight of sawmills stripping entire hillsides of pine on which local residents may have been refused permission to cut pine for their own use. The situation is more offensive when the pines are on common ejidal land that the village has traditionally considered its own. Another source of irritation is the hiring by COHDEFOR of outsiders instead of locals. For example, fire-control work, is highly sought after and to fill the brigades COHDEFOR invariably hires outsiders who have their identification papers in order. Few campesions have such papers.

RECOMMENDATIONS

- Preserve and Study Ethnic Environmental Management Systems. Indigenous ethnic groups (Appendix 3) can make valuable contributions to the larger society of Honduras, particularly in transferring their base of knowledge about utilization of tropical forest resources. Their socioeconomic adaptations to these fragile ecosystems have evolved over hundreds of years reflecting systems of stable resource use. The impact of encroachment by ladinos (persons of Spanish blood, perhaps mestizo) onto tribal areas represent a threat to the loss of this fundamental knowledge and to the survival of the ethnic and socioeconomic disinctiveness of tribal populations. Conflicts between ladino and Indian cultures should be viewed as potentially detrimental to the preservation of perhaps unique environmental management systems in Honduras.

- Preserve Archeological Resources. Those sites given highest priority by IHAH should be addressed by the GOH and the donor community and preservation strategies, both in the short and long term, should be formulated. Those sites recorded on the national registry should be evaluated for their heritage and touristic values in the near future.

- Support FENATRILIH. With financial and organizational assistance, FENATRILIH could become an effective political organ for the Indian.

- Increase Understanding of Campesino's Perception of Environment and Natural Resources. In trying to understand the campesino who lives in the forest and his attitude towards the conservation of local natural resources attention should be given to the way in which he views his participation in the benefits that the forest has to offer. In the first place, it is important to realize that the campesino does not regard the forest as an ideal place for earning a living nor for achieving personal progress. The forest does not provide him with immediate food, nor does it generate a permanent source of employment. The perception of the campesino is

that he has only his own labor to count on, that he does not own the soil he works on, nor does he own the trees which surround him. The real wealth of the forest comes from the harvesting and sale of timber itself, not from the subordinate activites of collecting resin or other by-products. Until the campesino can become involved with the forest in such a way that he is allowed to participate in the wealth that it has to offer, he will not take care of it.

- Issuing Identification Papers to Campesinos. The GOH should issue proper identification papers to campesinos currently without them. Having appropriate papers would enable campesinos to participate more fully in the various economies of their region.

IV. ENVIRONMENTAL CONSIDERATIONS IN AGRICULTURAL DEVELOPMENT

INTRODUCTION

This chapter describes the agricultural environment of Honduras and addresses a number of environmental problems evident in the agricultural sector. Two sections comprise this discussion of environmental problems:

- Critical environmental issues such as discrepancies between actual and potential land use, land tenure, stream flow and agricultural use of water resources, pesticides in the environment, deforestation and slash and burn agriculture, and erosion.
- Constraints to development that are perceived as precluding viable alternatives, including such topics as the landless rural population, cattle production and environmental degradation, allocation of resources for small farmers, and institutional fragmentation.

In addition, action items are recommended that could improve the ability of the GOH and USAID to address the key issues and constraints discussed.

THE AGRICULTURAL ENVIRONMENT

A summary of the ecosystems of Honduras is found in Table IV-1. There are eight ecological life zones in Honduras (Figure IV-2) for which appropriate land uses have been recommended, taking into consideration climate, geomorphology and crop adaptations (Table IV-2). More detailed life zone and association mapping has been completed for the departments of Altantida, Comayagua, Cortes, Franciso Morazan and Yoro, but are not published yet.

CRITICAL ENVIRONMENTAL ISSUES

Discrepancies Between Actual and Potential Land Use

The total land area of Honduras is approximately 112,988,000 hectares of which it is estimated that 25 percent has a potential for agricultural use, 66 percent for forest and non-agricultural lands and 9 percent for urban and undefined lands (Table IV-3). The best soils for intensive agricultural use are located on the coastal plains and river valleys of the north (Figure IV-1) and south coast (i.e. Nacaome and Choluteca in the south; Guayape, Patuca and Aguan in the central and northeast; and Sula and Lean in the north) and in the interior valleys of Zamorano and Comayagua (Figure II-1, p. 26). Current and projected areas of important crops are shown in Table IV-4.

In comparing potential with actual land use, only about one-third of the land classified as adequate for annual crops is utilized in this manner. In contrast, much land that is utilized for annual and perennial crops is only classified for forestry or extensive uses such as wildlands or cattle farming. These apparent paradoxes are caused principally by the existence of large holdings using good soils extensively for cattle or reserve lands while small holdings on steep slopes and/or poor soils are utilized intensively by a dense population. For example, livestock grazing on alluvial soils of the Caribbean lowlands may be

TABLE IV-1

THE AGROECOSYSTEMS OF HONDURAS

ographic Area	Estimated % Total Land	Estimated % Total Population	Predominant Agricultural Activities
rthern Coastal ains and Lower untains Slopes	13	24	Bananas, Pineapple, Live-Stock, Sugar Cane, Citrus, African Oil Palm
stern Lowlands	20	1	Sparse Riverine Agriculture Near Coast
ntral Highlands	65	70	Shifting Agriculture, Small Farmers Produce Basic Grains, Coffee, Tabacco, and Livestock, Some Vegetables and Fruits.
cific Lowlands	2	5	Cotton, Sugar Cane, Melons, Vegetables, Livestock
TALS	100	100	

re IV-1. The fertile soils of the north coast of Honduras are ex- it for intensive agriculture. Pineapple production at Standard 's Monte Cristo Farm near La Ceiba produces fruit and juice xport and provides steady employment for thousands of people is region *(Courtesy of P. Dulin).*

economically viable, but certainly represents an underutilization of the land resources.

Land Tenure

Land tenure is characterized by many small holdings and a few very large holdings (Table IV-5). There are an estimated 195,297 farms, over 50 percent of which have less than three hectares. Most small farmers practice shifting and semipermanent agriculture, generally on sloping or marginally productive soils, whereas the large commerical farms utilize some mechanization, fertilizers, and pesticides on the better agricultural lands. The incorpation of the landless rural population into a productive agricultural economy continues to be an

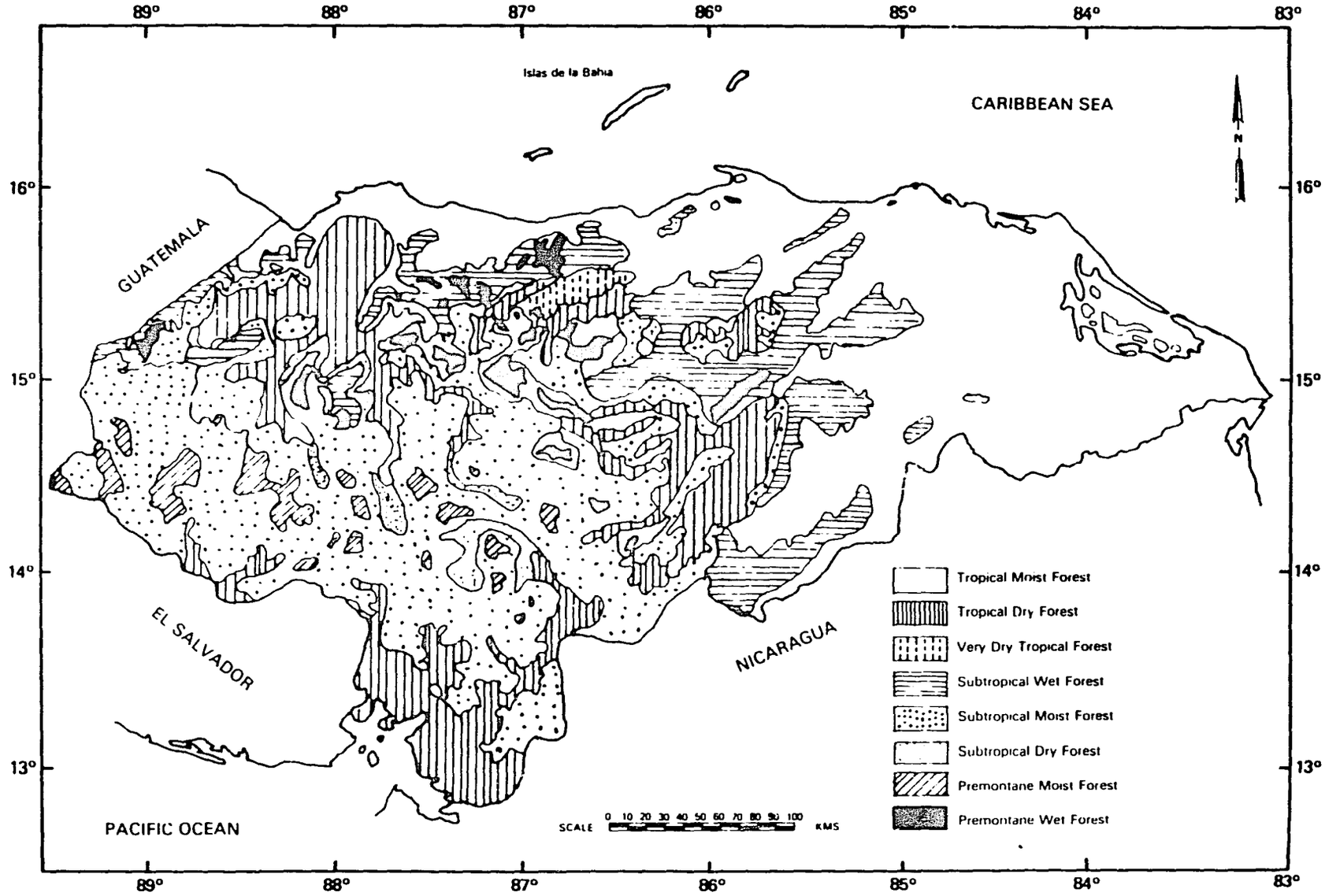


Figure IV-2. Ecological map of Honduras according to the Holdridge Life Zone System.

TABLE IV-2

LIFE ZONES OF HONDURAS AND THEIR RECOMMENDED USE

Symbol[a]	Ecological Formation	Recommended Use	Principal Recommended Species	AREA	
				Hectares	Percent
BH-T	Moist Tropical Forest	Intensive agriculture on alluvial soils, cattle production on leveled moderately sloping lands, and forest production on steep slopes.	Bananas, cacao, rice, rubber, yuca, tropical fruits, African oil palm, pejibaye palm, robusta coffee, beef cattle, and native forest species.	3,723,900	29.0
BS-T	Dry Tropical Forest	Intensive agriculture with supplementary irrigation on alluvial soils, intensive cattle production and cultivation of annual crops without irrigation on non-alluvial soils of gentle to moderate slope, permanent forest production on steep slopes.	Cotton, sugarcane, tobacco, rice under eventual irrigation, sesame, corn, yuca beans, sorghum, tropical fruits (mango, papaya, zapotillo, citrus, etc.) cattle on irrigated on non-irrigated pasture an swine, native forest species.	1,721,800	15.2
BMS-T	Very Dry Tropical Forest	Intensive agriculture with irrigation on alluvial soils, annual crops without irrigation and extensive cattle production on leveled and moderately sloping land, forests on steep slopes.	Sugarcane, cotton, corn, milo, millet, henequen, melons, tropical fruits, beef cattle, and native forest species.	34,750	0.003
BMH-ST	Wet Sub-Tropical Forest	Agriculture on deep volcanic soils and gentle to moderate slopes, dairy production on volcanic soils of moderate slopes, forest production on non-volcanic soils and on steep slopes.	Coffee, tea, sub-tropical fruits and native forest species.	1,607,850	14.1

TABLE IV-2

LIFE ZONES OF HONDURAS AND THEIR RECOMMENDED USE (Continued)

Symbol[a]	Ecological Formation	Recommended Use	Principal Recommended Species	AREA	
				Hectares	Percent
BH-ST	Moist Sub-Tropical Forest	Intensive agriculture and cattle production on lands of gentle to moderate slopes, forest production on steep slopes.	Arabica coffee, tobacco, corn, sugarcane, peanuts, sub-tropical fruits (pineapple, avocado, citrus), dairy cattle and swine, pine (for wood and resin).	4,058,750	35.4
BS-ST	Dry Sub-Tropical Forest	Agriculture (with supplementary irrigation) on alluvial soils, extensive cattle production on non-alluvial soils of moderate slope, forest production on steep slopes.	Cotton, sugarcane, tobacco, rice corn, beans, millet, tropical fruits (mango, papaya, zapotillo), pine (for wood and resin).	170,900	1.5
BH-MB	Pre-Montane Moist Forest	Intensive agriculture and cattle production on gentle to moderate slopes, forest production on steep slopes.	Potatoes, corn wheat, alfalfa, vegetables, flowers, temperate climate fruits, dairy production, swine, pines.	298,950	2.6
BMH-MB	Wet Pre-Montane Forest	Forest production on lands of moderate slopes and forest managed for watershed protection on steep slopes.	Native forest species, in particular pines and firs.	243,300	2.1

SOURCE: Mapa Ecologico de Honduras (1962), prepared by Dr. Leslie M. Holdridge, Organization of American States.

[a]Symbols appear on key to map (Figure IV-2).

TABLE IV-3

LAND USE FOR THE PERIOD 1970-1972 AND 1975-1977

	1970-72		1975-77	
	(1000 Ha)	%	(1000 Ha)	%
Forest and Underutilized Land	6,544.9	56.91	7,380.0	65.85
1. Tropical Hardwoods	3,408.3	29.64	3,920.0	34.98
2. Eroded Lands and Other	397.8	3.46	760.0	6.78
3. Pine Forest Areas	2,738.8	23.82	2,700.0	24.09
Agricultural Land	3,869.0	33.64	2,800.0	24.98
1. Cultivated	1,370.5	11.92	1,769.1	15.78
-- Crops	643.8	5.52	719.6	6.42
-- Cultivated Pastures	735.7	6.40	1,049.5	9.36
2. Non-Cultivated	2,498.5	21.73	1,030.9	9.20
-- Potentially Available	1,924.5	15.87	741.0	6.61
-- Natural Pasture	449.6	3.91	289.9	2.59
-- Fallow	224.4	1.95	-	-
Urban Areas, Mangroves and Swamp Areas	1,086.1	9.44	1,028.8	9.18
Total Geographic Area[1]	11,500.0	100.00%	11,208.8	100.00%

[1]The total area was officially modified after 1972.

SOURCE: U.S. AID 1980. Originally from CONSUPLANE, Plan Nacional Agropecuario 1979/83.

TABLE IV-4. CURRENT AND PROJECTED AREAS OF IMPORTANT CROPS*
(Units of 000 hectares)

	Current	Projected (1983)
Basic Grains		
Corn (1973-74)	319.9	386.1
Beans "	70.4	70.4
Rice "	14.8	14.8
Sorghum "	59.0	59.0
Wheat (1973-77)	0.2	0.8
Vegetables		
Tomatoes (1973-74); Potatoes, Onions, Garlic, Cabbage	3.39	4.12
Starchy Crops		
Banana (1973-74)	42.7	51.4
Plantain (1977-78), Yuca (1973-74)	11.5	21.2
Fruits		
Oranges, Lemons (1975)	2.45	2.05
Pineapple (1975-77)	1.0	3.1
Melons (1975-77)	1.5	2.5
Cashew (1977)	0.9	7.9
Oil Seed Crops		
African Palm (1978)	2.8	7.6
Coconut (1973-74)	3.8	4.5
Sesame (1973-74); Peanuts Soybeans (1975-77); Castor Beans (1977-78)	3.5	5.38
Other Cash Crops		
Cacao	0.5	1.0
Sugar Cane	35.0	45.2
Coffee	116.5	121.2
Tabacco	10.3	12.7
Cotton	7.7	13.7
TOTAL	707.84	834.25

Source: U.S. AID. 1978.

*Year of current census given in parentheses.

TABLE IV-5

NUMBER AND SIZE OF FARMS AND AMOUNT OF FARMLAND

Individual Farm Size (hectares)	Number of Farms	% of Total	Total Area of Farms (hectares)	% of Total
Less than 1	33,774	17.3	21,534	0.8
1-2	38,643	19.8	53.584	2.0
2-3	28,699	14.7	69,865	2.6
3-5	23,631	12.1	93,696	3.5
5-20	47,478	24.3	468,983	17.6
20-50	15,164	7.8	461,464	17.5
Greater than 50	7,908	4.0	1,485,949	56.0
TOTAL	195,297	100.0	2,655,095	100.0

SOURCE: U.S. AID 1978. 1974 Agricultural Census.

important social problem with long-term environmental consequences.

Stream Flow and Agricultural Water Use

The combination of long dry seasons and irregular rainfall patterns in many parts of Honduras results in substantial seasonal variations of streamflow requiring careful crop scheduling and irrigation to insure harvest.

The supply of surface water is ample for the country as whole, but its distribution is not uniform. Many of the regions with the highest population density and demand are located in zones with lower water yields. During the dry season, rivers discharge only about 40 cubic meters per second as compared with six times that amount in the wet season.

It is unknown whether salt water intrusion may be occurring in the lower Choluteca River since cotton and vegetables are being irrigated at periods that coincide with low surface-water flow. No data was available to estimate freshwater requirement for esturaries and mangroves located at the mouth of the Choluteca in the Gulf of Fonseca.

Although there are few available data describing agricultural pesticide or fertilizer concentration, it can be assumed that the agricultural contaminants become more concentrated during periods of low streamflow, especially in cotton-growing regions. Periods of peak streamflow produce sediments and

flooding on potentially productive lands in the lower watersheds. Rates of erosion have accelerated due to deforestation, overgazing, and inappropriate land uses. Eroded lands have increased from 3.5 to 6.8 percent of total lands from 1970 to 1977, but should be viewed as only a rough approximation (SRN, 1977).

Pesticides in the Environment

The status of pesticide use is not clear due to the lack of adequate documentation and the continually changing aspect of pesticide utilization. In 1978, the value of pesticides (herbicides, insecticides, nematocides, fungicides) imported to Honduras amounted to $18.6 million of which two-thirds was of U.S. origin. Water quality data show that DDT, dieldrin, toxaphene, methyl and ethyl parathion and endrin were utilized ·avily in cotton growing areas, r.marily in Choluteca and Olancho (CAITI, 1976). However, no information was found that estimated pesticide use on vegetable crops, basic grains or export fruit produced in other parts of Honduras. Since banana and pineapple production is destined partially for U.S. consumption, pesticides applied by the two ultinational companies are those pproved by the USEPA since all fruit ust meet tolerance standards.

In 1980 the Federal Insecticide, ungicide and Rodenticide Act was romulgated into a regulation stating hat any U.S. exporter who is shipping cancelled pesticide must notify EPA. he U.S. Embassy is notified and in urn explains the health hazards to the ost country. The law was passed in rder to control indiscriminate dumping restricted pesticides on third-world ountries. Since July 1980 there has een only one report of DDT imported Honduras from the United States. his does not imply that harmful esticides are not being applied on elds since there are no laws which control importation of pesticides from neighboring countries or Europe.

All shipments of beef exported to the U.S. are inspected and analyzed for pesticide residues at port of entry. Since September 1980, there have been five cases where export meat has been rejected because tolerance levels were exceeded with DDT, dieldrin, and/or heptachlor. These violations stand out since there were no citations previous to September, 1980, nor after December, 1980. There is no evidence as to the source of the Honduran meat contamination problem particularly concerning indiscriminate use of agricultural pesticides. Obviously pesticide levels in the Honduran environment have not been quantified and more effort should be devoted toward their investigation.

Deforestation and Slash and Burn Agriculture

Roper (1980) attributes a deforestation rate of 80,000 hectares per year to slash and burn agriculture practices in the broadleaf forests resulting in an equivalent gross commercial value loss of more than 300 million dollars annually. Cliff (1980) estimates that 50,000 to 60,000 hectares of pine forests are cut over each year through commercial timbering activities. Natural and artificial regeneration of pine forests is impeded due to forest fires on an estimated 20,000 to 2,000,000 hectares each year. Fuelwood is by far the most important energy source for domestic use with 97 percent of Honduran households using fuelwood for cooking. Annual collection and consumption of fuelwood is estimated by CONSUPLANE at 2,767,000 tons per year or the equivalent of greater than 22,500 hectares of forest.

Shifting agriculture, the traditional cultivation practice in Honduras, is used in piedmont and in mountain areas since the more level lands of the valleys are used for intensive cultivation of commercial crops such as bananas, sugar cane,

ɔtton and cattle. The growing popu-
ıtion and an influx of immigrants from
l Salvador and Nicaragua have resulted
ı an even greater number of campesinos
ɔving into the steep mountain areas
learing virgin and secondary forests
ɔ cultivate beans and corn. With
ttle or no appropriate cultivation
ıd conservation techniques, the soils
e usually exhausted of nutrients or
ghly eroded in 2 to 5 years. The
ınds are then fallowed, abandoned, or
eded with grasses and sold to cattle
oducers, thereby expanding grazing
ınds. The campesino then either
ncentrates his farming on remaining
nd or moves on to clear new forest
eas. Continuing growth of the rural
pulation results both in shortened
llow periods and expansion of the
ttlement onto marginal land.

osion

A basic distinction exists between
osion as a natural geological process
d erosion provoked by people.
ologic erosion occurs where tropical
getation has been disturbed by storms
landslides. But, due to rapid
tural revegetation, the basic soil
ructure remains intact. In contrast,
e removal of vegetation, overgrazing,
ltivation of annual crops or other
tivities have accelerated erosion.
ese practices increase runoff and
ourage mass movement of soil (see
gure VI-2, p. 93). Given the same
ɔpe and climate, the physical struc-
re of a soil becomes the variable
ıtrolling the susceptibility of that
ll to erosion under different uses.
ıce some rural areas have already
rpassed their carrying capacity in
ms of human settlements and poten-
al agricultural productivity,
ısures of erosion might be used as
licators of environmental degrada-
ın. The National Acadaster Survey is
empting to document the potential
sibility of Honduran soils.

Weathering is generally more rapid
the Caribbean coast where rainfall
is relatively high, resulting in more
water being available for chemical
reactions and leaching than on the
Pacific side where total rainfall is
less and the dry season longer.

CONSTRAINTS ON DEVELOPMENT

General Considerations

The following concerns affect the
integrated development of the agri-
cultural sector:

- Lack of offical acceptance that environmental management goes hand in hand with economic development both at the sectorial and national level.
- Lack of a well-defined environmental management strategy which legally links an official land use policy with agrarian reform and the overall national development plan.
- Absence of institutional guidelines and environmental management criteria that link agricultural credit with technical assistance in areas of soil conservation.
- Inappropriate technologies for small farmers, or inappropriate land utilization.
- Promotion of high energy agricultural technologies which the small farmer cannot afford and which create dependency on foreign energy sources.
- Lack of developed institutional linkages that promote information exchange and avoid duplication.

Some of the responsibility for these
weaknesses lie with international donor
agencies that provide funds for local
agricultural credit programs or direct
technical assistance for agricultural
development of watershed management
projects without providing environ-
mental management support and
training.

Landless Rural Population

The demands for land and the processes of shifting cultivation and invasion of forested lands are well documented and emphasize the severity of the problem of the landless rural population (Figure III-4, p. 47). Unfortunately a large majority of the people that have the greatest impact on natural resources are those occupying untitled lands. They are not incorporated into the agrarian reform process because they lack papers and in essence are non-entities, out of reach of any governmental institution or regulations. Even the implementation of an appropriate national land use policy may have considerable difficulty in encompassing the migratory rural population since they frequently invade new forest lands or areas with little road access.

Since shifting cultivators are frequently forced to utilize marginal lands, yields decrease and weeds and pests become more difficult to control after one or two crops, so they move on to search for new areas to clear. Without radical changes in rural employment opportunities combined with an increased agircultural productivity on the best soils, and completion of more equitable land distribution, this process of invading broadleaf forests and cultivation of marginal steep lands can be expected to continue.

Often associated with the above-mentioned process are cattlemen who purchase the "improvements" (land clearing) from the shifting cultivator and who plant pasture grasses. Consequently, what was historically a rational cropping/fallow-system is now semi- or permanent agriculture without fallow periods which allow for nutrient recovery by successional vegetation. Converting marginal steep lands that are classified for protective and forestry use to pasture will result in poor pastures and costly losses of soil resources. In dry areas with sloping soils, there is the tendency to overgraze leaving little vegetative cover to hold the soil during periods of heavy rainfall. In humid areas, exposed soils are susceptible to erosion and pasture quality difficult to maintain. Ideally on suitable sites, good yields can be maintained with combinations of crop mixes and low inputs of fertilizer and pesticides, thus maintaining soil fertility and stability.

The conversion of the rural population to a permanent agriculture adapted to soils and ecological characteristics of the area, will help stabilize these people where the land is capable of producing sustained yields.

Effectiveness of Agrarian Reform

The agrarian reform movement has set as a goal the relocation of 120,000 families on 600,000 hectares. As of 1980, 33,381 families (1,292 groups) have been placed on 209,403 hectares (Figure IV-3). In brief, the rate of new land settlements per year is just about equal to the annual increase in the rural population. Consequently the land reform program on a national basis has had little net effect in reducing the extent of minifundia or landlessness as it existed in 1978.

Rate of abandonment of farms by farmers has been high, particularly in the largest project, the Bajo Aguan, which has approximately 25 percent of the total land in the agrarian reform program. Reasons for poor performance of reform groups is summarized below:

- "Collective farming" systems presently used by INA are not acceptable to many campesinos.
- High incidence of natural disasters--i.e. hurricanes floods, droughts.
- Choice of crops, level of inputs, and general farming systems implemented were not compatible with the ecological constraints of the area.
- Heavy concentration on production of basic grains and subsequent

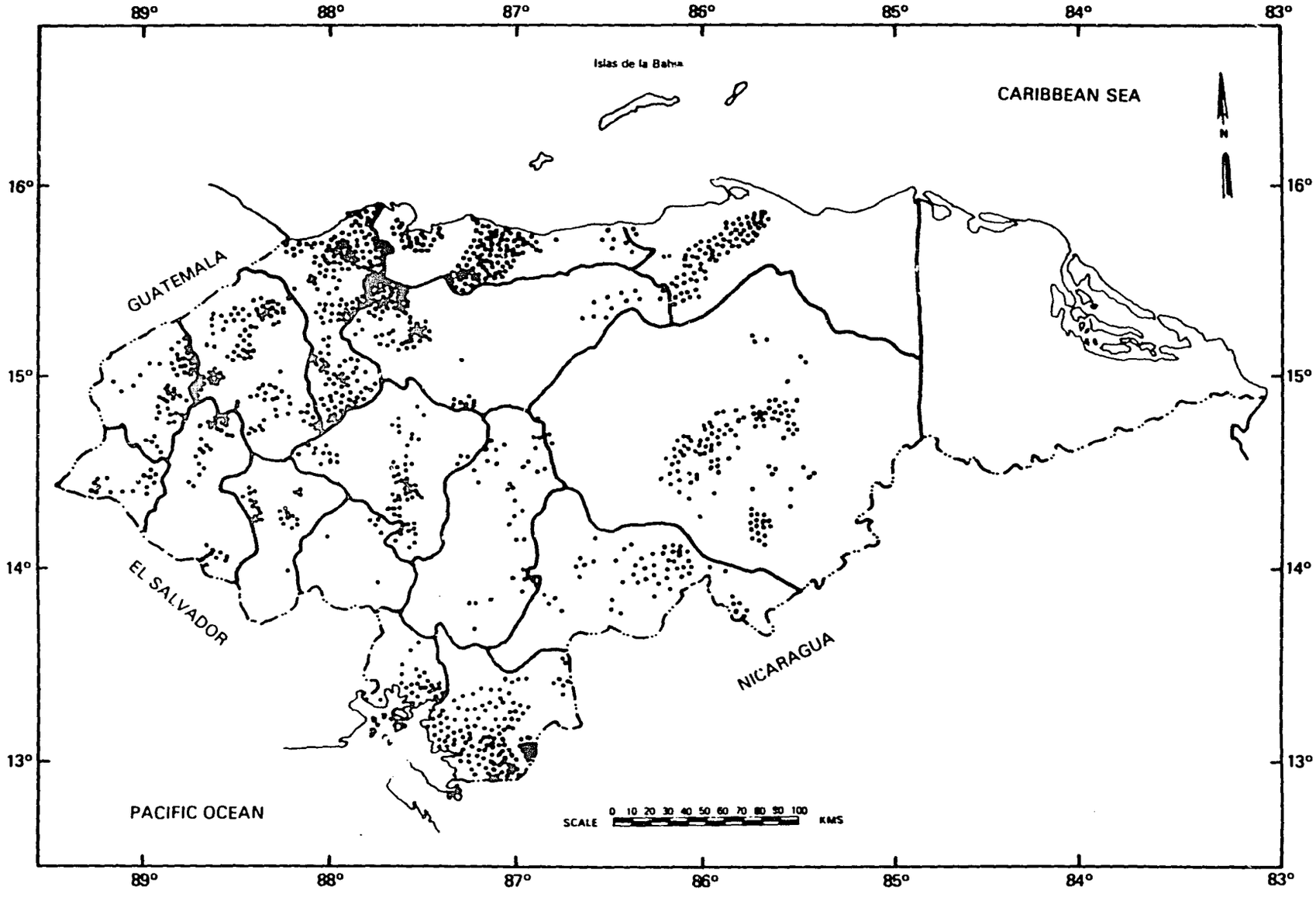


Figure IV-3. Approximate location of campesino groups of the agrarian reform movement by municipality.

failure to purchase grains at previously announced support prices.

- Poor management decisions that extend agricultural credit against inadequate evidence of specific yields and ability to repay loans or utilize sophisticated technology with untrained labor.
- The land area legally designated for the Bajo Aguan project was predominantly marginal with some lands of more than 15 percent slope.

Under the agrarian reform law, the beneficiaries of the program are eventually to assume full responsiblity for production activities. This implies the need for a program of farmer training. Adequate training for beneficiary groups to prepare them for future managerial roles does not exist and short courses are poorly coordinated with respect to content and target group. Before large government investments are committed, it is recommended hat the present land reform program be critically reviewed in terms of economic, social and ecological acceptability and compatibility with the national agricutural development policy.

Cattle Production and Environmental Degradation

Overemphasis of cattle production to the exclusion of alternative land uses and location of cattle enterprises on unsuitable lands are major constraints to development.

In recent years beef exports have increased markedly and now rank fourth (after bananas, coffee, and wood) in terms of foreign exchange earnings (Figure IV-4). There are approximately 2,200,000 head of livestock, 10-15 percent of which are slaughtered each year for the export market. With unlimited access to foreign markets it would be possible to export virtually all the meat produced, to the detriment of the Honduran consumer.

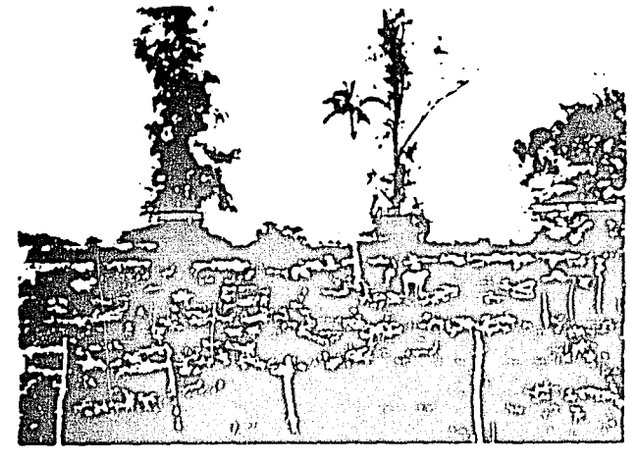


Figure IV-4. Cattle production, as shown in this photograph from La Ceiba, continues to be one of the most important income producers for the agricultural sector *(Courtesy of J. Dickinson).*

Meat production (45 kilograms/ hectare/year) combined with milk production (208 liters/ hectare/year) could yield a combined gross income of $140 hectare/year which serves as an incentive to intensify and expand beef production in suitable and marginal areas alike.

Approximately 60-70 percent of all the beef produced comes from small livestock producers (15-20 head each) who may or may not have land titles. This is the group who will most likely expand their grazing on adjacent steep lands since credit assistance provided by the government, combined with incentives of high price, promote exploitation of marginal resources. Evaluation of grazing practices and of exploitation of Central American natural resources for benefit of foreign markets have been critical (Myers, 1981; Shanek 1980).

Continual exploitation and expansion of cattle grazing in marginal steep lands not ecologically suited for this activity can cause increase in river sedimentation, loss of soil and overall resource degradation due to overgrazing and soil slippage. Therefore, it is important that ecological criteria and the philosophy of environmental management be incorporated as an integral

part of the loan evaluation procedure to avoid conflicts between short-term economic interests and long-term human well-being and land resource productivity.

Allocation of Resources for Small Independent Farmers

Small farmers produce sixty percent of the basic grains and sixty to seventy percent of the livestock in Honduras. Although small farmers utilize and manage a large portion of land and water resources to produce their crops and livestock, their access to services is limited and government assistance is often slow and poorly timed. That a large percentage of small farmers are essentially living outside of the economy is demonstrated by comparing the use of agricultural technology with farm size (Table IV-6).

To imply that external assistance needs to be increased or is lacking for agricultural development is misleading. In 1978, 10 major assistance agencies provided the equivalent of U.S. $170 per rural inhabitant, approximately

TABLE IV-6

USE OF AGRICULTURAL TECHNOLOGY BY FARM SIZE

Size of Farm (HA)	Total No. in Country	No. (and %) Using Fertilizer	No. (and %) Using Bought Seed	No. (and %) Using Some Type of Input*
1 - 3	101,116	2,923 (2.9)	2,354 (2.3)	8,921 (8.8)
3 - 5	23,631	1,062 (4.5)	562 (2.4)	2,986 (12.3)
5 - 10	28,259	1,615 (5.7)	926 (3.3)	4,514 (16.0)
11 - 20	19,219	1,428 (7.4)	922 (4.7)	4,239 (22.1)
21 - 50	15,164	1,509 (10.0)	1,264 (8.3)	4,814 (31.7)
51 or More	7,908	1,609 (20.3)	1,650 (20.9)	4,284 (54.1)
TOTAL	195,297	10,146 (5.2)	7,678 (3.9)	29,663 (15.2)

*Fertilizer, Insecticides, fungicides, Herbicides, Veterinary Products and bought Seed.

SOURCE: U. S. AID, 1978.

double the average annual rural per capita income. Of the farm credit assistance, 60 percent went to agrarian reform programs, 25-30 percent to medium-sized cattle farmers and only 10-15 percent to small to medium independent farmers.

Institutional Fragmentation

The key agricultural development institutions are plagued by overlapping assignments, the duplication of functions and technical manpower and fragmented jurisdictions. Consequently, competition for agronomists occurs among INA, MRN, and BANADESA since each agency provides technical assistance to carry out agricultural development programs and services at the local level.

The current fragmented agricultural sector organization--duplicative functions, duplicative and competitive manpower structure, uncoordinated institutional policies, ineffective coordination of operations and lack of flexible authority and operational resources in the field--adds up to a reduction in the opportunity for effective and efficient delivery of developmental services to the agricultural sector. External financing agencies have and continue to contribute to this fragmentation by insisting on establishing projects with relatively autonomus authority.

There is also fragmentation in the functions performed and services delivered to the areas under agrarian reform and to those in non-reform areas. For example, in the Aguan valley the INA project is situated near Tocoa and COHBANA has a project in Isletas about 40 kilometers away. COHBANA is responsible for assistance in banana production; INA assists with oil palm and grapefruit as well as funds capital improvements such as land leveling and drainage, and MRN assists with basic grain production, all in the same area.

Land reform areas are surrounded by small independent farmers who require technical assistance and credit. Farm size and income are criteria for delivering some government services; in other instances the crop itself (bananas, coffee) governs how the farmer is served.

INSTITUTIONAL ANALYSIS

Institutions Affecting Agricultural Development

The following list includes the principal governmental institutions that directly affect agricultural production, land use, research, agricultural credit, and agricultural planning (Anderson, 1977).

National Cadaster Program (PCN). This program was begun in 1976 with a series of loans and grants from AID. Its objectives are:

- to establish a registry system to help the government issue clear land titles
- to develop an efficient property-tax administration to assess taxes and increase government operating income
- to perform an agricultural resources inventory involving the collection, analysis, and organization of accurate resources information concerning soils, water resources, vegetation, and other factors, over a 71,746 square kilometer project area in the country.

A secondary activity of the project is to prepare a land-use potential classification for the country based on the USDA soils classification. This classification would serve as the primary tool in land planning (Figure IV-5) and could further serve as a tax assessment tool (i.e., paying less taxes for more appropriate uses). In 1980, AID extended its support of the program with approximately 3.3 million dollars as part of the "Honduras Natural Resources Management Project."

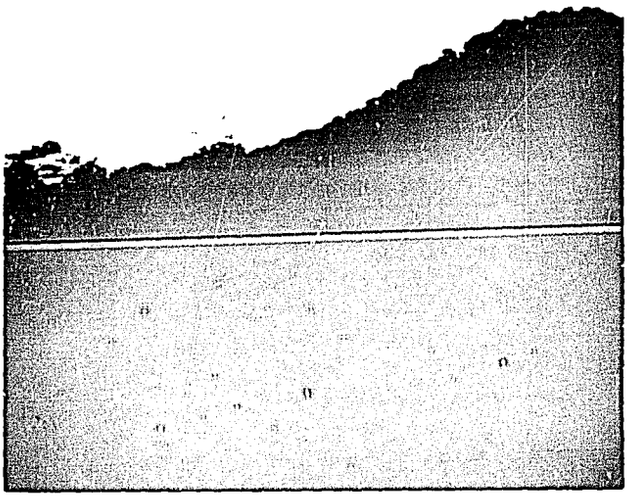


Figure IV-5. Appropriate land use would preclude use of steep slope areas for agricultural purposes such as depicted in the photograph from La Entrada *(Courtesy of P. Dulin).*

Instituto Nacional Agrario (INA). INA was established in 1963 as a semi-autonomous land reform agency directly responsible to the chief of state for expropriating private lands and transfering and titling these lands to land reform beneficiaries. Historically, campesino pressure through demonstrations and land invasion has provided impetus for land reform activities. Further pressure may be expected to increase as a result of dramatic changes in nearby Nicaragua and El Salvador. Since its inception INA has expanded in response to crises and political pressures, adding departments and functions as the situation demands.

Most of the land to be transferred or titled under the agrarian reform law was for new settlements on previously uncultivated land with little or no infrastructure. Since 1978 the efforts of INA have been dedicated to assisting the established, high cost land reform settlements with farm management, training, marketing, and technical assistance. This overemphasis on established land reform settlements neglect the large majority of smaller settlements and precludes the redistribution of additional land.

In addition to its land reform and social functions, INA also provides some technical assistance, but is not responsible for credit, research or marketing (Anderson, 1977). To date there is little evidence that environmental management concepts are applied to the implementation of land use policy or production systems by INA.

Ministry of Natural Resources (MRN). This ministry is composed of five separate departments: Planning, Agricutural Operations, Renewable Natural Resources, Mining, and Water Resource. Agricutural Operations and Renewable Natural Resources are responsible for production, research, and extension in the agricultural sector. There are only 300 extension agents for the entire country of whom fewer than 50 percent actually have contact at the medium and small farmer level. The program for soil conservation generally emphasizes fertility rather than soil and water conservation practices. The ministry is organized into seven regional offices and serves the agrarian reform sector as well as independent farmers.

Instituto Hondureno del Cafe (IHCAFE). This autonomus institute was established to provide assistance to small coffee farmers and co-ops. Its functions include: research, technical assistance, sales of inputs, road construction, co-op promotion, crop diversification, marketing information and regulation of export marketing. Of all the agencies engaged in agricultural development IHCAFE is probably having the greatest impact by providing an integrated package of services to the small farmer.

Banco Nacional de Desarrollo Agricola (BANADESA). The former Banco Nacional de Fomento has been restructured to serve as the principal credit and banking agency for agricultural development. Loans are available for

production of basic grains, livestock, citrus, fruit tree crops, vegetables, oil seed crops, coffee, cotton, cane and others. Generally INA has to supply a guarantee since almost all the small farmers applying for loans do not hold land title.

A brief summary of loan procedures and problems follows:

- Upon receiving a credit petition, BANADESA sends an inspector to evaluate land, to discuss the planting schedule, and to prepare a budget for estimated production costs.
- Agricultural extension agents (MRN) accompany BANADESA inspectors and work in coordination on the evaluation.
- There is no ecological (i.e. land capability) consideration for loan disbursements. If soil conservation measures were recommended and clearly defined then these costs could be incorporated into a loan agreement, but currently they are unspecified and consequently omitted.
- Long-term loans (5-7 years) for livestock, perennial crops, or equipment require land title as collateral, but short-term credit (6 months) usually uses a crop mortgage for collateral. This procedure encourages exploitive land use, often on marginal soils, and contributes to an unstable relationship between farmers and the land resource.
- Loan default is much greater with farmer groups organized in cooperatives under the reformed sector compared to private independent farmers (an estimated 60 versus 40 percent). Small farmers engaged in shifting agriculture rarely receive credit assistance.
- External sources (USAID, WB, IDB) do not require the evaluation of environmental management (land use capability, crop adaptability, level of production inputs, appropriate technologies) criteria for loans for institutions extending agricultural credit to Honduran farmers.

Corporacion Nacional Del Banano (COHBANA). This autonomous corporation was established to provide assistance to independent small and large owners, co-ops and agrarian reform groups on banana lands as well as to manage banana projects on land turned over to the agrarian reform program. It provides credit, farm management, technical assistance, capital improvements and marketing. COHBANA is supposed to be self-sustaining from revenues generated by a surcharge on production under its control.

Direccion General de Fomento Cooperativo (DIFOCOOP). This decentralized unit of the Ministry of Economy is responsible for the legalization of cooperatives for oversight of the legal requirements for operations of such co-ops, and for training and development programs relating to cooperative development. Facilitating the operation of agricutural sector co-ops constitutes the most significant activities.

Consejo Superior de Planificacion Economica (CONSUPLANE). This intersectorial institution is responsible for national planning and has a section devoted to agricultural planning which designs the national development plan, the annual agricultural operating plan, reviews each sector budget, coordinates external technical assistance and evaluates programs. There is an environmental unit within agricultural planning that is responsible for conservation of natural resources for all sectors. However, lack of funding and personnel has resulted in little impact or utilization of this unit.

Agricultural Training Centers

The information presented here results from visits to the Pan American

Agricutural School and ESNACIFOR and analyses of agricultural training by AID, MRN and CONSUPLANE.

The six agricultural education institutions (Table IV-7) are the source of most of the professional trained in technical agriculture for the public and private sector. The graduates of these training centers frequently become involved in planning, extension, agrarian reform or forestry where a background in simple land use/land capability is needed in making decisions and implementing specific projects. With the exception of the National Forestry School, there is little emphasis in environmental management that teaches practical life zone ecology, land use capability classification, or appropriate technologies for small farmers. The National Forestry School has recently begun offering a multiple-use forestry course which will include aspects of agro-forestry, nurseries, pasture management, fruit culture, small animal production and fuelwood production.

RECOMMENDATIONS

General

- Support Land Use Capability Classification System. The National Cadaster Program has the mandate to produce a comprehensive and implementable land use capability/classification mapping system to provide the GOH agencies with the physical and biological data required to make sound agricultural and resource management decisions. However, little progress toward accomplishment of this system has been made due to budgetary constraints of PCN. The GOH should adequately fund and staff the Cadaster Program in order to enable it to carry out its responsibilities.

- Design Regulations to Implement Land Use Criteria. The legal basis to implement a common land use criteria for all institutions dealing with agricultural/forestry development (CONSUPLANE, MRN, INA, COHDEFOR, IHCAFE, BANADESA) is needed. This means an integrated land use policy that will apply simultaneously to agrarian reform, as well as forestry, coastal zone, and wildlands management.

- Promote Environmental Management Practices. Projects that incorporate environmental management practices such as soil conservation, watershed management, appropriate technologies and cropping systems for small farmers who tend to be utilizing marginally productive lands should be fully promoted.

- Use Fertile Soils for Intensive Production. Projects that intensify agricultural production based on sophisticated and high energy input technologies should be located on the best fertile soil available.

- Incorporate Environmental Management Criteria Into Curricula of Local Institutions. Existing training institutions (EAP, CURLA, ESNACIFOR, ENA, EAJFK) should have an environmental management curriculum that includes agroforestry practices, hillside farming, small farmer technologies, and land use capability criteria. Environmental education should also be made available to agricultural extension agents since they have the greatest contact with the rural population target group.

- Increase Assistance for Small Farmers. Future projects for small farmers are needed to determine appropriate farm size/economical unit and cropping patterns/crop selection to enhance productivity and return on investment.

TABLE IV-7

AGRICULTURAL TRAINING CENTERS IN HONDURAS

Training Center	Total years Education of Graduates	Title	Graduates/Y By "80/81
Escuela Agricola John F. Kennedy (EAJFK)	13	Agricultural Technician	45-55
National Agricultural School (ENA)	15	Bachiller	70-90
National Forestry School (ENF)	15	Forester	35
Mennonite School	10	Assistant Agronomist	10
Panamerican Agricultural School (EAP)	15	Agronomist	35
Centro Universitario Del Litoral Atlantico (CURLA)	16	Agronomist	70
		Forester	70
		TOTAL	335 - 365

SOURCE: Martinex, Jose L. 1977. Escuelas Agricolas de Honduras, Oferta y Demanda d Recursos Humanos a Nivel Medio y Superior. USAID.

- Emphasize Private Landholder Field Trials. Private lands rather than government agricultural experiment stations or model farms should implement demonstrations of erosion control, cropping systems, or appropriate technologies.

- Regulate Pesticides. The implementation of a law that regulates pesticide formulation, importation, utilization, and establishes safeguards to avoid water contamination and human poisoning is needed.

- Encourage Crop Diversification in Coffee Areas. Crop diversification in coffee growing areas should be encouraged, allowing small farmer to plant fruit trees or othe suitable crops in order to decreas the dependence on coffee.

Recommendations to USAID/Honduras

- Support advisory services for th design of research and development in integrated pest management for cotton and vegetabl crop production.
- Avoid promotion of new hos country institutional bureaucracies, and strengthen existin structure so that environmental management policies can b implemented.

- Develop project preparation guidelines that include environmental management criteria (i.e. land use, land capability, cropping patterns, appropriate technologies, water and soil conservation practices, etc.) to be incorporated at initial stages of planning. Overall environmental assessment procedures including social, economic and natural resource impacts need to be reviewed so that formalized evaluation does not deter project development, but takes a hard look at its approach and long-term consequences.
- Increase the awareness and practical application of environmental management concepts in all mission offices. The activities of the natural resources advisor, currently within the Office of Environment and Technology, should be expanded to serve and to guide sectors such as agriculture and civil engineering, which most directly affect the land and surface water resource base.
- Provide a short-term course or series of seminars for AID professionals that explains how environmental management is an integral component of the project planning process.

V. MANAGEMENT OF HONDURAN FOREST RESOURCES

NTRODUCTION

This chapter

- describes the forest resources of Honduras
- identifies critical problems that negatively impact the forest resource base
- provides an institutional analysis of selected national and international agencies
- highlights social forestry incentives
- reviews forestry laws, training centers and CHODEFOR projects.

series of recommendations designed to rengthen the management of forest sources are also presented.

E FOREST RESOURCE

In 1974 COHDEFOR estimated the ent of the forest resource to be:

- 7,4000,000 hectares of forest land in the following conditions: 68 percent containing productive forest, the rest degraded forest from industrial exploitation, agriculture, and grazing, and in mangrove and second growth brush
- 4,400,000 hectares of broad leaf forest and
- 3,000,000 hectares of pine forest.

Broadleaf forests are primarily ated in the departments of Olancho, on, Gracias a Dios, Cortes, El aiso and Yoro. Most of the areas of adleaf forest are small isolated s, usually on high mountains or r areas of difficult access. Pine sts are located in the Department Francisco Morazan, Comayagua, Olancho, Copan, Yoro, El Paraiso, Gracias a Dios, Santa Barbara, Ocotepeque, Lempira, Intibuca and La Paz.

The Broadleaf Forest

The principal commercial species for export are Caoba (Swietenia macrophylla), Cedro (Cedrela odorata), Granadillo (Dalbergia tucurensis), and Nogal (Juglans olanchana). Also important are Guanacaste (Enterolobium cyclocarpum), Cortes (Tabebuia guayacan), San Juan (Vochysia hondurensis) and Laurel (Cordia alliadora). Appendix 2 lists the principal commercial species found in the broadleaf forests of Honduras. All these are used domestically for furniture and house construction. In addition, San Juan (Vochysia hondurensis) is widely used. Other species provide gums, resins and medicines: resin from Liquidambar (Liquidambar styraciflua), latex from the Tuno (Poulsemia armata) and tannin from several species of mangrove, especially on the Pacific coast of Honduras.

Fuelwood is a very important energy source for the poorer people of Honduras since it is the principal cooking fuel. Over 5,500,000 cubic meters per year, or 5 times that used for all commercial wood production, are used to cook the family meals. This wood is primarily obtained from broadleaf species but pine is used at times. The preferred species is oak (Quercus spp.), which is usually split and dried. Charcoal is used principally in the cities. Around Tegucigalpa the hillsides have been denuded of trees. Photographs of the city in 1905 show the surrounding hills well forested with pine and hardwoods. The same

ills are now covered with marginal ettlements or grass.

The broadleaf forest is under attack rom all sides (See Figure V-1). The ampesino looks to the broadleaf forest s the source of future farm land. The attleman feels that the forest is an mpediment to development of the cattle ndustry of Honduras. The average Honuran looks upon the unexploited forest s a sign of underdevelopment. Even the ocal forester tends to view the natual broadleaf forest not as a resource o be managed but rather as a site for forest plantation.

Commercial use of hardwoods is limted because of the small domestic maret and a poorly developed export maret. Most mills only take about 10 perent of the volume harvested, including ahagony (Caoba) and a few other speies. The remaining species are left ehind, hence are unmarketable. Greater se could be made of these leftovers ecause approximately 50 percent of the tanding volume is marketable.

The greatest dangers to the broadeaf forest are the campesino pracicing shifting agriculture and the attleman who follows the shifting ultivator and converts the newly leared areas to pasture. Not only is he forest lost but also the wood is urned on the spot so that even the mmediate income from the valuable speies is not realized. Estimates of emaining virgin broadleaf forest indiate that more than 2,000,000 hectares ave been lost since 1960. The rate of learing is estimated at over 80,000 ectares each year or 4 percent of the emaining forest. If this rate contines, the last remaining broadleaf forsts will disappear within 25 years, a oss of inestimable value. The wood one has an estimated present value of ver $4,000 per hectare equivalent to a early loss of $320,000,000. And, vales of forest cover for watershed and oil protection, wildlife, although ever calculated, can be assumed to be reat.

The prognosis for the broadleaf orest is extremely poor. Pressures are strong, socially, economically, and politically. Without a change in the priorities of Honduras and the international organizations sponsoring development programs the pressure will continue on the virgin broadleaf forest.

The Pine Forest

Principal species of conifers in Honduras are Pinus caribaea, Pinus oocarpa, and Pinus pseudostrobus. The different species are distributed by altitude: Pinus caribaea from 0-600 meters, Pinus oocarpa from 500-1100 meters and Pinus pseudostrobus above 900 meters. Although all of these species are used as a wood resource, Pinus oocarpa has the greatest range and volume and is the major source of pine wood produced in the country. Pinus pseudostrobus has the smallest range and volume. The largest stands of Pinus caribaea are found in the Departments of Gracias a Dios and Olancho in the Culmi area.

The wood produced from these species is as durable as yellow pine or pitch pine on the international market. It has characteristics very similar to wood of the pine species of the southern United States. The major markets for pine wood are the Caribbean, Venezuela, and Europe.

Other commercial products of the pine forest are gum resin, pine seed and to a lesser extent firewood. Resin is partially refined in Honduras then sold to the international naval stores market (Figure V-2). Seed is collected from the forest and used for domestic reforestation programs and exported to more than 30 countries.

The area of pine forest has not diminished appreciably since the 1964 inventory, but the volume of the standing timber has been reduced from 48 million cubic meters in 1964 to an estimated 28 million cubic meters in 1980. This indicates that a far different problem exists in the pine forest than in the hardwood forest.

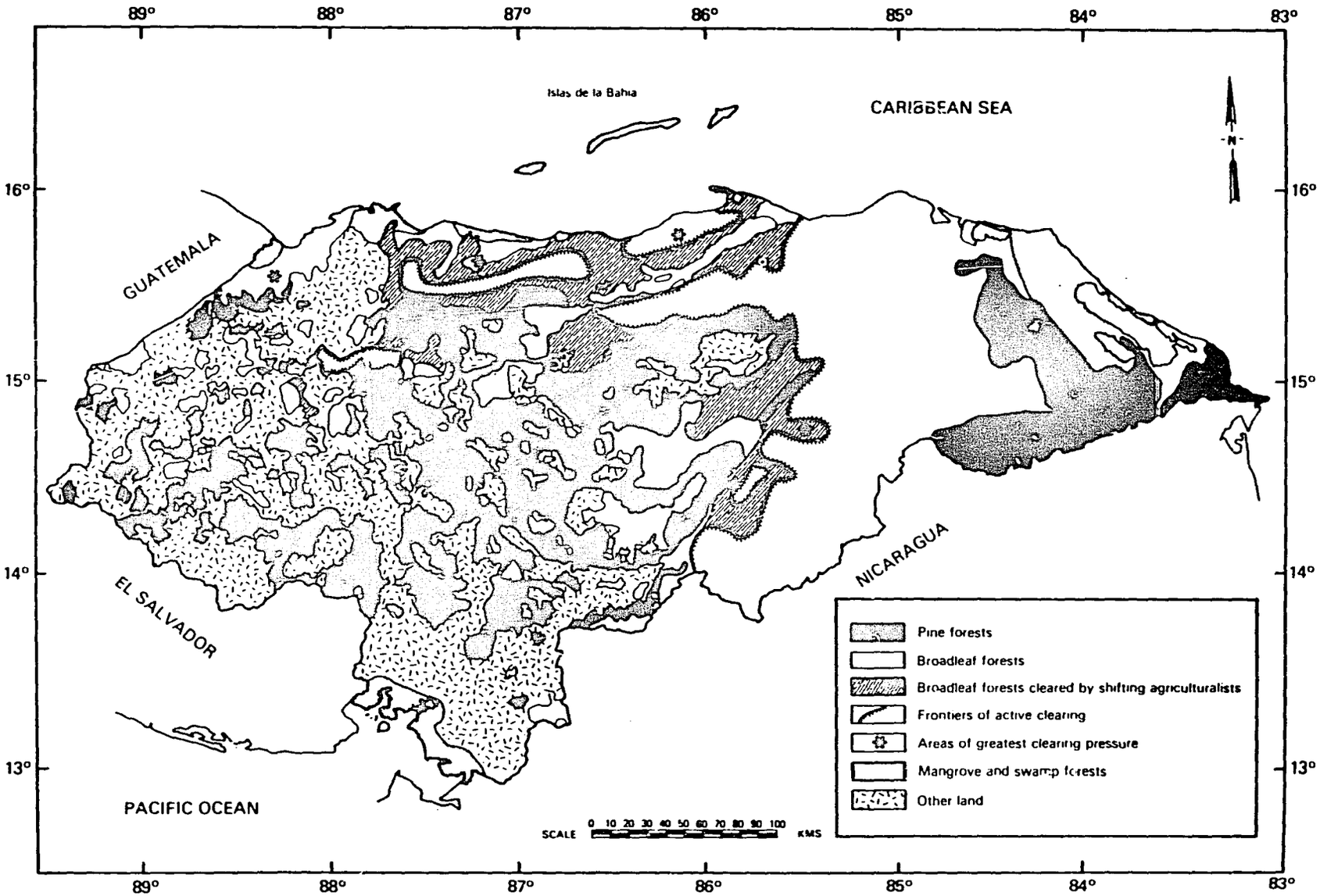


Figure V-1. Forest map of Honduras.

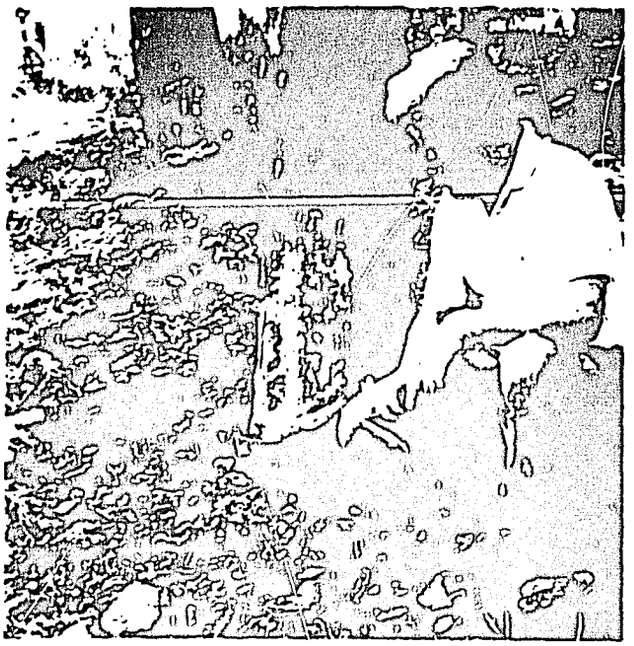


Figure V-2. Resination of pine trees before their eventual harvest provides cooperative employment for hundreds living in the pine regions *(Photo courtesy of P. Dulin).*

Cutting, both commerical and non-commerical, is reducing the density of the pine forest. Most commercial exploitation is in mature forests. These are rapidly being cut over with the only remaining extensive stands being in Olancho in the Corfino reserves. Non-commerical cutting is for fuelwood, used principally for burning lime in the areas of Siguatepeque in Comayagua and Talanga in Francisco Morazan. The second growth stands are exploited for fence posts, light posts, fuelwood, tobacco stakes, and other items.

The pine forests are not about to disappear from Honduras. Man's activities are instrumental in the wide distribution of pine. Repeated fires, agricultural activities and grazing aid in spreading these successional species. Natural disasters also help pine spread to new areas. For example, many areas on the north coast denuded by Hurricane Fifi in 1974 have come back in pure pine stands. Areas easily seen from the highway between Tela and La Lima where massive slides occurred in 1974 are almost fully covered by Pinus caribaea.

Pine is the major source of wood for the Honduran sawmill industry. It is most accessible and convertible to a product readily acceptable on world markets. Of the 241.5 million board feet of lumber exported from Honduras in 1980, 237 million board feet was pine. This industrial activity gives employment to more than 36,000 people. When the mature pine runs out, and if the second growth forest is not ready for production, the industrial wood sector will face severe disruption of production. Estimates of the present rates of cutting of the forests indicate that the mature pine forest will be gone in approximately 18 years. Commercial milling will stop and not be able to resume for approximately another 18 years. This assumption is based on the present poor growth of the secondary stands affected by fire and early cutting for uses such as posts, grazing, or agriculture.

Good forest management could encourage regrowth by preventing destructive fires, by encouraging reforestation, by controlling exploitation, thinnings, and destructive practices such as clearing for marginal agriculture. Better and more efficient utilization of the raw material would increase the life of the mature stand. Estimates of 60 percent waste of the useable material in standing timber may be low. Waste of recoverable wood at the mill may be as high as 50 percent. If better utilization of this material could be made the life of this important industry could be extended to cover the projected gap of 18 years, especially if forest management practices were improved to bring the second growth forest up to its potential for production.

MAJOR PROBLEMATIC AREAS

A number of major problematic areas in the forestry sector have been

identified by the field team:

- shifting agriculture
- grazing of cattle
- logging
- deforestation
- soil erosion
- underutilization of raw material
- fire
- reforestation
- poor communications among organizations
- management deficiencies.

Each problem area will be discussed with its accompanied sub-problems. An attempt will be made to point out the roots of the situation now facing the forest resource of Honduras.

Shifting Agriculture

In the tropics shifting agriculture is a threat to forest resources. The practice dates back to pre-Columbian times. At low population densities ·er long fallow periods this practice ı· ecologically sound. Several factors combine to cause shifting cultivators to invade areas of broadleaf forest in Honduras. Among these are population pressure, land scarcity, lack of access to land, lack of alternative employment and displacement by more powerful interests such as INA settlements or cattlemen.

Grazing of Cattle

This problem is closely related to he previous one. Shifting agriculture ontinues until yields decline at which ime a cattleman will purchase this improved" grazing land and plant it to asture. The campesino views land onverted to grazing land as irreverıbly removed from agriculturally suitble land (Murray, 1981). Former agriıltural land all over Honduras has een removed from agricultural produc-ion forcing the growing population of ıor Hondurans into the virgin forest · to the urban areas such as ·gucigalpa or San Pedro Sula. The statistics given earlier show what is happening to the forest in terms of loss per annum.

A second direct effect of grazing is fire. For example, many of the fires started in the pine forest each year are to improve grazing. Grass growth under pine forests is generally of very low productivity. But the young grass leaves provide temporary feed after a fire. These fires cause widespread destruction of young regenerating pine less than 3 years old. Fire is generally not a problem in the broadleaf forest.

A particularly destructive and wasteful activity is occurring in Olancho. The cattlemen are paying people to cut areas of virgin forest, burn it and then plant grass directly, bypassing the period of crop production. A principal cause of this problem is the open export market for beef. The United States has recently lifted the quota of beef allowed to be imported from Honduras. Cattlemen looking for short-term gains are taking advantage of this by rapidly exanding production, principally on previously forested areas.

Logging

Although the system of logging for pine used in Honduras is termed "clear-cutting," usually only about 60 percent of the trees on a site are cut. The others are left because they are too small, crooked or are thought to have rot. In hardwoods only selected species with specified size limits are taken, usually less than 10 percent of the stand volume. This results in not only greater waste but also makes returning for a salvage cut unattractive economically.

Pine logging is by far the most ımportant, but typifies logging practices in all forests. Loggers only pay a stumpage fee on logs removed from the forest. Saw mills buy only those logs guaranteed to produce saleable lumber ea·'ly. Logs with rot or other defects

are left in the woods. Truckers hauling logs are paid on a board foot basis measured by the Doyle Rule. This rule underestimates the volume of small logs in boardfeet.

The last and probably the greatest inducement to waste of the wood in the forest is its very low value (see page 77). COHDEFOR has set stumpage at only $6.00 per cubic meter, only about 20 percent of equivalent value in the United States. This not only does not pay for services in the woods such as setting up sales or monitoring extraction but also induces waste at every step in the conversion from standing timber to the final product. Marked disincentives result from these low prices. Both IDB and USAID have included stumpage valuation in project consideration.

In pine stands, roads produce erosion and occupy large areas of productive land. Methods of construction and road location are largely left to the logger. Waterways and drainage are only considered when absolutely necessary. Most mountain roads are unusable during the 4-6 month rainy season. Skid trials are over-used and often follow ridge tops or cross natural drainages.

Deforestation

A map of Honduran forests prepared by UNDP/FAO in 1967 has been modified to show the critical areas of deforestation and frontiers of active forest clearing (Figure V-1). Agricultural activities, logging, fire and natural disasters, such as hurricances, all contribute to deforestation. In the broadleaf forest, shifting agriculture is by far the major cause of deforestation. Once this forest is cleared, for all practical purposes, the land use change is permanent.

Industrial logging is often the first step in the loss of the broadleaf forest. Such logging seldom results in clear cutting, and selective cuts are made where trees of known value are removed. The access roads used to extract these trees provide the routes for invasion by campesinos looking for land to farm.

The pine forest faces a different set of problems. Clearing of this forest is usually the result of logging. Agriculture does not play a significant role except in southwest Honduras along the El Salvador border. Natural regeneration is generally more than adequate to replace the stand if a seed source remains. But yearly fires, common throughout the pine stands, kills all regeneration less than two years old and slows growth of young trees by scorching the crowns.

Pinus caribaea regenerates well. Studies show that more than 17,000 seedlings per hectare are common the first year after a fire. *Pinus oocarpa* does not regenerate as well. Variable seed production may be the major cause. *Pinus oocarpa*, when young, has the ability to sprout after a fire or if it is cut. This ability somewhat makes up for lower seed production. A study of this phenomenon should be undertaken to determine its importance for reforestation and fire protection. *Pinus pseudostrobus* is an active regenerator and as such is similar to *Pinus caribaea*.

Soil Erosion

Soil erosion and soil development are continuous natural proceeses. When people's activities disrupt the processes, problems arise. Deforestation and accompanying activities such as road building, logging, farming and grazing can be major disruptions. Most of Honduras is mountainous, and steep slopes are the rule. The soils are quite erodable when unprotected. The greatest cause of soil erosion is agricultural clearing on steep lands. The magnitude of this problem becomes apparent if one considers first that over 80,000 hectares of new forest land are cleared every year and second, much

arger areas of previously cleared orest land are refarmed.

The second most important cause f erosion is due to logging-related ctivities such as skidding logs r building access roads. Although hese activities probably produce the reatest per hectare erosion, only out 35,000 hectares are logged each ear. Therefore, the total amount erosion is far less than with agriilture. Since roads and skid trails e not water barred when they e no longer needed, erosion from e surface sometimes long after erations are terminated on the te.

The third major source of erosion is e to poor road construction and mainnance. Roads are not properly owned, ditched or culverted. Culrts, when installed, are poorly loted and too small. Full-bench roads e constructed when half-bench roads uld suffice. This drastically inases the side coast of loose soil. ds are often "in-sloped" further s holding more water on the surface. llasting of road surfaces is rarely e. Grading is only done when the d becomes impassable. Often water m an entire slope will be channelled o a single drainage causing massive sion due to the greater concentrain of water.

The fourth major cause of erosion is m natural diasters such as hurries. Nothing can be done to prevent s type of damage but the previous ee activities can and do intensify problem.

erutilization of Raw Material

The major part of the commercial d comes from the pine forest. Waste this resource starts at the stump. example, only the very best trees taken and from these only the best s. Logs are cut inacccurately, often ht or more inches too long. This rets in excess trim, often 8-10 pert of the log value. If any defect such as rot is found, the log is left behind.

Waste is common throughout the logging operation and continues into the mill. As referred to earlier, as much as 50 percent of the recoverable wood brought to the mill is lost by over-sizing, poor sawing methods and bad maintenance of the milling equipment. Nominal size 2 x 4's are often cut to 2 1/2 x 5 inches. This is done so that minimum sizes can still be reached with the badly maintained saw mill equipment.

Waste is also indirectly influenced by the marketing process. For example, no attempt is made to sell low grade lumber so that mills do not produce it, resulting in wood being consigned to the burn pile instead of the lumber pile. With hardwood milling, the problems are the same only the relative magnitude of waste is greater. Probably only 10 percent of the merchantable volume on a hectare of hardwood is removed to the mill and only about 50 percent of this actually becomes some saleable product.

The biggest loss of wood, however, results from agricultural activities. Most forest cleared for agricultural purposes is simply burned on the spot resulting in zero utilization.

COHDEFOR controls the sale and export of standing timber by law in Honduras. The established price for pine is $6.00 per cubic meter. Similar material is selling in the United States for approximately $25.00. The low price charged for the raw material induces waste. Several studies have shown that COHDEFOR's marketing is not aggressive and consists of basically taking orders. For example, they do not locate new markets for the wood products nor do they encourage development of new products.

Fire

Fire is a natural part of the pine ecosystem. It is the most important single factor maintaining pine in large

›anses of pure stands. Fire is rare the hardwood stands, but after the :ensive damage to the forest from ·ricane Fifi in 1974 several very ·ge fires occurred in the north coast ıntains.

In essence all fires in Honduras are ısed by people. Fires are started many reasons: preparing land for ming; improving grazing; eliminating ks and snakes; making access easier; ting; and eliminating competition reducing fire hazard due to litter ldup in the forest. Deliberate, icious fires are set but their num- is not extensive when compared with er types of fires. In some cases, h fires are the result of resentment COHDEFOR's activities since the pesino receives little benefit from DEFOR's exploitation of the forest.

Damage from fire is generally ıght to be restricted to young fast- ving pine stands. Fire will gener- y kill or severely damage young :s less than 3 years old. Larger :s often have their crowns scorched lose their leaves, representing a of growth for 2-3 years. Pine are .e resistant to fire and usually are killed outright except when very :g. Older trees are lost when "cat s" develop at the base of the trunk burn through. Losses of trees in re stands may reach two percent in t fire. If this figure is accurate ughout Honduras, the loss of volume to fires in mature stands could be iderable.

OHDEFOR has made great strides in ating and preventing wildfires ıg the last five years. They are developing a program of prescribed ing assisted by a technician pro- d by the Government of Great ıan. Most of the efforts of forest ;ement have concentrated on fire ıntion. Although fire breaks around cultural clearings were rare in , a clearing without a fire break ls rare. Fire towers and areas of :ction have also been established.

ıe Canadian International Develop- Agency has completed a program to create a fire prevention capability with COHDEFOR. Radio communications were improved and equipment to transport firefighters and to combat fires was provided. Technical assistance helped develop the policy and procedures necessary to prevent fires.

Reforestation

The Standard Fruit Company was planting trees in Honduras in the 1940s and 1950s. For example, over 2000 hectares were planted with a number of species. Of special note are the plantations of teak (Tectona grandis), a native species of the subcontinent of Asia (Figure V-3). Teak furnished wood for a furniture market during the 1970s. Although the wood is highly prized a large percentage of the volume was destroyed by clearing for agriculture or for establishment of African oil palm plantations. The teak was cut and burned on the spot.

COHDEFOR has been developing the ability to reforest since its inception in 1970. They have planted more than 3,000 hectares, mostly pine, during the period of 1974-1980. COHDEFOR is becoming quite successful at solving the technical problems of the nursery

Figure V-3. Plantations of teak, *Tectona grandis*, were planted near Rio Lindo by Standard Fruit Company in 1943 for commercial use *(Courtesy of P. Dulin)*.

and planting but has not been able to solve the social/cultural problem of people destroying the plantations by burning, grazing, or pulling up the trees after they are established.

COHDEFOR attempted a large scale project of reforestation, funded by the World Bank, in the southwest part of the country in cooperation with the CONSUPLANE project PRODERO. They established a plan to produce over one million seedlings and to plant 500 hectares. The plantation was a technical success but was soon destroyed by fires and grazing. The people of the region, although willing to plant the pines for pay, were not willing to sacrifice the land for forestry. New plans by COHDEFOR call for emphasis on education, forest protection and natural regeneration.

The broadleaf forests do not readily regenerate under present management practices. At present, management options only include: reserve status; selective cutting; or clearcutting followed by monoculture plantations. Unfortunately, clearcutting, burning and converting the area to crops or pasture is the expedient and most frequently selected use. Other options are apparently not considered. Techniques of strip or patch clearcutting, with the surrounding mature forest preserved until natural seeding of desirable species takes place, offer a potentially viable regeneration system. Agro-forestry methods, such as Taungya, might be used on soils appropriate for agriculture.

Natural regeneration is, and will be, the main process to maintain pine for some time. Plantations of planted pines are not presently feasible except where the natural seed source is absent or to fill in areas of spotty natural regeneration.

Poor Communications Among Organizations

This problem has resulted in conflicting resource use. Planning without consideration of impact on other sectors can adversely affect projects. For example, logging the upper watershed of the Aguan River is blamed in large part for the siltation and flooding in the Aguan valley. In another example CONSUPLANE, responsible for coordinating all national planning efforts, did not participate in 1980 in the preparation of the operation plan for the forestry sector. In fact they did not even receive a copy of the report through official channels but rather only received copies informally. The lack of communication is not only among development organizations but also among departments within the same organization. Coordination between the three operational departments of COHDEFOR, namely forestry, production, and commercialization, is only intermittant at best. Before coordinated development of the forest resource on an ecologically sound basis can be undertaken, communication lines between these agencies must be further developed and used.

Management Deficiencies

The forest manager must consider watershed protection as a major goal and constraint for activities of forest production. While COHDEFOR is directed by Decree 103 to be responsible for watershed management in Honduras, only a few small projects have been started. There is no real commitment to watershed management in logging and road-building or in other COHDEFOR activities. Catchment areas used for water production for cities have been reserved from exploitation in several parts of the country. This is a very extensive form of management and usually done at the insistence of the city, not COHDEFOR.

INSTITUTIONAL OVERVIEW

National Institutions and Key Groups

The institutions that control and influence the management of forest

resources include several government agencies and ministries as well as campesinos and cattlemen organizations. The fact that these different organizations have conflicting interests and difficulty communicating with each other causes problems because the externalities of one project become the economic impact of another project. For example, erosion from logging roads becomes siltation of a drinking water reservoir in the village below, and burning for pasture production eliminates pine regeneration.

COHDEFOR. This is the organization responsible for the development and management of the forestry sector, both public and private. In addition to protection of the national forest and restoration of national forest resources, COHDEFOR plans, promotes and finances the growth of efficient primary and secondary wood product industries. COHDEFOR also contributes to the betterment of the living conditions of the rural population, about a third of which live in the forested areas of the country.

The Board of Directors of COHDEFOR has the following members:

- President of the Republic
- Minister of Natural Resources
- Minister of Economics and Commerce
- Minister of the Treasury and Public Credit
- Minister of Defense and Public Safety
- Secretary of the Superior Committee of Economic Planning
- General Manager of COHDEFOR (nonvoting)

The corporation contains four operational departments directly responsible for carrying out the goals of COHDEFOR: forestry, production, commercialization, and finances.

- Forestry. The Forestry Department has direct influence on a national level and maintains eight different forest districts. These are divided into management units that are responsible for carrying out such activities as silviculture, protection, extension, nursery production, reforestation, watershed management and development of the social forestry system. More than 70 percent of COHDEFOR employees are in this department.
- Production. The Department of Production is charged with the development of the forest industry. They are responsible for controlling wood production nationwide. Services provided are the control of quality and technical assistance to the forest industry of the country.
- Commercialization. The Department of Commercialization is responsible for marketing forest products both domestically and internationally. The principal international markets for COHDEFOR are the Caribbean, Europe, Japan and other countries of Latin America.
- Finances. The job of developing and promoting the industrial forestry sector is assigned to the Finance Department. Strengthening primary and secondary industries requires financing equipment installations that allow optimum utlization of the raw material. Financing exceeded over $7,300,000 during the period 1974-1980.

The strategy for industrial development of the corporation has been to integrate investment from the private and the public sector to create companies such as Central de Aserrio de Siguatepeque, S. A. (CASISA) and Forestal Industrial Agua Fria, S.A. (FIAFSA). The CORFINO project in the forest district of Olancho has been initiated recently. This large scale project affects a considerable area of intensive forest production and reforestation and will require an investment of 150-200 million dollars during the 1981-1985 period.

COHDEFOR has a substantial investment in the Programa de Desarrollo

Forestal de Comayagua. This is a program to amplify the forestry activites of the region. The project covers over 1,200,000 hectares with investments of 15-20 million dollars planned for 1981-1985.

As could be expected in such a large and complex institution, a number of serious problems exist. Major among these are:

- Lack of clearly defined policies, regulations and guidelines. General laws exist, but few have specific regulations.
- Lack of coordination and communication, both within COHDEFOR and between COHDEFOR and other institutions.
- Poor performance in the implemention of plans and decisions.

These problems have created a large and indecisive bureaucratic organization. For a thorough institutional analysis of COHDEFOR see Cliff (1980). Although these problems seem formidable, they can be resolved only if assistance programs by technical and administrative experts develop and implement effective policies and procedures. The result of the internal problems of COHDEFOR is uncontrolled exploitation of the forest, usually with ecologically unsound methods.

COHDEFOR has over 340 trained foresters, about one-third are college graduates and the rest have some technical school training. This group of forestry specialists is among the largest in Latin America. Honduran foresters, while well educated, do not have sufficient practical experience. There are few role models or examples of successful projects for them to emulate. Standards of performance are loosely established and not enforced.

INA. This agency is responsible for implementing the Agrarian Reform law. They also are required to train and give technical assistance to campesinos who have received land under this law.

INA and COHDEFOR have the joint responsibility of delimiting forest lands. Interviews with INA personnel indicate that they are willing to cooperate with COHDEFOR but feel that COHDEFOR must take the initiative.

Past INA projects such as the development of the Aguan River Valley have forced people off valley land into surrounding forest lands. The project has had a high attrition since the "collective" farming approach proved unacceptable to a significannt portion of the new settlers. Also people without identification papers cannot participate in INA programs and are forced to go to the forest when displaced by INA.

MRN. This ministry is responsible for developing the agricultural production of Honduras. The minister is a member of the Directing Board of COHDEFOR and as such has direct input in both the forestry and the agricultural sectors.

The department directly responsible for park and reserve planning and wildlife management, RENARE, is situated in this ministry. There is little communication between COHDEFOR and RENARE.

ENEE. ENEE is charged with the development of the electrical power systems for Honduras. This requires building dams, reservoirs and power lines throughout the country. These activities permanently remove lands from forest production. Power lines and roads provide additional access for colonization of forest lands.

SECOPT. Road construction is a key factor in the development of a country. In Honduras, however, it also plays a major role in the destruction of the forest resource, especially of the broadleaf forest. Road construction causes erosion and removes some land from production. Usually the roads built by SECOPT are well constructed but poorly maintained. The road from Progreso to Yoro, for example, exhibits erosion, slides and clogged culverts. The Yoro Road passes through what was high forest only five years ago but is now largely cut over and planted in

orn and beans. The steep slopes in his area are nearly 100 percent. rior planning could have minimized the roblems associated with such roads.

Cattlemen. This group is a major ontributor to deforestation and other npacts on the forest resource. They ave formed a politically powerful ssociation and are able to influence and management policy at all levels. ne activity of planting former agrilltural lands with pasture grass has cacerbated the deforestation problem / forcing marginal farmers into preously unfarmed forest. In areas of ancho, cattlemen are paying workers cut the forest, burn the wood and ant grass directly without going rough a period of farming.

The Campesino. Although the campeno plays a major role in forest source destruction, he potentially uld participate in the productive nagement of the resource. The role the campesino is discussed in the llowing section, Social Considations In Forest Management.

ternational Institutions

IDB. The IDB is a major source of ids for rural development projects. is the principal sponsor of the ayagua Forest Development projects COHDEFOR as well as of the conuction of the principal road network CORFINO. It has a limited technical iff and often uses organizations such FAO to provide needed technical istance.

U.S. Peace Corps. The Peace Corps long been an important force natural resource development in duras. There have been 34 volunrs assigned to COHDEFOR since 1974. y have filled mostly field positions at present are mostly assigned to s promoting the social forestry tem in rural areas. These people often young and inexperienced; many are just out of school. However, they have earned great respect throughout Honduras and are known to work well under difficult conditions. Lack of experience is the greatest limitation of the Volunteer.

FAO. FAO has the longest continuous experience in Honduran forestry. Experts are often technically capable, have developed some outstanding projects, and are very thorough in planning. A major concern about FAO is its record of inadequate training of local counterparts. After completion of an FAO project, Honduran agencies often find that they do not have the technical skills or experience to continue with project implementation.

AID. After a lapse of more than 10 years AID has expanded its portfolio and now puts emphasis on natural resources projects. The first such AID project in Honduras, the Choluteca watershed management project, is interesting because it requires that several GOH agencies cooperate in its implementation. This integral approach to building resource management institutions should assist in developing better lines of communication.

AID is hampered in its ability to develop and manage its programs because of a lack of technical staff experienced in natural resources program development and supervision. AID/Honduras presently has only one trained forester, a recent graduate.

AID is in the early development phase of a large forest management project with COHDEFOR. This and the Choluteca program would challenge the ability of a highly experienced project manager. AID needs to reinforce its capacity to manage and supervise natural resource development projects.

World Bank. The World Bank has much the same role as IDB in Honduras. Of note is their support of the forestry segment of the CONSUPLANE--PRODERO project for rural development in southeast Honduras.

Government of Great Britian. British aid in forestry has been very successful. An example is the development of a COHDEFOR seed processing facility at ESNACIFOR which now exports tree seed all over the world while providing high quality seed for the reforestation needs of COHDEFOR. Another successful program, that of developing procedures for prescribed burning in pine stands, has been completed. Many of the practices for nursery operation and reforestation have been developed by British program personnel. The secret of their success seems to be tackling specific problems with a few very highly skilled, dedicated people who work closely with Honduran field technicians.

CIDA. The Canadian International Development Agency has worked closely with COHDEFOR in the areas of fire protection, forest inventories, broadleaf forest management, and industry financing. CIDA began funding such forestry projects in Honduras in 1977.

JICA. Japan is the most recent country to provide aid for development in Honduras. Their only project in forestry is an inventory with aerial photographs for the pine areas of La Mosquitia.

SOCIAL CONSIDERATIONS IN FOREST MANAGEMENT

The U.S. Forest Service once was able to carry out its work in nearly complete independence of non-technical, social considerations. Professionals were working in isolated areas where most of the resident population was employed in some aspect of forest management. This all changed in the mid-1960s. People everywhere were questioning technical decisions based on values never before considered important: aesthetics, recreation, wilderness preservation and downstream effects of logging. Even private industry has encountered problems of a social nature. For example, in the state of Arkansas Weyerhaeuser Company found that people resented the company removing the oak/hickory forest and planting pine in its place. Although the local people had no legal title to the land, they surely felt that they had a right to use the land as they had for years for squirrel hunting, for free grazing, and for myriad other uses. Reaction to Weyerhaeuser's operations was equipment sabotage, arson in the pine plantations, and even at times shots fired at the foresters.

These problems are similar to what is now going on in Honduras. Technicians disregard, or do not understand, the needs, desires or customs of the local people when planning the development of the forest. Honduran foresters have not been trained to understand or work with rural people. The forester is often from the city and does not have a feeling for life in the rural areas. Those programs that are developed to aid the forest dwelling campesino are designed to distract him from destructive activities. For example, a campesino is given beehives, hoping that he will make enought money to stop his destruction of the forest. Another example is the establishment of resin collecting cooperatives in hopes that the campesino can reap some economic benefits from the forest. In either case the new activity is economically marginal and does not involve the campesino in the management of the forest or in the major economic benefits derived from forest use.

COHDEFOR has only recently emphasized the needs of the campesino population because of cutural bias and a lack of knowledge or experience in dealing with rural people who, often illiterate, have distinct cultural and ethnic values. The legal mandate of COHDEFOR permits incorporation of the campesino in forest management. The needs and desires of this group of people must be considered in any forest resource development plan undertaken. It is not enough to initate management plans to rectify damages caused by campesino

activities. The campesino must be fully integrated into the management of the forest. He must receive direct benefits for his work there. These benefits could include wage labor, ownership rights, and development of an entrepreneurial feeling toward the forest resource.

An example of a project in which the social factor has been included is the broadleaf forest management project of COHDEFOR, with technical aid from CIDA. COHDEFOR is planning to create a new forest district in 1982 in the project area to give the project greater priority. Included in the project is formation of cooperatives of campesinos to selectively cut valuable trees and to hand saw them into cants for sale to local sawmills (Figure V-4). These cooperatives will also encourage the harvest of wood that would otherwise be burned by the shifting agriculturist.

Reserves of virgin forest are being delimited so that farmers know where they are. Plantations of special use species, such as eucalyptus for fuelwood, are being planted where land is available. In a cooperative venture INA will delineate lands that can be put under agroforestry systems such as Taungya, where management and conventional shifting agricultural practices are combined. However, full implementation of the project is in jeopardy because both CIDA and COHDEFOR have limited budgets. Given the tremendous loss of valuable timber to shifting agriculture each year, this type of effort deserves broader support from the development assistance community.

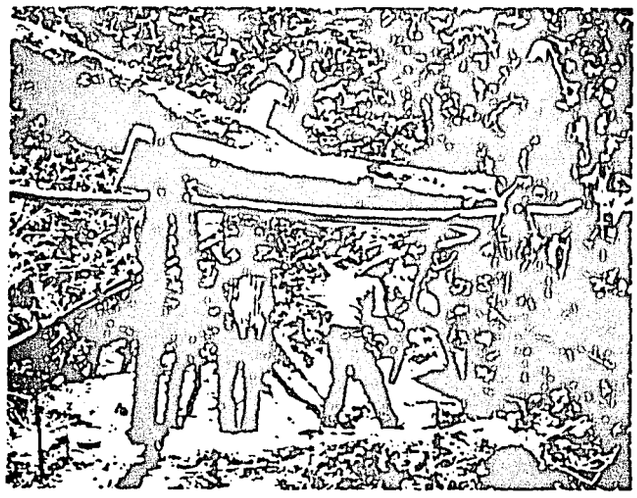


Figure V-4. Traditional methods of pit-sawing timber are still employed by rural people throughout Honduras to furnish their own building materials and to provide a secondary source of income. Such methods are used by campesino cooperatives such as Union de Suyapa shown in this photograph *(Courtesy of P. Dulin).*

REVIEW OF FORESTRY LAWS

The principal laws governing forest management are Decree 85, the Forest Law, and Decree 103, the Law of COHDEFOR. Decree 85 outlines forest conservation and forest management requirements for Honduras. Of special note are the following parts:

- Chapter III--Definition, classification, declaration and administration of forest areas and zones. This section gives the basic rules for classifying forest lands.
- Chapter V, Article 31--Definition of private land ownership.
- Chapter VII--Protection of forest areas. This chapter requires that forest management plans consider watershed, soil, scenery and wildlife uses before approval.

These laws have not been enforced. Many of the law's requirements are unclear because Decree 85 was written before COHDEFOR was created. The responsibilities of COHDEFOR are outlined in Decree 103. Article 8, which designates COHDEFOR as the forest administrator of the state, requires COHDEFOR to select, manage and maintain national parks.

FORESTRY TRAINING

CURLA

This agricultural college in La Ceiba is attempting to develop a

Bachelor of Science level forestry program. They have an impressive list of classes but have very few trained professors. They are located far from the pine forests but very close to the hardwoods. COHDEFOR professionals say that graduates of CURLA (about 10 each year) are not adequately trained and have no practical experience. To give broader field training, CURLA, for the first time in 1981, is offering a field camp in Talanga in the pine forest.

It is questionable whether CURLA can develop a staff of teachers sufficiently experienced to produce well trained foresters within the five year program. Another concern is the lack of employment opportunities for foresters. For example, COHDEFOR now has over 340 trained foresters; new job opportunities are rare; and the private sector only employs a few foresters.

ESNACIFOR

This forest technician school operated by COHDEFOR is a regional school that is attended by students from Central America and the Caribbean. There have been a few students from South America. The school has a good reputation for producing well trained people with emphasis on field work. COHDEFOR has cut the number of scholarships offered to Honduran students to 25. This further reflects the job situation for foresters in Honduras.

The school should include more course work in multiple use management of the forest, range management, watershed management, wildlife management, park management and soil conservation. This well-run school is a valuable resource for not only Honduras but also for the entire Central American region.

REVIEW OF MAJOR COHDEFOR PROJECTS

CORFINO

This project is a sawmill/pulp mill complex that will utilize the last remaining large stands of mature pine. The feasibility studies and management plans were done by the Finnish consulting Firm of Jaakko Poyry. The actual pulp mill has not been selected but the first sawmill is being installed at Bonito Oriental in the north central part of Honduras. The next scheduled installation is a plywood plant. The managers claim the environmental impact of the project is being considered in the planning.

INFONAC

COHDEFOR will conduct a national inventory of the pine areas and produce up-to-date maps in conjunction with IDA. The inventory is essential for forest management planning in Honduras.

Plan Comayagua

COHDEFOR with technical assistance from FAO and financing from IBD is establishing an integrated management plan for the watershed of the El Cajon Dam project.

Choluteca Watershed Management Project

The Ministry of natural resources with AID financing is conducting an interagency project to project and rehabilitate the watershed of the Choluteca River. Some other agencies included are COHDEFOR, INA and National Cadaster. This is notable because of the attempt to form interagency cooperation.

CONCLUSIONS

- COHDEFOR is the key agency for protection, management, and development of the forest resource.
- Interagency territorialism and lack of communication are serious detriments to effective management of the forest resource of Honduras.

- The social considerations of forest resource management are not fully integrated in the management decision process.
- The environmental cost of projects is not generally considered during the project planning stage.
- There is serious underutilization of the raw materials produced in forest exploitation is evident.
- Inexperience and lack of direction are serious impediments to effective management of the forest resource.
- International funding controls the direction of forest resource management in Honduras.

ECOMMENDATIONS

eneral

Strengthen Agroforestry Training. CURLA should abandon the goal of producing foresters and should use their existing capability to produce agriculturists with strong training in forestry, i.e. agro-foresters.

The need to solve agricultural problems in the forests of Honduras requires trained personnel. They could be educated at CURLA. The location of the school is ideal, closely situated to the main areas of destruction of broadleaf forest in the Departments of Colon and Olancho. The need for agro-foresters is region wide. Financial aid and technical assistance will be required to accomplish this goal.

Encourage Cooperation on Projects. Major efforts must be made to force interagency cooperation on natural resource development projects. The Choluteca Watershed Management project, funded by AID is a major step forward in this respect.

Emphasize Social Forestry. All natural resource development projects should include social aspects in their planning. The rural population must be included in the work of management and must receive benefits directly from the forest. The requirements of Decree 103, Chapter II especially Article 25B, D, E, and F stipulate this necessity.

- Include Impact Analysis in Pre-Project Studies. All projects having influence on the forest resource must have some form of environmental impact analysis. This should be required as input for budget preparation by the Ministry of Hacienda and Credito Publico. The ministry should accept no agency budget or internationally funded project that does not have such an analysis.

- Improve Utilization of Forests. Underutilization of the raw material of the forest resource requires excessive cutting. Estimates of over 60 percent waste in the pine forest indicate that better utilization of this resource could effectively increase the Gross National Product of Honduras and would extend the life of the forest industry of Honduras. Improved utilization of the pine resource should include:
  - Increasing the stumpage value to represent a residual value based on conversion costs and product value.
  - Basing timber sales on lump-sump appraisals of the stumpage value.
  - Setting nominal lumber sizes with maximum and minimum size limits.
  - Providing technical aid to mills to improve the efficiency of conversion of roundwood to lumber.
  - Converting wood waste to energy.

  The broadleaf resource will require better access to the areas, satellite mills and improved marketing of commerical woods. Fuelwood production will become important.

- Include Regulation, Technical Aid and Coordination Components on All Forest Projects. The following considerations should be included in all forest management projects for Honduras.
  - Decrees 85 and 103 must have regulations to spell out responsibility and authority to manage the forest. These regulations should then be enforced on forest management projects.
  - Technical aid for administrative functions of Honduran agencies is needed. All natural resource development projects must recognize this fact.
  - To assure better coordination among the various international funding institutions, periodic meeting of the counterpart leaders are required. AID should initiate these sessions.

Specific Projects

- Implement Broadleaf Forest Management Project. The COHDEFOR/CIDA broadleaf management project can serve as a pilot for a much larger project. Because of the diverse problems, the large area of broadleaf destruction and the level of funding required, a multilateral interagency project is recommended to include:
  - Agro-forestry system development.
  - Satellite mills to utilize the raw material.
  - Social and physical needs of the people such as schools, medical facilities, and roads.
  - Reforestation.
  - Park and reserve identification.
  - Bilogical studies of a taxonomic and ecological nature.

- Implement Special Projects in Pine Savannas. The Mosquitia area has over 900,000 hectares of very thinly forested pine lands. The main management problem is control of fire. With the exception of the gallery forests along major rivers, little agricultural potential exists since the soils are of low, productivity. The land is generally flat with slightly rolling hills.

  The low cost of forest management and extraction and the low possibility of other uses makes this area ideal for forest management. Large areas can be stocked from natural seed fall from the native Pinus caribaea, and field-tested reforestation with bareroot Pinus caribaea seedlings can be accomplished when no seed source exists. The area could be a major producer of softwoods by the year 2010 if put under management today. Problems are posed by limited access and political problems with Nicaragua.

- Prepare Integrated Forest Management Plan for Pine Forests in Central Honduras. COHDEFOR is now at the stage where rapid forestry industry growth is waning and stagnation is beginning. A program to take a large area of young forest and establish prudent forest management practices that include the people of the region would set an example of how forest managment should be implemented. AID and COHDEFOR have begun a pilot project to address these concerns.

VI. WATERSHED MANAGEMENT

WATERSHED PROBLEMS AND RESULTANT CONSTRAINTS ON DEVELOPMENT

The importance of good watershed management in Honduras for the production of water for domestic and industrial needs, agriculture, hydroelectricity, and freshwater and estuarine productivity cannot be underestimated.

Geomorphic processes have created a heavily dissected system of drainage oriented primarily to the North with approxiamtely 85 percent of the total land-area draining into the Caribbean Sea. Figure VI-1 illustrates the major drainage systems of Honduras. Population density and the resulting demand for water is not in proportion to the available water supply. Domestic water is rationed in Tegucigalpa, Comayagua, Siguatepeque and most cities in southern Honduras at least seven months out of the year. In addition to domestic use, water is extremely important in Honduras for the generation of hydroelectricity which accounts currently for 90 percent of all electricity consumed in the country. In the major valleys of Choluteca, Talanga, Comayagua, Sula, Aguan and along the Atlantic littoral region there is heavy demand on surface waters for irrigation of commercial crops such as bananas. Stream-fed estuaries on both the Caribbean and Pacific Coasts are nurseries for fish and shellfish species which are important for domestic consumption as well as for export.

The Government of Honduras has on paper the institutional infrastructure to address watershed management problems in the country. Its organizational and executive capabilities are inadequate to reverse the current trend in resource degradation. Ambiguity in actual laws dealing with watershed management has led to jurisdictional conflicts among the land-managing agencies. The absence of a land-use capability system acceptable to all land-management organizations and applicable to all land development plans and activities, has led to uncontrolled, inappropriate uses of the land. Inappropriate land use is causing the rapid deterioration of the principal watersheds of the country resulting in the degradation of the productivity of soils, forests, and aquatic ecosystems with resultant longterm impacts on the economy and quality of life.

Pressure by campesinos on the steeply sloping upper watershed areas has led to their widespread degradation. The government's inability to either control deforestation or offer the campesino viable alternatives is leading to the loss of soil productivity through leaching and erosion, downstrean sedimentation and flooding, decreased water quality and loss of aquatic ecosystem productivity. Reversal of this trend in watershed deterioration is an essential element in avoiding the entrenchment of underdevelopment and a closed cycle of poverty in Honduras.

Watershed degradation is human induced, stemming from inappropriate use of the land resources. The direct causes are deforestation and uncontrolled slash and burn agriculture on marginal lands. Indirect causes are:

- Lack of an effective legal and technical basis for regulating the use of land.
- Lack of natural resources information, absence of attractive alternatives to current agriculture practices.
- Lack of trained personnel needed to adequately manage land and water resources.

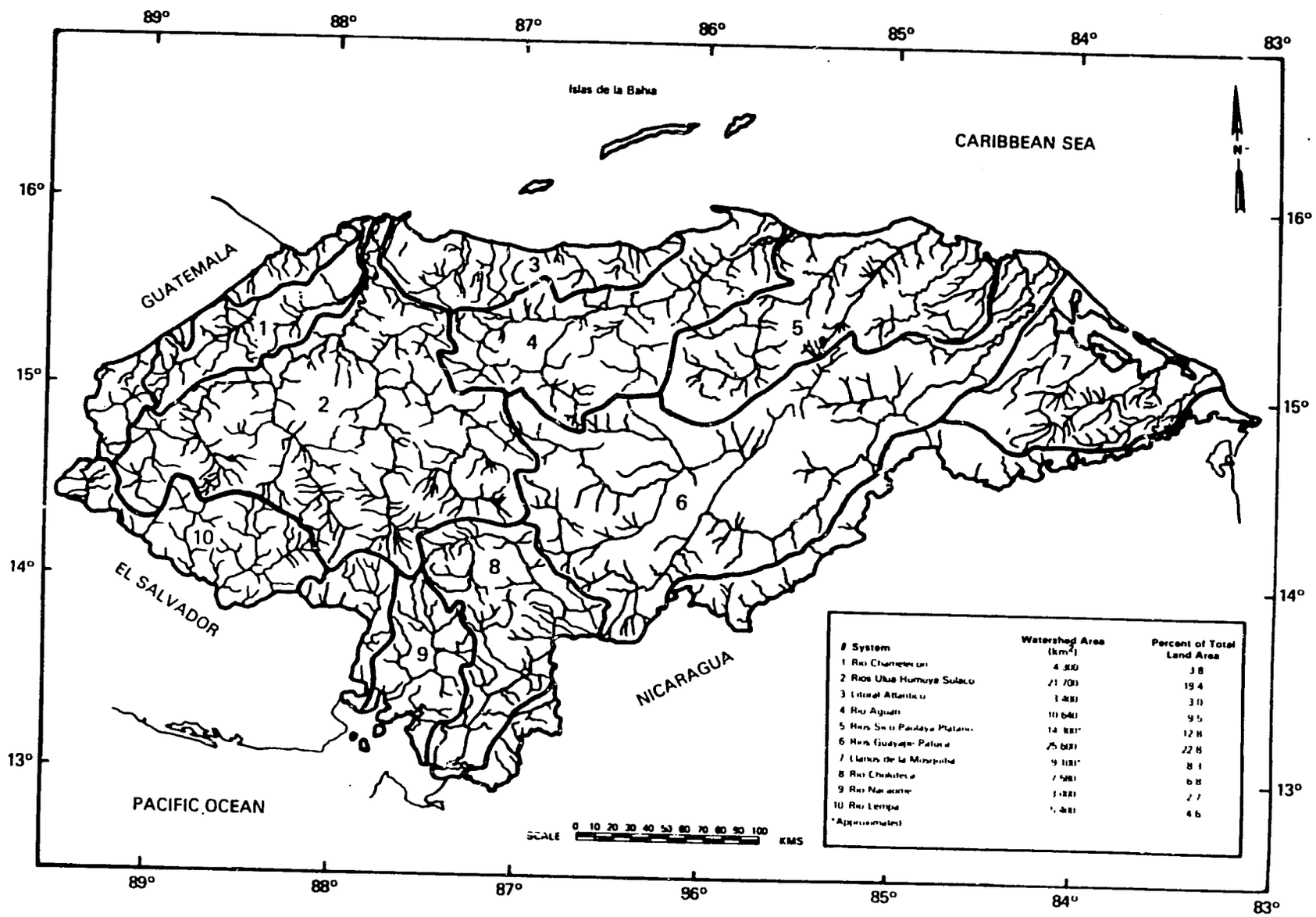


Figure VI-1. Principal drainage systems of Honduras.

- failure of research and educational institutions to focus on human and technical problems of watershed management.

Deforestation

Of the estimated 9.5 million hectares of land actually suited for forest 2.2 million have been deforested. Soil erosion rates on lands once covered with forests have been accelerated to the point that estimated soil losses in some areas of the country average from 100 to as much as 500 metric tons per hectare annually. Eroded lands have increased from 3.5 percent to 6.8 percent of total land area in the 5-year period from 1972 to 1977. Roads on steep slopes are poorly constructed without regard for natural drainage or differing soil and geologic characteristics, causing accelerated erosion, slumping and landslides. Shifting cultivation and cattle grazing also contribute to gullying and mass movement (Figure VI-2). Eroded soils cause the sedimentation of local streams, fouling water supplies, silting of reservoirs, and an increase in the potential for damaging floods. A secondary impact, more serious in the long-term, is that roads provide increased access to previously inaccessible areas for shifting agriculture and grazing. A particularly serious case is the San Esteban-Bonito Oriental road which has resulted in a large area, suitable only for forestry, being cleared for agriculture.

Figure VI-2. The advance of pasture and agriculture onto steep slopes results in an increase in mass movement as depicted in the Choluteca River watershed *(Courtesy of P. Dulin).*

Increased runoff from deforested lands can cause greater than a tenfold increase in the peak flows in streams after heavy rainstorms. Eroded soils cause the sedimentation of stream channels, reducing their carrying capacity. This factor coupled with increased peak flows results in increased flooding in downstream valley areas. The following are some instances of flooding attributed in part to inappropriate upstream land use and deforestation:

- Flooding in the Sula valley (drainage of the Ulua and Chamelecon rivers) causes an estimated 33.5 million dollars damage annually to agriculture and infrastructure over a geographical area of 370 square kilometers.
- RENARE estimates that the value lost to erosion and loss of soils and flooding in the Aguan river and Atlantic littoral watersheds is in excess of 4.5 million dollars per year, a figure which is considered very low because it does not include all watersheds.
- Annual floods in the Choluteca river valley damage 3,400 hectares of prime farmland and pasture.
- Floods in the Atlantic littoral region in 1976 caused an estimated 1.3 million dollars of damage to roads and houses in the La Ceiba area. The same year, floods in the Aguan river valley caused 1.7 million dollars damage to infrastructure and extensive damage to commercial crops.
- Floods resulting from the heavy rains of hurricane "Fifi" in 1974 were the worst on record

throughout the country, killing approximately 12,000 people, primarily in the Sierra de Omoa area; causing an estimated 150 million dollars damage in the Sula valley; and flooding nearly 470 square kilometers in the Choluteca river valley.

Land Use Policy

Mandates exist for COHDEFOR to regulate the use of lands suited for forests, for the MRN to regulate use of agricultural lands (See Chapter IV), and for INA to carry out the agrarian reform law. Because of the ambiguity among mandates, poor communication among the various agencies, and the absence of criteria for good land use planning and management, control of destructive land use practices is difficult to achieve.

Although several laws and decrees have been promulgated by Honduras in order to protect and maintain watersheds, they are not effectively implemented. Under the MRN's 1972 Forest Law (Decree 85) there is a mandate that there be "....promotion of multiple use of forest areas; including recreation, maintenance of certain wild flora and fauna, regulation of grazing and pastures, water production, and the conservation, restoration, and stabilization of soils." The same law has established protected forest reserves in the following areas: the mangroves of the Gulf of Fonseca, Montana del Cuzuco, Guanaja Island of the Bay Islands, The Pelo river watershed in the Department of Yoro, the watershed of Lake Yojoa, and La Tigra Mountain near Tegucigalpa.

In 1974, a new Forest Law (Decree 103) created COHDEFOR as the national forest agency and transferred to it all forestry functions previously executed by the Ministry of National Resources. COHDEFOR is mandated to "...execute permanent and systematic works for the protection of the forests against fires, plagues, infirmities, destruction by overgrazing, and t prevent accelerated erosion of soils, and to "...execute directly, or i collaboration with other relate organizations, the indispensible worl for the protection of watersheds." COHDEFOR is the legal principal in the execution of watershed management activities, protection and maintenance of forest reserves. Unfortunately, neither Decree 85 nor 103 specifies the need or framework for management plans. Consequently to date, COHDEFOR has not developed a national watershed management policy or plan, nor has it formulated management plans for forest reserves.

A major problem in the promotion of appropriate land use is the absence of an acceptable, adaptable land use capability classification for the country. Without this tool it is nearly impossible to develop integral plans for good land management, agrarian reform actions, agricultural development, and forest management. Based on physical resource data (climate, soils, vegetative associations, slope, etc.) land should be classified as to its capability - i.e., capacity to support certain uses. This information in annotated map form could then be used as a basis for making land-use management decisions by all agencies concerned. Jurisdiction of each of the land management agencies would then be mandated according to appropriate use. It is hoped that such a tool will be developed as part of the Natural Resources Management Project financed by AID.

Lack of Natural Resources Information

The accelerating rate of deforestation renders obsolete estimates of forest cover before reports are published. As a result forest industries are planned to use nonexistent resources and the useful life of reservoirs is overestimated. Priorities for resources development and conservation cannot be formulated

without frequently updated information on vegetation cover and the rate and location of deforestation. The lack of soils information has led INA to situate campesino groups in areas of unproductive and erosion-prone soils. Bridges are continually being destroyed in the Atlantic littoral region, their design being based on poor hydrologic information. In addition to the problem of scarce information, existing data are inadequately searched or used, field surveys and interviews are not conducted to supplement the data base.

Training, Research and Extension in Watershed Management

Although there are several educational institutions that deal with forestry, agriculture, and land management, their capacity to conduct training and research addressing the problems of watershed management is limited. The Forestry School in Siguatepeque is producing a number of technicians in forest management and wood industry, but has not found funding for a program in watershed management. The University Center of CURLA has a forestry program designed to train forest management and wood products engineers but lacks watershed management expertise, and an agricultural program producing agronomists oriented toward commercial production with no emphasis on small farmer technology (i.e., hillside farming). The Pan-American Agricultural School also addresses commercial agriculture. Thus, the real problems of watershed degradation, namely shifting agriculture and cattle raising by ever-increasing numbers of campesinos, are being ignored by the educational institutions. Neither experiment stations nor extension programs address the campesinos' need for alternative agricultural technologies. Underlying the failure of the above institutions to address watershed degradation is the government's unwillingness to give priority to resolve the problems or to initiate collateral actions in the areas of land tenure reform and family planning.

WATERSHED MANAGEMENT IN HONDURAS

The following section presents a succinct description of recent watershed management projects and programs in Honduras. Also covered are projects and organizations which have (or will have) an impact on watersheds. A critique follows the description of each project and serves to further define problem areas, weaknesses, or successes of the projects. Figure VI-3 illustrates the areas affected by the projects mentioned.

Integrated Watershed Management Project in the Northwest

Project Description. This project was an outgrowth of the UNDP-FAO-COHDEFOR project: "Planning and Implementation of the Correction of Watersheds Affected by Hurricane Fifi." The project was started in 1976 with the objective of stimulating a change from the inappropriate land uses on steeply sloping land of the Sierra de Omoa mountain range West of San Pedro Sula (No. 1 in Figure VI-3). Damages and death from the hurricane in the area were much higher because of the extensive deforestation on the higher mountain slopes and resulting increased flooding and landslides. Project activities were later expanded to the Lake Yojoa watershed in 1978 and Macuelizo in 1978 (No. 2 and 3 in Figure VI-3). The project involved multilateral technical and financial support to COHDEFOR from FAO, and technical personnel support from the U.S. Peace Corps. Principal activities over the three management areas in the project, Sierra de Omoa, Lago de Yojoa and Macuelizo, involved:

- soil conservation projects on 361 hectares

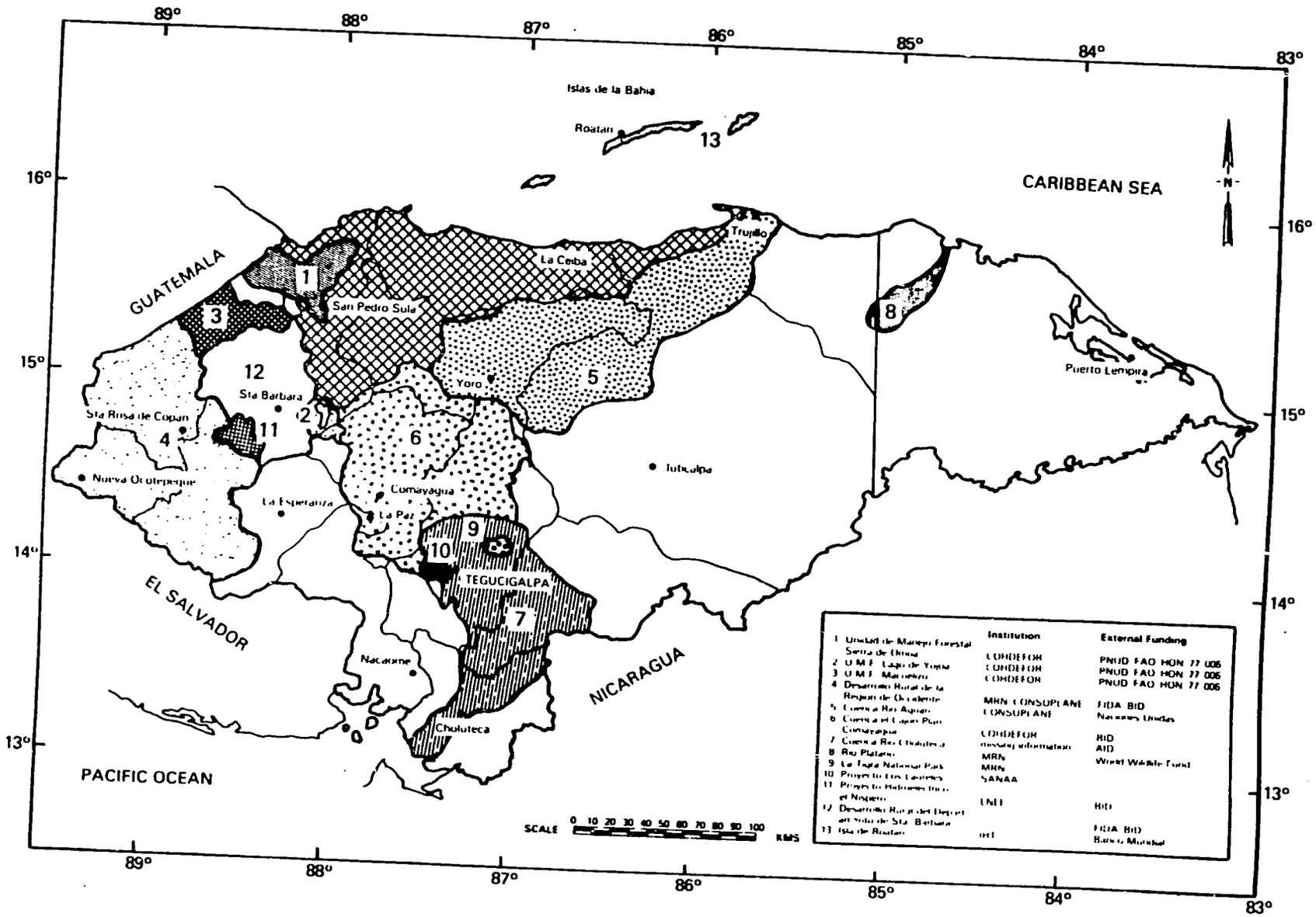


Figure VI-3. Projects of watershed management importance.

- agricultural extention for crop improvement and diversity
- reforestation of mostly fuelwood species on 467 hectares, and
- forest protection (fire prevention and cutting permits).

The project strongly emphasized social forestry and the development of a communication and information system well adapted to the 1834 campesinos in 70 aldeas in the project areas. The project produced 11 useful manuals and publications developed during the 5-year project life (until Feb. 1981). These publications provide a technology package including social action and communication, soil conservation, agricultural extention, reforestation, economic analysis, and watershed management planning (See List of Publications in Table VI-1). The project is still being supported by COHDEFOR without international assistance in its northwest forest district where the project teams include 25 persons distributed over the three management areas. Due to current fiscal problems at COHDEFOR, the future of the project is questionable.

Critique. This project's most important contribution to watershed management in Honduras was that it addressed the overriding watershed problem of shifting agriculture at its source--the small subsistence farmer. It made important advances in the introduction of management techniques of hill lands that approached an economical alternative to shifting agriculture. It succeded in developing a simple yet effective social action-extension program serving as a model that has influenced other promotion programs in the country. The transfer of the technology to technicians in COHDEFOR, but especially to campesinos, has been at least marginally effective and represents an important first step in the development of a social action scheme for watershed management activities.

The limitations of the project were related to its failure to convince the COHDEFOR leadership of the importan of project activities to the manageme of forest lands. Administrators we not convinced of the project's wid spread applicability. In some i stances, the project perhaps overd its objectives. For example, terra construction requires a heavy inves ment of both time and labor in propo tion to the amount of watershed pr tection acquired. Hillside ditches most cases are just as valuable f protection but involve less work. Tl introduction of cropping practices a new crops to better protect wateshe was ill-conceived from an economic a cultural perspective. Lack of accep ance and unprofitability has cause some campesinos to return to trad tional shifting agriculture, growi corn and beans. The food-for-wo incentive program bought participatic only as long as the food was available Extension of conservation practices a new crops to new areas was not seen a profitable or culturally acceptable t campesinos.

Watershed Experiments in the Los Laureles Watershed

Project Description. The Lo Laureles watershed supplies the capita city of Tegucigalpa with 60 percent o its domestic and industrial water (No 10 in Figure VI-3). COHDEFOR, wit assistance from the U.S. Peace Corps began a series of watershed managemen experiments and pilot management proj ects in order to assess the potentia of reservoir sedimentation. Thes experiments were the first in th country to estimate the impacts o different land uses on watersheds, t assess impacts of erosion and run-of characteristics from roads and land under different land uses, and t measure sedimentation rates in streams. The most important contribution of the project is its providing scientific evidence in Honduras that inappropriate land uses and road construction ca lead to increased erosion and

TABLE VI-1

INTEGRATED WATERSHED MANAGEMENT PROJECT PUBLICATIONS

Working Paper No.		
1	Michaelsen, T.	Un sistema de clasificacion de la tierra por capacidad de uso para tierras marginales.
2	Camino, V.	Estimacion de costos y beneficios de la reforestacion y la conservacion de los suelos en el Noroeste de Honduras.
3	Michaelsen, T.	Manual de conservacion de suelos para tierras de ladera.
4	Rodriguez, E.	Manual de cultivos multiples en obras de conservacion de suelos.
5	Bauer, J.	Guia de reforestacion en comunidades rurales.
6	Dongelmans, L.	Analisis financiero de reforestacion para lena y de cultivo en terrazas.
7	Bauer, J.	Plan de manejo, Sierro de Omoa.
8	Gonzales, L.	Guia para el uso de filminas.
9	Rodriguez, E.	El cultivo de frutales en obras de conservacion de suelos.
10	Wiff, M.	Manual de comunicacion para el desarrollo rural en tierras de ladera.
11	Michaelsen, T.	Informe final del proyecto de la ordenacion integrada de cuencas hidrograficas.

degradation of soil resources, increased run-off, sedimentation of streams and reservoirs, and increased flooding.

Critique. Even though the experiments at Los Laureles illustrated the need for good watershed management practices in order to insure the quality and quantity of water entering the municipal reservoir and to insure its useful life (i.e., prevent sedimentation), the government has failed to heed the information and has to date done little to manage the Los Laureles watershed. Siltation of the reservoir continues making its economic life questionable. Nutrient build-up in the reservoir has accelerated the spread of water hyacinths and other aquatic plants, restricting use of surface waters and accelerating evaporated losses.

Integrated Rural Development Program of the West (PRODERO)

Project Description. PRODERO was created through cooperation and funding of the Inter-American Fund for Agricultural Development and the IDB, and with technical assistance through the Organization of American States (No. 4 in Figure VI-3). The program being carried out by the MRN began in 1979 with a forestry component involving COHDEFOR. Initially, 500 hectares of pine were reforested in the Santa Rosa de Copan area, but were eventually lost because of a failure in the collaborative effort between COHDEFOR and the target group - the campesinos. The project objectives have been to spur rural development in the area by creating "agricultural committees" at the local level. The integrated program involves nearly all aspects of development including agricultural extension, reforestation with fuelwood, soil conservation, social action, health, nutrition, infrastructure and markets. The integrated rural development program of Santa Barbara (No. 12 in Figure VI-3) is being developed along the same lines with the same funding organizations using CONSUPLANE as the program executor/administrator.

Critique. Although it is too early to critique the operation of PRODERO, the organization of groups at the local level for purposes of integrated development involving all aspects of the local socioeconomy appears to be an excellent approach to the problems of underdevelopment. The success of the project will depend on the collaboration of the various government agencies, a process that has not occurred to date.

Integrated Rural Development of the Bajo Aguan Valley Region

Project Description. This project, initiated in 1979, is primarily funded and executed by UNDP, involving CONSUPLANE as the counterpart executor. The objectives of the project are to:

- increase knowledge of the natural and human resources of the area.
- establish a regional planning system for purposes of the study and development of the region.
- coordinate government agencies working in the area as dictated by the regional and national plan.
- increase investments in the region within the framework of the plan, thereby assuring productivity of the program.

Specific projects include: studies for a system of dikes for flood control; dams for flood control, irrigation, and electrical energy production; regional and urban development studies and plans; and a watershed management plan (soil and water resources management). The project area includes that of the Aguan Valley, the location of the largest agrarian reform project coordinated by INA (No. 5 in Figure VI-3). The watershed management component has involved the preparation of maps related to drainage, land use, topography, which allows the comparison of actual and ideal land use. A diagnosis for future studies and management plans are also included.

Critique. Emphasis in the project has been given primarily to costly infrastructure to control floods within the valley instead of the upstream areas of the watershed where shifting agriculture and deforestation are exacerbating an already serious flooding situation. The watershed management component in the upper stream segments should be given an equal if not higher emphasis in the project.

Natural Resources Management Project

Project Description. This project is being carried out through a series of loans and grants provided by AID and

londuran contributions. The project as two major objectives:

- to strengthen Honduran institutions' capacity to better manage the country's natural resources.
- to implement a watershed management program in selected subwatersheds of the Choluteca river to increase farmers income through the development of improved agriculture and forestry practices designed to conserve soil and water resources.

Specific to the first objective, the ·oject aims to develop a natural source management policy based on a tential land use classification and improved resource data base which is rrently being developed as a result another AID supported project - The tional Cadaster Program. The key to is objective is:

- to establish an effective resource development organization which would bring together the various resource management agencies
- to study and collate existing land use policies and resource management laws into a comprehensive and effective package
- to develop and propose new and needed laws and regulations
- to administer the natural resource management institutions.

The second objective is to test agement approaches to assist in eloping a national policy. Prinal components of the "Management of Choluteca River Watershed" project l focus on activities to reduce sh and burn hillside farming and zing practices and encourage .onal use of the land (No. 7 in ıre VI-3). The project has the .owing goals:

- to reforest 13,000 hectares with pine and fuelwood species
- to promote soil conservation practices and structures, and improved cultivation on 18,000 hectares
- to improve pastures on 5,000 hectares, all within 5 years.

Critique. The overall design of the natural resources policy and planning objectives is a valid approach to the problems of resource management in the country. The support intended for the national agricultural planning commission is a positive step toward improving upper level planning and decision making. The development and eventual promulgation of the land-use potential classification system should provide a valuable tool for institutions involved in the management of land.

The watershed management plan overstates the government institutions' capacity for such development activities. As was shown in the FAO/COHDEFOR Integrated Watershed Management Project, only 361 hectares were treated with soil conservation practices and 467 hectares were reforested during the five-year project life. The goal of reforesting 13,000 hectares and improving 23,000 hectares in the Choluteca project seems overly ambitious. Furthermore, the project document supplement on watershed management fails to describe in sufficient detail the coordination needed for project implementation.

The El Cajon Hydroelectric Project

Project Description. The 650-million dollar hydroelectric project is being funded through loans provided by a consortium of lenders led by the IDB. As a condition to the IDB loan, the Bank initially required the development of a watershed conservation plan that would insure the useful life of the project. The COHDEFOR Watershed Management Unit began the background work on a management plan for the 8,320 square kilometer watershed and a clearing plan for the 90 square kilometer reservoir area in 1978. A pre-feasibility plan was drawn up and submitted to IDB in March of 1979. An interinstitutional workgroup was formed in 1978 as directed by the chief of the state, to handle problems of infrastructure, agricultural extension,

forestry, health, relocation of families within the reservoir area and ecological studies. The interinstitutional workgroup was to address the complex problems of development that would be brought about by the construction and operation of the huge hydroelectric facility. The group has not met in over a year. No plans have been made for relocation; no plans have been made for the clearing of the reservoir; and no environmental or socio-economic impact studies of appropriate scale have been performed. As for the watershed management plan that would promote the appropriate use of land, soil conservation techniques, reforestation, and social action and consciousness-raising, an effort was made to employ the concepts developed from the integrated watershed management project (FAO/COHDEFOR) in the management of the watershed of the El Cajon Project. This approach would take advantage of techniques developed over a 5-year period and would have include physical and socioeconomic characteristics that were stipulated in the pre-feasibility plan prepared by COHDEFOR and presented to IDB.

In the interim, the Plan Comayagua (No. 6 in Figure VI-3), a project funded by a $10 million loan from IDB, offered to combine efforts with the proposed watershed management strategy in order to demonstrate a more comprehensive organizational approach to the critical issues. A forest management plan would provide for the reforestation of over 40,000 hectares of pine lands within the watershed as well as the harvest of existing mature timber. IDB sent a mission to Honduras and recommended that the watershed plan was not needed and dropped their previous offer to fund it.

As of July 1981, the Plan Comayagua has no socioeconomic plan of action written into their activities although forestry projects are being considered for possible implementation in the management area. Regardless, there is no money allocated at this time from COHDEFOR or IDB to provide for management of a watershed that drains 8 percent of the total land area of Honduras.

Critique. The first and obvious question is: Why risk 650 million dollars on a hydroelectric project when the watershed is being degraded by activities of deforestation, shifting agriculture, and erosion and sedimentation? The answer is less obvious. Over the last century, hundreds of such hard lessons have been learned as reservoirs have been silted up or have undergone eutrophication as a result of activities in upstream watersheds (Figure VI-4). It is an act of negligence on the part of the funding agencies to ignore the very real problems of watershed management in the El Cajon watershed. Construction of the dam began in 1980, and the gates are due to close and the dam to begin filling in 1985. As of yet no plans have been made for the relocation of families, the cleaning of the reservoir area (something that would take two years to accomplish), nor the handling of the influx of people into the watershed area and resulting resource management problems. Poor watershed management is very likely to negatively affect the useful life of the reservoir and its economic viability.

GENERAL WATERSHED-RELATED ACTIVITIES UNDER COHDEFOR

As explained earlier, COHDEFOR has the principal responsibility of directing watershed management activities in Honduras as directed under Forest Laws 85 and 103, those dealing with lands suited for forests (i.e., lands with slopes of greater than 15 percent). COHDEFOR currently has five programs under its Forests Department which are watershed management-related and are briefly described below (these

Figure VI-4. Narrow deep river gorges such as shown for the El Cajon dam site offer potentially valuable locations for hydropower production. Such sites, however, require well-planned watershed management programs to sustain the life of the impoundment by reducing sedimentation *(Courtesy of J. Dickinson).*

functions are more fully described in the Forestry Chapter V).

Watershed Management Section

The Watershed Management Section was created in 1976 to deal directly with land-management related problems of soil and water resources. This Section was responsible for the Los Laureles Watershed Management Project and the Integrated Watershed Management Project of the Northwest. The focus of the Section has been primarily on social problems and land use, small farmer agriculture and related deforestation-a result of the Integrated Watershed Management Project. The Northwest District is charged with the ongoing integrated project and has 25-30 technicians working in social action, soil conservation, and reforestation with fuelwood species. The Central Office has four technicians with advanced degrees to handle mid-level management responsibilities and who are currently without major project responsibilities. The Section has not to date worked on incorporating watershed concepts into forest management plans in the various districts.

Fuelwood and Alternative Energy Sources Project

This cooperative project between COHDEFOR and CATIE began in 1980 and has to date collated growth rate information on existing native and exotic tree plantations (fuelwood species) and is currently completing a domestic fuelwood-use survey to determine areas of critical fuelwood shortages. The objectives are to develop techniques and plans for small- and large-scale fuelwood plantations for critical fuelwood areas in Honduras, thereby providing a renewable energy source and avoiding continuing deforestation associated with fuelwood collection. Several pilot plantations using essentially exotic species will be planted in the critical areas and will be monitored for growth rates and acceptability to the consumer. The project to date, employs two forest engineers and has had only limited support from COHDEFOR.

Another element of this project is being carried out with support of the ICAITI through the Center for Industrial Development in Honduras. This element will disseminate information concerning more efficient fuelwood stoves (such as the "Lorena") and carry out workshops and demonstration projects to stimulate their use in the rural areas.

Social Forestry System

Since its beginning in 1975, the Social Forestry System has organized 127 groups of campesinos consisting of some 4,500 families in projects of resination, gum and chicle extraction, artisan pit sawing of hardwoods and pine, and honey production. Recently the system is promoting the use of the "Lorena" stove in rural areas in order to reduce the amount of wood used in domestic cooking. A special program co-sponsored by the European Economic Commission is the "indigenous program", involving five tribes of the Jicaque

Indians in the Department of Yoro. The orientation of the program is one of social action for the integration of the people living in the forests into local forest management plans.

Forest Protection Unit

The historical focus of the Protection Unit has been on extinguishing forest fires and related protection activities. Not until recently has the Unit begun to attack the root of the problem--the campesinos and cattlemen. Nearly all fires are human-caused, originating with slash and burn activities, burning for pasture clearance, or arson. The Unit is now using communication packets developed by the Integrated Watershed Management Project in an attempt to educate the campesino regarding the importance of the forests.

Broadleaf Forests Project

This project was begun in 1978 with the support of CIDA with the principal objective of controlling the advance of shifting agriculture into the broadleaf forests. It is located in the northeastern part of the country from the southeast of Catacamas, north to the Departments of Olancho and Colon. Its goal is primarily to insure the existence of the wood resource for commercialization at COHDEFOR's sawmill at Bonito Oriental (CORFINO Project).

Activities of the project include social action among the campesinos of the region to promote alternatives to slash and burn practices including agricultural extension, alternative employment opportunities (crafts, pitsawing of timber), reforestation with plantations of fuelwood species, introduction of "Lorena" stoves, and production of charcoal.

A unique feature of the project is its establishment of "breech-lines" or borders to delineate the limits of the forest reserves. Those already living within the reserves are incorporated into the project through social action (see Social Forestry System), while the others are restricted from access. A series of patrol roads facilitate the vigilance of the reserve by forest guards.

ESNACIFOR

Though semi-autonomous, this school is actually subsidized by COHDEFOR and has recently been accorded the role of a department in its organizational structure. Created in 1969 with the assistance of FAO, the school offers programs of forest management and forest industry. Although no formal watershed management program exists at the school, courses that treat the topic are a routine part of the two programs. The school is currently working with the city of Siguatepeque in a program to resolve problems of municipal water supply caused by the deterioration of watersheds that supply the city's water.

The school has offered a number of national and regional watershed management short courses and seminars, providing a forum for the dissemination of watershed management information and expertise. Since 1979 when the School prepared a proposal for a watershed management curriculum as the third basic program, it has been trying to obtain funding. The program would contain both a forest management-related element and a small farmer element (social forestry).

OTHER ORGANIZATIONS AND ACTIVITIES RELATING TO WATERSHED MANAGEMENT

ENEE

ENEE is mandated to provide electric energy services to the country. Among its particular functions are the

planning and execution of projects to meet present and future electrical energy demand. The company is constantly upgrading facilities and extending electrical service to rural areas. Two hydroelectric projects are now under construction that, when finished, should satisfy electrical energy demand through the year 2000: El Cajon (described previously) and El Nispero. As far as could be detected, ENEE has no management plans for the watershed of El Nispero (No. 11 in Figure VI-3). The results of deforestation and shifting agriculture, namely increased erosion, sedimentation, and eutrophication, could interfere with the operation of the diversion dam and tunnel and interfere with the turbines.

Another example of a watershed where an adequate management plan has not been employed is Rio Lindo/Lago Yojoa. The Lago de Yojoa-Rio Lindo hydroelectric system uses the 330 square kilometer watershed (No. 2 in Figure VI-3) for water collection and the 90 square kilometer Lake Yojoa for water storage in generating presently 90 percent of Honduras' electric energy. Even though the watershed has been declared a forest preserve there has been only a nominal effort for its protection by COHDEFOR.

Based on an estimated 2,800 Megawatts of total hydroelectric potential for Honduras, ENEE has projected other large and small hydro-developments to address future demands. Development of these and past projects has been carried out with loans provided by international development assistance banks, and the project planning and construction has been carried out by international contractors.

U.S. Peace Corps

The Peace Corps has been working with COHDEFOR since its inception in 1974. Approximately 25 volunteers have been working in various watershed management-related projects with COHDEFOR including the Los Laureles and the Integrated Watershed Management Project and the Social Forestry System. These volunteers have provided valuable service in watershed experimentation, soil conservation, reforestation, social action, and agricultural extension. Some 10 volunteers are now working with COHDEFOR in social forestry projects involving environmental education, alternative activities for campesinos such as pit-saw use, apiculture, alternative agriculture, agroforestry, construction of efficient fuelwood stoves.

A total of seven Peace Corps volunteers worked with the National Cadaster Program in the collection of natural resources data. Such programs were later dropped from Peace Corps programming because of the lack of immediate village-level impact.

CURLA

The programming focus of CURLA is on commerical production of agricultural and forestry products. AID is supporting the University with grants for infrastructure and equipment improvements and has provided scholarships for its students to foreign universities. AID is studying the possibility of hiring an administrative aide for the Center and has recently approved funds for the hiring of a Honduran master's-level sociologist and agricultural economist to reinforce those educational aspects. AID is currently offering nearly 50 scholarships to foreign universities in various natural resource and agricultural fields. These are administered through CURLA.

Watershed management is not a formal part of the curriculum but represents a part of the other programs (forest management, forest industry, agronomy) with a multiple-use focus on soils, ecology, hydrology, and reforestation. There is no programming, however, addressing the concerns of the small farmer. According to school officials there is very little collaboration with

COHDEFOR in the school's forestry program.

La Tigra National Park

Situated northeast of Tegucigalpa, Honduras' first national park has a multiple function (No. 9 in Figure VI-3). Besides providing a recreational/educational service to the community, it also includes the cloud-forest watershed that supplies 30 percent of Tegucigalpa's domestic water needs. RENARE is maintaining the park with a small budget. The watershed is demarcated with fencing and guards; however, human settlements are rapidly surrounding the area endangering the watershed protection functions of the park. (See also Chapter VIII on Wildlands).

Lago de Yojoa Multiple-Use Area

The Lago de Yojoa watershed (No. 2 in Figure VI-3) has long been considered as a valuable national resource, both for its recreational potential and its hydroelectric energy production. In 1975, an effort was begun to develop a multiple-use management scheme for the Lake and contributing watershed. In 1978, the "Lago de Yojoa Multiple-Use Management Plan" was published. It included action plans to be carried out by the various resource management agencies of the government. Only COHDEFOR initiated a program under the plan through the expansion of its project "Integrated Watershed Management of the Northwest" to the Lago de Yojoa watershed. The plan stands as the first multiple-use management plan in Central America and awaits implementation by the various resource agencies.

RECOMMENDATIONS

Again, it is emphasized that watershed management is an integral part of good forest management, which is covered in Chapter V on Forestry. The following are recommendations derived from the overview of the present state of watershed management in Honduras.

- Implement a Land-Use Capability Classification. A hierarchical land capability classification applicable at a national, regional and local scale must be accepted by all institutions as the legal basis for planning and enforcing land use decisions. Institutions to which the classification would be particularly valuable are COHDEFOR, INA and the MRN. The AID Natural Resources Management Project should include a program for strengthening the land use policy and decision-making capacity of the government.

- Integrate Social Forestry with Watershed Management. Given a capability classification applicable to steep upper watersheds, programs should be oriented toward helping the small-scale farmer adopt practices most appropriate to such sites. Such programs should be complemented by exclusion of colonization in the most sensitive areas and a program of land-use reform to bring underutilized valley land into more intensive occupation and use.

- Improve Institutional Coordination. COHDEFOR should combine and coordinate the efforts of the various divisions under its Forest Department that deal with social action and the campesino. The social forestry system, watershed management section, fuelwood project, broadleaf forests projects, and the social action portion of the Forest Protection Unit should be combined into one entity to take advantage of a multifaceted approach to social action. All of these projects and programs deal with social action at the campesino level, yet all are working essentially independent of

each other. By combining the operations, social action and communication strategies could be standardized. All aspects of forest management and protection could be included in one promotion effort, and human resources could be best allocated to solve critical problems.

- Develop Monitoring Capabilities. A natural resources monitoring program should be developed to periodically assess the extent and dynamics of environmental degradation in Honduras. Land use, forest cover, water resources, and erosion levels could be monitored for qualitative and quantitative changes using remote sensing imagery complmented by aerial photographs and field investigation. Such a program would provide a perspective on the dynamics of land use, and change and the basis for focusing remedial action.

- Coordinate Educational Efforts. Current educational activities in existing institutions are inadequate to address watershed mangement problems. The government should promote environmental education beginning at the high school level and offer intensified and specialized educational activities at higher levels. ENSACIFOR in Siguatepeque has been seeking funding since 1979 for a watershed management program. CURLA offers programs in forestry and agronomy, but is weak in both areas. AID should reevaluate its support of CURLA and consider promoting a reorientation of its program to emphasize watershed management and small farmer agriculture. The pine forestry program is illogical in the context that the Center is located in a broadleaf forest area. It would make much better sense to promote a program of watershed management in the broadleaf forests incorporating aspects of flood control, soil conversation, control of shifting agriculture and reforestation using the watersheds of the Rio Aguan and the Atlantic littoral as models.

- Establish Forest Reserves to Protect Watersheds. Honduras should legally declare and actively maintain multipurpose forest reserves in broadleaf forests above 1,200 to 1,400 meters elevation. The primary purpose of these forest reserves would be for water production and flood control. Secondary justification would be for protection of recreational and wildlife resources and species diversity.

  Figure VI-5 illustrates those areas deserving such forest reserve status. Factors to consider in establishing a reserve include contribution to water supply, irrigation and stream flow regulation. Management should be closely regulated by COHDEFOR in collaboration with SANAA, the various muncipalities and villages, and the MRN. Many of these areas coincide and would complement those areas suggested for wildlands in Chapter VIII. Several of the areas proposed here are already declared as legal forest reserves under Decree 85.

- Use Watershed Planning For Total Resource Management. Fully integrated, multiple-use projects are viewed as the only viable means for alleviating the socioeconomic problems impeding the rational use of natural resources in Honduras. Such programs should be developed using watersheds as the natural project boundaries. They should include full participation of the target population group (i.e., the small farmer) and the executing organizations in both the planning and implementation phases. Such programs should include, among others, the following elements:
  (1) Land use classification
  (2) Economically attractive alternatives to inappropriate activites

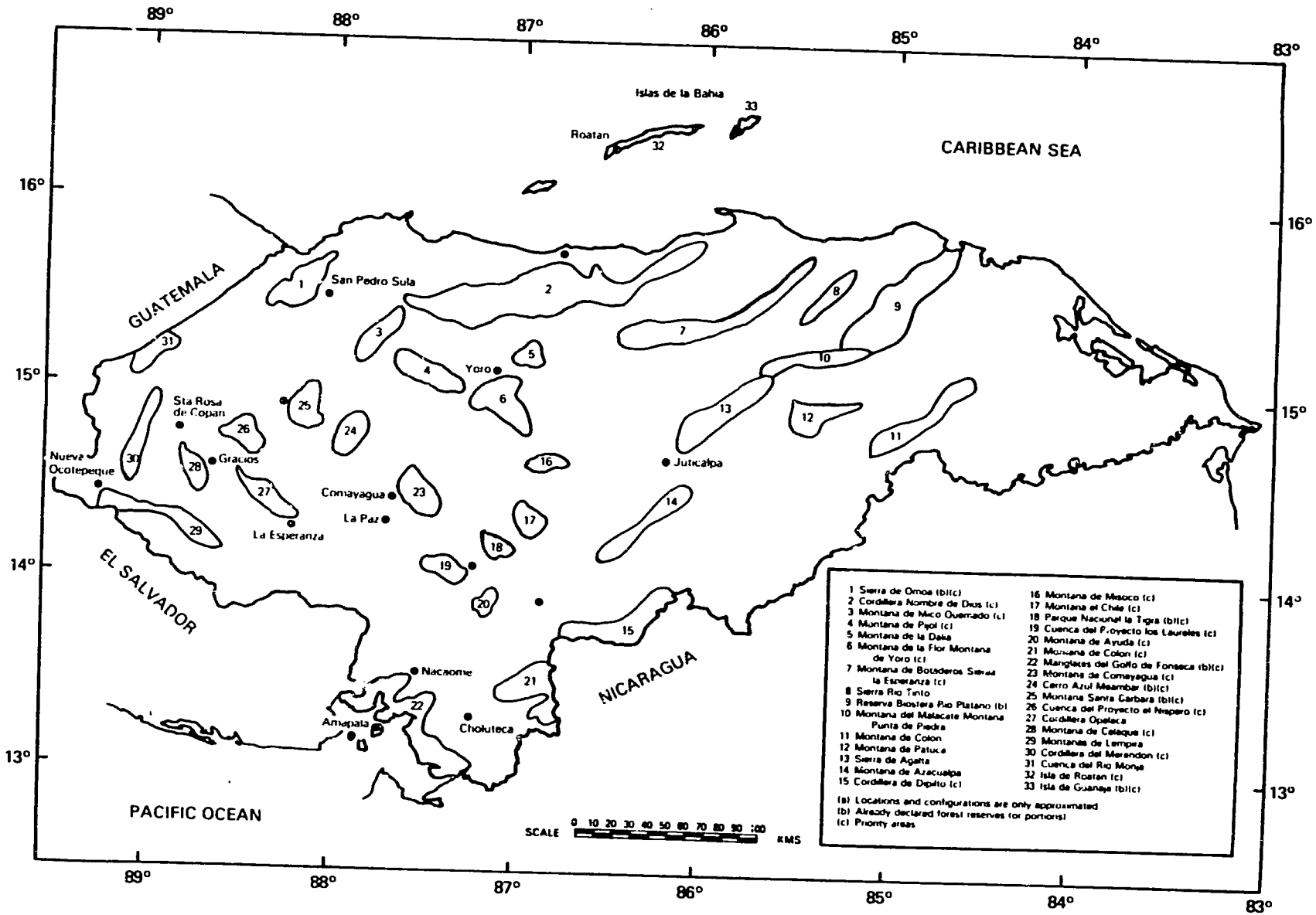


Figure VI-5. Potential Forest Reserves.

(3) Market and potential commodity studies
(4) Environmental education
(5) Agricultural extension
(6) Energy policies and management with emphasis on renewable forms such as fuelwood plantations
(7) Related infrastructure improvements
(8) Health and nutrition
(9) Forums for feedback from target population
(10) Accurate monitoring of socioeconomic as well as environmental feedback
(11) Appropriate technology on all levels
(12) Village level semi-autonomy of project activities.

- Monitor Projects within Development Assistance Community. Development assistance institutions including AID should be staffed to take an active role in technical monitoring of projects during the implementation phase. Such involvement would provide feedback for more effective project design in the future. Watershed management criteria should be an integral part and condition for funding of infrastructure and settlement projects.

- Improve Inter-Institutional Communications. Honduras should take a more active role in promoting interchange and feedback from the other bilateral and multilateral assistance organizations. With over 600 million dollars in assistance funds being spent in the country annually, programs of the various assistance agencies are too often overlapping and conflicting and can exceed the absorptive capacity of the institutions involved. It would be valuable to set up periodic "summit conferences," inviting key assistance organizations. Such conferences could provide the necessary feedback that would facilitate the better identification of underdevelopment problems, especially in watersheds, and could provide forums for the development of complementary strategies for solving these problems so that each organization's activities would complement the others' in scope and objectives.

VII. MANAGEMENT OF FRESHWATER AND MARINE RESOURCES

INTRODUCTION

This chapter decribes the freshwater and marine resources of Honduras, identifies major areas of concern for the GOH and development assistance community that affect the management and use of these resources, and recommends a number of action items to improve the capabilities of people and institutions to manage these resources. Greater emphasis is placed on the coastal environment than on inland freshwaters because marine resources both offer greater potential for economic development than freshwater resources and are being severely impacted by development activities to the neglect of most responsible GOH institutions.

THE COASTAL ENVIRONMENT

Physical Base and Climatic Patterns

The Caribbean Coast. The coastal plain varies greatly in width, extending some 75 kilometers inland along the Ulua and Aguan river valleys and in the Mosquitia. Total coastline length of 680 kilometers is characterized by alluvial deposits inland from long stretches of sand beaches. Coastal headlands occur in a zone from La Ceiba to Trujillo and in an area near the mouth of the Sico river. Major river systems that drain approximately 85 percent of the country include the Chamelecon, Ulua, Aguan, Sico, Paulaya, Patuca and Coco. In addition to these features numerous coastal fresh and brackish water lagoons are characteristic of the northern coast (Figure VII-1).

Offshore the continental shelf extends an average width of 19-28 kilometers from Puerto Cortes to the mouth of the Patuca river from which it broadens to a maximum width of 240 kilometers. The total area of the shelf is estimated to be 49,000 square kilometers, an effective national resource base equal to 40 percent of the land area of Honduras.

The platform is characterized by many submerged banks and cays mostly between Puerto Cortes and Trujillo and from Punta Patuca eastward. The major features include the large submerged Rosalind and Gorda banks, the Caratasca and associated cays, the Cochinos cays and the Bay and Cisne islands. The Bay Islands consist of eight islands and 65 cays with a total land area of 238 square kilometers. The three major islands Roatan, Guanaja and Utila were found to be a part of a discontinuous submerged ridge system (the Bonacca Ridge) extending from the mainland. This system represents the upthrust section resulting from the meeting of the Caribbean and North American tectonic plates. The islands are "high" islands with only Utila having more than four percent of land classified as flat (defined as having a slope of less than five percent).

The Caribbean climatic regimen is dominated by the location of the Bermuda High resulting in prevailing easterly and southeasterly trade winds. These winds may shift as winter cold fronts move across the coast resulting in north and westerly winds accompanied by rainfall. The wet season extends approximately from mid-April to October with an average rainfall of 1800-2500 millimeters per year. Though the southwest Caribbean Sea is not known for a high incidence of hurricanes, in the last century the north coast and

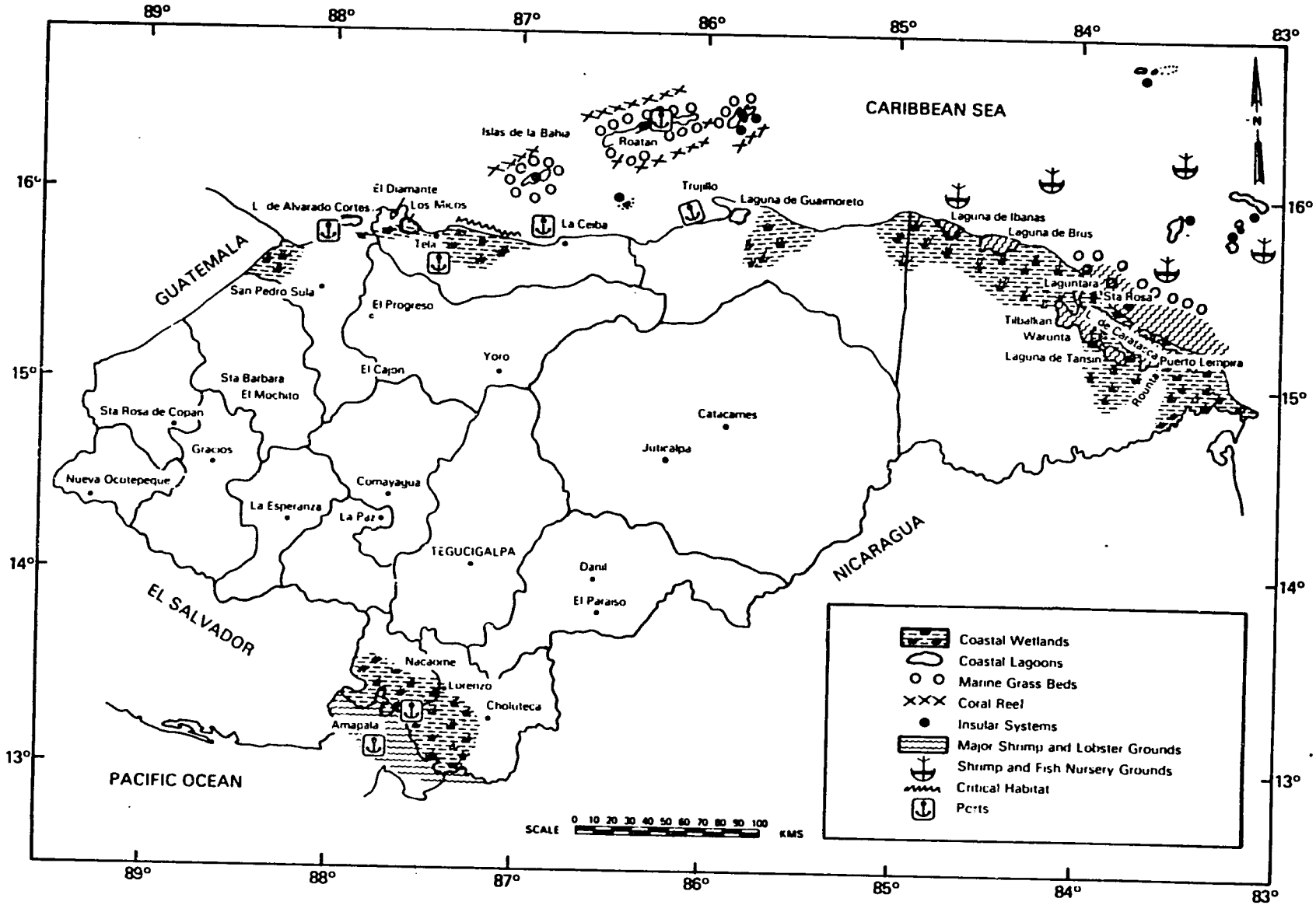


Figure VII-1. Significant coastal and marine areas.

Bay Islands have been hit by 13 hurricanes and eight tropical storms. In 1974, Hurricane Fifi caused widespread loss of life and property damage.

The current regimen is dominated by an offshore westerly oceanic current averaging 0.8 centimeters per second. A nearshore counter current has been detected that may be part of a seasonal cyclonic gyre in the Gulf of Honduras. Tides are semidiurnal with a spring range of 0.5 meters.

The Pacific Coast. On the Pacific coast, Honduras shares the Gulf of Fonseca with the neighboring countries El Salvador and Nicaragua. Despite this shared sovereignty the physical geography is such that the recognized territorial waters of El Salvador and Nicaragua preclude any Honduran claim to waters outside of the inner part of the gulf. Thus, according to standards of international law, Honduras' rights to external waters are restricted to freedom of transit.

The Gulf can best be described as a large shallow depression bordered by a broad coastal plain averaging 40 kilometers in width and 162 kilometers in length. The Gulf coastline in Honduras is dominated by mangroves and associated wetlands fed by five major river systems draining approximately 13 percent of the country. They are the Goascoran, Nacaome, Choluteca, Sampile and Negro rivers. An estimated 50,000 hectares are classified as mangroves and wetlands in the Gulf of Fonesca.

The Honduran portion of the gulf basin is characterized by a shallow fine silt and sand bottom with many shoals. The fine sediments characteristic of the upper estuary grade into a fine to medium sand in the outer gulf.

The seasonal temperature range averages 28 to 31°C. The wet season occurs during the period May to October with peak periods in June and September. Annual rainfall is less than that encountered on the Caribbean coast, averaging 1500-2000 millimeters per year.

Very little is known concerning the gulf current regimen. Studies indicate that in the eastern part of the gulf a surface current velocity of 1 meter per second is typical during a spring tide with the potential of 1.5 meters per second estimated for ebb tides following heavy rains. Tidal currents are probably very strong resulting in shifting bottom as the Pacific tide is diurnal with an average range of three meters.

Coastal and Marine Ecosystems

The diverse range of productive tropical marine ecosystems depicted in Figure VII-1 is described below.

Coastal Wetlands and Mangroves. These areas are found in abundance on both coasts and occupy an estimated 3,000 square kilometers. Mangroves and associated estuarine waters generally have a high primary productivity and serve as a nursery area for important species of finfish and shellfish (Figure VII-2). Mangroves effectively trap nutrients and sediments as well as stabilize coastlines.

Figure VII-2. Mangrove forests such as those shown in this photograph along the coast of Roatan are an important resource to be managed prudently since they serve as vital nursery and feeding grounds for many commercially important finfish and shellfish *(Courtesy of R. DuBois).*

On the Caribbean coast the dominant mangrove species are Rhizophora mangle and Laguncularia racemosa. Behind the mangrove swamps the area is dominated by species of palm, Erythrina cristagalli and Pachira acuatica. On the Pacific coast dominant mangrove species are R. mangle, R. samoensis, Conocarpus erecia, L. racemosa, Avicennia bicolor, and A. gerinans. Major wetlands include areas adjacent to the bay of Omoa, the Ulua river, a zone from Tela to La Ceiba, Rio Aguan and the eastern lagoons on the Caribbean coast and almost all of the Pacific coast.

Coastal Lagoons. Fresh and brackish water areas are characteristic of the North Coast. Although an inventory of these areas does not yet exist, a crude estimate of surface area is 1,400 square kilometers. Many lagoon systems with no permanent opening to the sea are opened seasonally as a result of flooding in the wet season. These openings facilitate the enrichment of coastal waters with nutrients as well as provide entry to coastal species for purposes of feeding and reproduction. Turbid lagoons, specifically between the rivers Salado and Cuero, represent excellent habitat for the endangered West Indian manatee Trichechus manatus (Figure VII-1). These and other lagoons represent critical habitat for several species of migratory birds, brown cayman and fish such as cuyamel (Joturus richardi), guapote (Cichlasoma motaguense), sardine (Astyanax), Dormilon amadus and freshwater shrimp (Macrobrachium). From a commercial perspective these lagoons represent critical nursery areas to the three species of shrimp that comprise a $25 million per year fishery in Honduras (see below). Predominant vegetation includes Caribbean mangrove species and the water hyacinth, Eichhornia crassipes.

Marine Grass Beds. These submerged grass flats are characteristic of shallow, clear, calm-water marine areas such as found in protected coves, lagoons and behind the more exposed outer reefs. Grass beds, along with mangrove ecosystems, represent areas of high primary production in tropical shallow water marine ecosystems. Characterized by marine grasses such as Zostera and Thallassia, these beds provide habitat for a varied flora and fauna. Grass beds provide nursery and feeding grounds for many reef fish, primary habitat for the commercially valuable queen conch, Strombas gigas, and feeding grounds for the green turtle. These areas are prevalent on the Caribbean coast of Honduras most notably inside the barrier reef of the Bay Islands. On the North Coast, a patchy distribution occurs with more extensive development on the eastern portion of the Honduran platform.

Coral Reefs. Though some scientific questions remain whether coral reefs represent net production or steady state systems, there is little doubt that they represent the most diverse of tropical marine ecosystems. Reef distribution, type and component species depend on a host of environmental factors including clarity of water, temperature and salinity regimens, nature and depth of substrate and degree of exposure to wave action. Among the many species associated with reefs several species of fish, namely Serranids, Lutjanids, and Sciaenids, and spiny lobster, Panulirus angus, are of commercial importance. Reef distribution on the north coast is patchy outside the influence of river systems. The better developed reef systems are offshore in clear water adjacent to Honduras' numerous islands and cays (Figure VII-3). These reefs reach their greatest development in the fringing barrier reef off the northwestern coasts of the Bay Islands. Ranging in depth from 1-2 meters from the surface to more than 30 meters before grading into the insular shelf edge, the reef represents one of the few true barrier reefs in the Caribbean.

Figure VII-3. Coral reefs develop offshore of the north coast of Honduras in the Caribbean. The reef margin is visible in the background where the surf is breaking *(Courtesy of R. DuBois).*

Insular Systems. The islands and cays prevalent off the North Coast of Honduras represent unique and fragile ecosystems. Combining a terrestrial component that often provides habitat for endemic species, they have been protected from past degradation by their isolation. This isolation is rapidly being breached as these areas are increasingly exposed to human migration and settlement, agriculture, tourism and commercial development and recreational activity.

Coastal Demographics and Development

Largely as a result of its physical constraints, Honduras, in contrast to other Central American countries, has focused its major development efforts toward the Caribbean rather than the Pacific coast. The north coast is divided into five departments: Cortes, Atlantida, Colon, Gracias a Dios and the Bay Islands. The combined population of the five departments is an estimated 903,000. On the south coast the two departments of Valle and Choluteca possess approximately 382,000 inhabitants. Demographic data on the individual departments and their respective major cities are found in Table VII-1.

San Pedro Sula is the major industrial city in the country (Figure VII-4). Puerto Cortes serves as the country's principal port as well as the location of the only free port and refinery in Honduras. To the east between Tela and Trujillo coastal developments serve principally the major banana and African oil palm plantations that dominate the region. La Ceiba has begun to diversify its economic base. Other development includes tourism in Tela and road and port development in Puerto Castilla. Further east, the remainder of Colon and Gracias a Dios departments are still relatively inaccessible, inhabited mostly by Misquito, Garifuna, Paya, Sumo and some ladinos. The Bay Islands provide a base for the commercial fishing industry of the country along with tourism which thus far plays only a secondary economic role.

On the south coastal plain the major economic emphasis is on agriculture with rice, sugar cane and cotton being the dominant crops. The country's primary source of salt production occurs to the west of San Lorenzo.

MARINE FISHERIES

The Fishery

The distinction between the industrial and artisanal fishing sectors is easily discerned. The industrial effort, located primarily in the Caribbean, is focused on the lobster and shrimp resources adjacent to the Caribbean coast. The richest shrimp grounds are located on the wide continental platform off the northeast coast in waters of 40 meters or less in depth (Figure VII-1). Three shrimp species are exploited commercially, the white shrimp, *Penaeus schmitii*, the spotted pink shrimp, *P. brasiliensis* and the

Table VII-1

COASTAL DEMOGRAPHIC DATA FOR HONDURAS

Caribbean Departments and Respective Major Coastal Cities	
Cortes	542,581
San Pedro Sula	303,434
Puerto Cortes	64,621
Atlantida	214,080
Tela	67,736
La Ceiba	81,771
Colon	114,052
Trujillo	30,157
Puerto Castilla (Nueva)	1,600
Gracias a Dios	31,005
Puerto Lempira	21,863
Islas de la Bahia	12,395
Pacific Departments	
Valle	117,744
San Lorenzo	18,976
Amapala	6,868
Choluteca	264,278

brown shrimp, P. duoranum. These three species live as adults off the outer continental shelf. Spawning may be year round with seasonal peaks. Once eggs hatch, the post-larvae migrate to estuaries where they feed and pass the juvenile life stages before returning to offshore grounds for feeding and spawning purposes. The major juvenile shrimp grounds appear to be the Laguna de Caratasca and adjacent lagoons.

The lobster fishing effort is concentrated on the many offshore cays and submerged banks on the northeast coast. Areas of primary importance are Rosalind and Gorda Banks and Vivorillo Cays. In addition to these areas, illegal fishing of Colombian and Nicaraguan-claimed waters appears common, notably on the Quita Sueno and Serrana Banks. The fishery is based on the spiny lobster, Panulirus argus, with only minor exploitation of P. inflatus and P. interruptus occurring.

The artisanal fishery on the north coast is concentrated on the nearshore

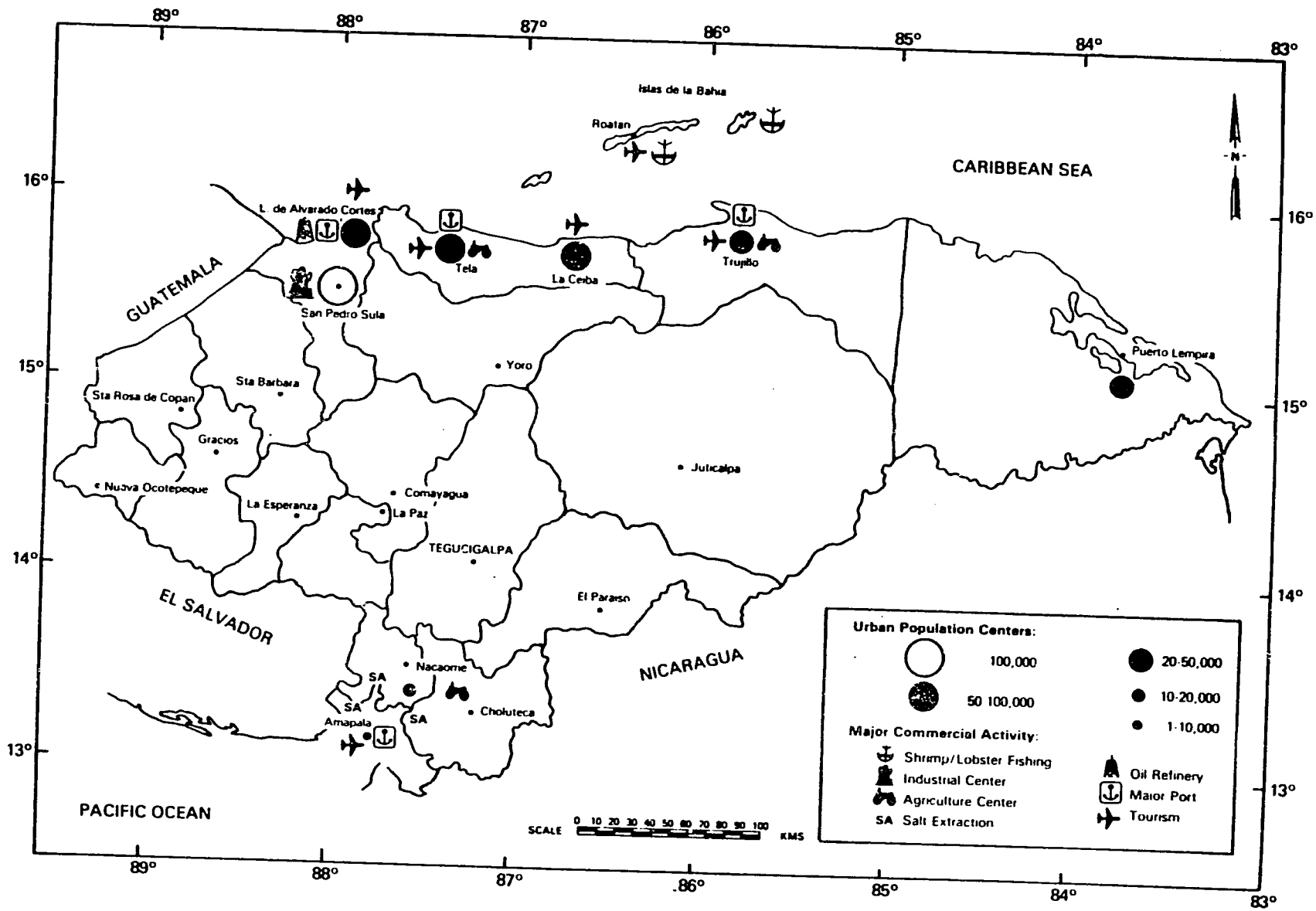


Figure VII-4. Centers of coastal population and development.

waters and coastal lagoons. The resource is mainly finfish including Serranids, Lutjanids, Sciaenids and Mugilids. In addition to finfish, shellfish such as octopus (Octopus vulgaris), squid (Loligo pealei), and blue crab (Callinectes Sp.) are occasionally exploited. The exploitation of conch (Strombas gigas), commercial or otherwise, has largely ceased as populations have been overexploited.

Due to the exclusion of Honduras from offshore fishing grounds and the geophysiography of the Gulf of Fonseca, there are no major fisheries on the Pacific coast. The Honduran estuaries, however, do provide critical habitat for the large offshore shrimp populations exploited by Nicaragua and El Salvador (P. occidentalis, P. vannameiand, P. stylirosiris). Populations of shrimp and lobster do not reach commercial size in Honduran waters. The major resources exploited at the artisanal level are a diverse number of finfish, two species of arcshells, Anadara tuberculosa and A. similis, and the mangrove oyster (Crassostrea mangle). The latter three species appear to be under intense exploitive pressure. In addition, juvenile white shrimp are caught using cast nets.

The Fisherman

The industrial sector is dominated by seven shrimp and lobster companies, six of which are located on the two Bay Islands of Guanaja and Roatan, and the seventh in Puerto Castillo. Each company has its own processing, packaging and freezing facility capable of handling both lobster and shrimp. At present, the fishery for both shrimp and lobster is closed to the entry of additional boats, with commercially licensed boats fixed at 217, down from a peak of 275 in 1978. Shrimp boats account for approximately two-thirds of the fleet. Of the 217 boats approximately 35 are independent, selling their catch to the highest bidder. Whereas the shrimpers use seine nets, the lobster fishery is somewhat equally divided between use of divers and pots. Catch is landed heads-off and subsequent by-catch is thrown back. The industry is estimated to employ 3100 between the primary and secondary sector.

The only commercial venture on the Pacific coast is located in Amapala. It is a processing and packaging plant that buys shrimp from foreign boats permitted to fish external waters.

Information on the artisanal sector is uncertain. FAO estimated in 1980 that there exist approximately 4,000 fishermen of which 3,000 are found on the Caribbean coast the remainder in the Gulf of Fonseca. The fleet consists of approximately 1,500 small vessels mostly dugout canoes or cayucos of which only one fourth are outfitted with motors. Typical gear utilized are cast nets, fish hooks, gill and trammel nets.

The Market

The industrial exploitation of shrimp and lobster began in the early 1960s to serve the U.S. market. The industry grew at an accelerating rate until 1978 when a fleet size of 275 was reached. In the same year approximately 5,108 metric tons of fish and shell fish were caught (Table VII-2). In 1978 fishery exports accounted for $24.8 million divided almost equally between shrimp and lobster exports. This accounted for 3.6 percent of the total country's exports and 4.7 percent of the total agricultural exports. There are indications that the lobster resource has been overexploited as reported landings have declined by approximately 50 percent each year since 1978 with relatively equal level of effort as measured by licensed boats. This trend continued into 1981 as landings for the first six months were one half that for a similar period in 1980. Similarly, after the

TABLE VII-2

FISHERIES CATCH TRENDS SINCE 1960 FOR INDUSTRIAL AND ARTISANAL SECTORS (METRIC TONS)*

	1960[a,b]	1970[a,b]	1978[a]		1979[d]		1980[e]	
Industrial								
Shrimp	191	2,243	2,288	(170)[c]	516	(140)[c]	1,643	(137)[c]
Lobster	105	1,225	2,547	(98)	1,138	(96)	732	(75)
Fish	298	274	171	(3)	187	(2)	129	(3)
Other	141	166	102		367	(8)	33	(7)
Subtotal	735	3,908	5,108	(271)	2,208	(246)	2,537	(222)
Artisanal								
Shrimp	-	-	124		57		128	
Lobster	-	-	3		3		2	
Fish	0	0	1,002		901		948	
Other	-	-	143		127		154	
Subtotal	-	-	1,272		1,088		1,232	
Total	735	3,908	6,380		3,296		3,769	

Notes:
a) From Estadisticas Pesqueras 1978
b) Includes artisanal catch
c) From NMFS 1981, Multi-purpose vessels have been divided between shrimp and lobster categories
d) From Estadisticas Pesqueras 1979 (draft)
e) From Estadisticas Pesqueras 1980 (draft)

*Size of the fishing fleet is indicated in parenthesis for the years 1978, 1979 and 1980.

disastrous year for shrimp in 1979 concern has been expressed for the status of stocks. A moratorium on new entries into the fleet was set in 1979 and the shrimp season closed from March to June 15. Other factors affecting the industry are increased fuel costs and interest rates.

Artisanal fishermen supply the local domestic demand. A relatively simple distribution system is required to serve the more distant Tegucigalpa and San Pedro Sula markets.

Fishery Potential

Based on previous FAO sponsored exploratory fishing surveys, there are four potential resources capable of sustaining commercial exploitation:

- sharks

- a red snapper and grouper compex associated with the continental shelf edge
- a pelagic resource including tuna, barracuda, and wahoo
- a deep water crustacean resource.

To determine if these resources in fact can sustain commercial fishing pressure the Corporacion Nacional de Inversiones is proposing an exploratory fishing survey to be funded by IDB in 1982.

Mariculture

The only large scale effort in mariculture in Honduras is the culture of two species of Pacific shrimp by a U.S. concern, Sea Farms. The effort first began in 1973 with the object of developing a completely integrated facility with hatchery and 2000 hectares of ponds. Due to several difficulties, including the lack of availability of gravid females, the effort was reduced to a grow-out facility. At present there are 250 hectares in ponds with an estimated production of 90 metric tons per year (tails only). Shrimp juveniles are trapped at high tide and then placed in ponds until marketable size is reached before harvest.

Major Areas of Concern

The marine commercial fishery sector is responsible for submitting only catch data to RENARE. Declining stocks of shrimp and lobster indicate that more stingent enforcement of existing management regulations is essential if the economic viability of this sector is to be sustained. Surveillance and collection of such data as species, size, and fishing effort expended are currently deficient.

Degradation of northern lagoons is resulting from contaminated irrigation return water and city sewage (L. Alvarado), overexploitive fishing pressure (L. Micos) and construction activities (Guaymoreto).

Additional concerns include: increasing stress on the Gulf of Fonseca ecosystem from pesticides and sedimentation from the Choluteca watershed; mangrove destruction associated with salt production; over-fishing of shellfish species; and increased turbidity and habitat destruction associated with maintenance of the Puerto San Lorenzo navigation channel.

There is a serious lack of trained personnel, infrastructure and funds to provide the essential research needed to effectively exploit the potential high value marine resources of a vast area of ocean and continental platform recently claimed through declaration of a 200 nautical mile Exclusive Economic Zone (EEZ).

FRESHWATER FISHERIES

The Fishery

The total freshwater surface area in Honduras is an estimated 43,000 hectares which includes rivers, lakes and freshwater lagoons. The major lake in the country is Lago Yojoa which is situated approximately 600 meters above sea level, has an area of 30,000 hectares and an average depth of 20 meters. The lake is fed by several streams, and its outlet via the Rio Lindo is used to generate hydroelectric power. Depending on season and water availability, the lake level may vary as much as 5.5 meters.

There is little information available on the ichthyofauna of the freshwater rivers. Lin (1956) and Carr and Giovannoli (1950) described 24 species of fish in the Choluteca river system. In the Caribbean watershed Goldman described 48 species representing 32 genera in the river Ulua. Indigenous species that are consumed locally include the sardine, Astyanax fasciatus, three species of cichlids, of which the

guapote, Cichlasoma motaguense, is of greatest importance; the endangered cuyamel, Joturus pichardii; and 2 species of freshwater shrimp. Several other species have been introduced and include the black bass, Micropterus salmoides, introduced into Lago Yojoa in 1954; and Tilapia nilotica and T. mozambica introduced into the lake and rivers subsequent to that date.

The Fisherman

There are an estimated 300 registered inland fishermen, the majority of whom fish in Lago Yojoa. This figure should probably be doubled to account for the unregistered inland fishermen.

Lake fishermen use three to four meter dugouts, small rowboats and some outboard powered boats. Handlines, nets, cylindrical traps, and occasionally spears and arrows are used for fishing. Despite laws prohibiting their use, dynamite and a toxin extracted from the roots of a plant called timbo are used in unknown quantities in rivers and streams. As early as 1956 the rivers Patuca, Aguan, and Ulua has their fish populations reduced to insignificant levels as a result of abusive use of dynamite and toxins. There are no data to indicate the extent to which these rivers have recovered, and other rivers have reportedly had their fish resource similarly decimated. It is not known whether the practice of killing fish with pesticides exists in Honduras. It is recommended (see Chapter IX) that fish be analyzed in Yojoa to determine the levels of toxic materials occurring as a result of contamination of the lake by effluent from the Rosario Development Corporation mine.

The Market

Lago Yojoa is the only area where records of landings are maintained. In 1980 landings were an estimated 80 metric tons. Fish that are not consumed directly are sold in the local market.

Fishery Potential

There are no unexploited freshwater bodies in Honduras. Any increase in productivity of freshwater fisheries will come from increased understanding of the ecosystems involved, improved management of fishing and control of activities affecting the quality of the water resource such as pesticide use, upper watershed degradation and waste disposal.

Aquaculture

Aquaculture offers another area for significantly increasing freshwater protein production. Research on rapidly diminishing and prized species, such as the cuyamel, should be encouraged to understand life cycle and critical habitat needs with the objective of rebuilding natural populations. Research on potentially valuable species such as the indigenous species of Macrobracium should be pursued rather than relying on introduced species. Introduction discourages research and may create an irreversible ecological event such as competitive exclusion of one or more indigenous species. It is recommended that introduction of exotics be confined to hybrids and males until the potential ecological impact can be better evaluated and research on native species accelerated.

The first recorded aquaculture experiment was the unsuccessful introduction of a species of Guatemalan carp in 1936. This was followed by additional attempts at reproduction of local and imported cichlids and black bass, and included the construction of ponds in Comayagua by the Centro Nacional de Agronomia, Ganaderia and Escuelas Rurales. The first national effort at aquaculture started in 1956

with the construction of a hatchery for cichlids in Picacho. Juveniles were made available to people who had ponds available for stocking. The hatchery is still operating and serves primarily as a distribution facility.

In 1977 with assistance from AID, construction began on an eight hectare, 36 pond, pilot hatchery at El Carao in Comayagua. The objectives of the facility were to provide juvenile fish to regional distribution centers and to conduct technical training and research. Today, the principal cichlid species being cultured are T. nilotica and T. mozambica. Experimental work is also being conducted on the native Guapote and the introduced freshwater shrimp Macrobrachium rosenbergii. At present, users of these services are mostly private individuals and a few cooperatives. The project has suffered from past mismanagement, present budget cutbacks and contaminated supplies of freshwater contaminated from pesticide use in nearby farming areas. There are an estimated 90 non-commercial ponds in the country that range in size from 14 to 10,000 square meters.

The largest commercial aquaculture facility on the Caribbean coast is Aqua Finca near San Pedro Sula. At present there are 26 hectares under management with ponds ranging in size from 0.02 to 0.8 hectares. Originally the site had been used as a growout facility for the freshwater shrimp Macrobrachium rosenbergii produced at the hatchery located on Bahia Omoa. This hatchery has since been closed and the cycle completed at the growout facility with salt water trucked in from the coast. Aqua Finca has their own processing and packaging plant and ships approximately 23,000 kilograms of heads-off shrimp to the United States per year. Areas of interest for possible future development include polyculture with Tilapia and mariculture projects with one or more of three commercial shrimp species that occur on the Caribbean coast, similar to the Sea Farms operation on the Pacific coast.

Major Areas of Concern

The major concerns related to freshwater fisheries are:

- Inadequate means to implement and enforce existing legislation, leading to degradation of the resource.
- An inadequate information base concerning internal waters (excluding Lago Yojoa) upon which to build management strategies.
- Widespread aquatic degradation resulting from illegal fishing methods, indiscriminant pesticide use as evidenced in Choluteca, Chamelecon, Aguan, increased sedimentation from degraded watersheds (Choluteca, Chamelecon, Ulua) and industrial outfall or development (Lago Yojoa by Rosario Development Corp., Rio Bonito by Olancho Forest Projects, and the Ulua and Chamelecon rivers by the El Cajon Hydroelectric Plant).
- Tendency to introduce exotic species with identified life cycles rather than to conduct research and develop management strategies for indigenous species.

MINING

Salt Extraction

At present the major mining activity entails salt extraction from waters in the Gulf of Fonseca (Figure VII-1). Salt is extracted by an estimated 105 small scale operations using 311 ovens to heat and evaporate water. At a much larger scale, six operations employ salt pans in which solar energy is used to evaporate water. A major concern associated with salt extraction by use of wood-burning ovens is the chronic destruction of mangroves for firewood. For example, salt pan construction requires clear

cutting mangroves. One producer currently extracting 50,000 kilograms of salt per year clear cutdown 100 hectares of mangroves for his operation.

Petroleum

Honduras is totally dependent on imported oil to meet all of its petroleum needs and 80 percent of its total energy requirements. As of August 1980, 15 exploration wells have been drilled on the north coast on the adjacent platform. Only one well on the northeastern platform near Laguna Caratasca indicated presence of hydrocarbons. Much of the Caribbean platform has been granted as concessions to several oil companies, with the exception of a large national reserve on the northeastern outer platform. On the Pacific side, approximately one-half of the Honduran part of the Gulf of Fonseca is being solicited for concession status.

To reduce the country's dependency on foreign oil the World Bank has approved a three million dollar loan to promote petroleum exploration. The focus will be primarily one of collecting information, geostratigraphic mapping, and training. The project is presently being delayed as the Bank and Honduras attempt to find agreement on a coordinating mechanism. Other related projects include a feasibility study for the construction of a 410,000 barrel capacity transhipping terminal in Amapala and a proposed deepwater oil terminal in Puerto Castilla.

Oil spills are a potential hazard. The 14,000 barrel per day refinery at Puerto Cortes is owned and operated by TEXACO. TEXACO has not been involved in any oil spill incidents in the last three years. The Company belongs to the Clean Caribbean Cooperative with a response team based in Boston. An oil spill contingency plan does exist but there is no trigger mechanism to enact the plan. Only one person in the plant has any formal oil spill response training and no training exercises have been conducted since 1979. Equipment, though appropriate, appears minimal and includes one skiller, two patrol boats, absorbants and dispersants. This equipment is to be augmented this year at a cost of $80,000. No formal plan of coordination exists between TEXACO and the GOH in the event of a toxic substance spill by either of the parties. In day to day operations oily waters are treated by an API gravity separator followed by evaporating ponds before discharge.

Non-ferrous Metal Mining

The effects of mining by the Rosario Resources Corporation on Lake Yojoa is treated in Chapter IX.

Major Areas of Concern

The major concerns related to mining are:

- Inadequate human and financial resources to enforce existing legislation to prevent aquatic degradation resulting from discharge of contaminants by mining operations.
- No coordination mechanism to respond to toxic spills between the two primary users and shippers of toxic substances (TEXACO and GOH).
- Inadequate preparation to respond to an oil spill by TEXACO employees.
- A need for alternative means to extract salt without necessitating mangrove destruction, such as use of planted fuelwood stocks, solar drying, etc.

PORT DEVELOPMENT

Capacity

At present there are five ports operating in Honduras with an annual movement of cargo exceeding 50,000

metric tons. Three of the five ports, namely Puerto Cortes, Tela and La Ceiba, are located on the Caribbean coast; the remaining two, San Lorenzo and Amapala, service the Pacific. The total metric tonnage handled in 1979 was 3.2 million tons, 69 percent of which moved through Puerto Cortes.

In addition to these ports there are several minor ports that serve coastal trade: On the Caribbean, Roatan, Utila, Limon, Triona, Santa Rosa de Aguan, Puerto Playa, Brus Laguna, Guaquira, Puerto Lempira; and on the Pacific coast Coyolito, Puerto Grande, Raton and Puerto de Sierra.

Caribbean Ports

Puerto Cortes situated on the northwestern coast near San Pedro Sula possesses the most complete port facilities and services in Honduras which includes 5 wharves capable of handling petroluem, liquid bulk cargo, bananas, roll on/roll off and containers. A free zone was created in 1976 adjacent to Puerto Cortes for the purpose of providing a major regional center for distribution of goods. The 30 hectare free zone was built from fill material dredged from the Gulf of Omoa. The remaining two active ports on the Caribbean coast are finger piers that serve primarily for the exporting of plantation fruit and coastal trade. In the Bay of Trujillo construction began on a deep water port in 1978. The project, partially funded by the World Bank, has been plagued by delays and contractor disputes and activity at present is suspended until negotiations are completed. For purposes of construction and future operations, a service road was completed connecting Trujillo with the port, passing over the entrance to the Lagoon Guaymoreto. In 1978, 1,600 people were removed from the area and resettled in a community of 198 new houses south of the Port. The Trujillo Port will serve the Olancho Forest Industries and Aguan Valley agriculture projects, with possible future expansion into an oil transhipment superport.

Pacific Ports

Amapala and San Lorenzo are the principal ports on the Pacific coast. As a result of the shallow depth, lightering was required between Amapala and San Lorenzo. Honduras commissioned the construction of the new port of San Lorenzo in 1975. The site chosen was a mangrove area served by an access road built on fill material. In order to make the area accessible to deep draft ships a 35 kilometer navigation channel and turning basin was dredged in 1979. A total of 1.5 million cubic meters of material was removed at a cost of 3.2 million dollars. It is estimated that maintenance dredging would be required once every four years. No environmental assessment was made prior to development.

Port Administration and Existing Legislation

The GOH created an autonomous institution in 1965 with the mandate of developing and modernizing the Port of Cortes. This institution, Empresa Nacional Portuaria (ENP), operates under its own Board of Directors composed of several government ministers as well as representatives of associations of workers, shippers and businessmen. In 1974 ENP was given authority to operate all the country's cargo ports.

ENP consists of the Board and administration composed of eight divisions, one of which is the Division of Planning and Technical Supervision. Their responsibilities include assessment of ocean current and substrate conditions, placement of navigation buoys and supervising of dredging operations.

Despite the presence of legal provisions and remedies in the legal code of ENP that address contamination of port

waters, there are neither craft nor inspectors to monitor ships outside of those in berths. In 1980, despite the large tonnage passing through Puerto Cortes, only one company was fined for discharging contaminants into the Bay. Ballast dumping may occur much more than the number of levied fines indicate, as tar deposits have been observed on the beaches of the Omoa Bay. The greatest portion of the country's potentially toxic substances pass through the Port of Cortes (Table VII-3). Despite this activity there exists neither a contingency plan for toxic spill clean up nor equipment to do so at the Port.

Major Areas of Concern

- Despite past experience and present and proposed major port development projects impacting the coastal and near shore marine zones, ENP or its contractors still fail to determine environmental impact and address means to mitigate identified impacts. This is a critical concern.
- Stricter enforcement of existing legislation to prevent ships in port from discharging contaminants into adjacent waters is needed.
- The absence of a contigency plan to respond in the event of toxic oil spill in the heavily used Port of Cortes is a serious concern.

TOURISM

History

In recognition of Honduras' tourism potential the GOH created the Instituto Hondureno de Turismo (IHT) in 1972. A technical and economic feasibility study was completed in 1975. Three areas were examined for their suitability for development: the Copan area in western Honduras due to its importance as a Mayan archeological site; the Tournasal area stretching along the north coast from Punta Sal to Trujillo, with its many pristine sand beaches; and the Bay Islands due to their insular nature, clear water and coral reefs. Since the original study, much of the focus for development has been directed toward Copan and the Bay Islands and not the Tournasal area. A World Bank loan will be used to cover half of the estimated 38.3 million dollar cost of the various tourism development activities.

Administration

The IHT is organizationally placed directly under the presidency of the GOH. The component of IHT responsible for setting guidelines for development is the Unidad Tecnica. This group is composed of six administrators and eight technical professionals including hotel managers, economists and architects. The IHT has the power to declare an area a tourist zone; this does not change ownership rights or status but does prevent degradation of those resources that originally justified the designation.

Major Areas of Concern

Tourism related concerns are:

- Absence of an environmental capability in the technical group responsible for evaluating tourist development projects.
- Absence of legislation requiring IHT to address environmental considerations before granting approval.

A CASE STUDY OF BAY ISLANDS DEVELOPMENT

The physical characteristics of the Bay Islands are described in an earlier

TABLE VII-3

QUANTITIES OF POTENTIALLY TOXIC SUBSTANCES IN HONDURAS (1979) AND THEIR PORT OF ORIGIN OR DESTINATION (Metric Tons)

Product	Port					Total
	P. Cortes	Tela	La Ceiba	San Lorenzo	Amapala	
Imports						
Chemicals	56,039	4,066	8,561	474	7,976	77,116
Fertilizers	19,811	13,687	9,733	1,420	-	44,651
Crude oil and Derivatives	553,983	10,630	402	-	-	565,015
Exports						
Gas and derivatives	547	-	-	-	-	547
Total	630,380	28,383	18,696	1,894	7,976	686,782

section, Physical Base and Climatic Patterns.

Based on the national census of 1974 the population of Roatan was 8,250, distributed among the following ethnic/cultural groups: negro (50%), anglo/white (23%), black carib (6%), foreigner (3%), and mixed (15%). Today the population of the three islands is estimated at 12,000.

Until recently the dominant cultural influence has come from the British Caribbean. Insular land use patterns are characterized by coastal developments associated with scarce flat land found on the coast. The sea had been the major source of sustenance with agriculture limited to low lying fruit plantations and occasional small subsistence agricutural plots. Increased immigration of ladinos from the mainland has brought heavy pressure on the steep lands of the interior of the major islands. Shifting agriculture and expanded grazing have contributed to gullying and mass movement of soil (Figure VI-2) which in turn threatens the sensitive coral reefs close to the coast.

In the early 1960s the islands began to be examined as sites for potential tourist development. Prior to 1960 there existed only one hotel on the three islands; today there are 17 with a total of 248 rooms. In recognition of this growth potential, the islands were included in a technical and economic feasibility study for tourist development. Projected tourist arrivals were predicted to climb from 9,200 in 1980 to 27,000 by 1990. Based on recommendations from the study, IHT and the GOH requested a loan from the World Bank. This loan, which focuses on the development of the Copan region and Roatan, was approved in 1979.

The World Bank loan is now providing a line of credit for hotel and tourist enterprises as well as for the lengthening and paving of the runway at the Roatan airport to eventually provide jet service. In an earlier project the World Bank and the GOH funded the construction of a road that opened up areas in Roatan previously reached only by foot path.

The World Bank loan, under a provision for technical assistance, required the preparation of an environmental control plan for Roatan. The terms of reference called for:

- a natural resources inventory of the Island to include geomorphology, geology and soils, water and hydrologic resources, coastal dynamics, beach and vegetation inventories and climatological studies
- an evaluation of the human resource base
- an inventory of existing community infrastructure.

Based on this information a land-use capability statement was to be developed, with recommendations and regulations for zoning presented and regulations for environmental control outlined.

Unfortunately the management study has drifted out of phase with other activities such as road building and runway extension. The value of such a study must be questioned once major development projects have been identified and funded. Such a natural resources management plan can best be utilized prior to development rather than after irreversible commitments have been made to infrastructural projects.

In the design of the Bay Islands development plan, areas of concern that need to be addressed include the following:

- Technical assistance to Island authorities to aid in implementation of the management study's list of recommendations.
- Management options in the areas newly opened and soon to be opened by road, most notably the completion of the loop between Coxen Hole-West End-Sandy Bay and the access road to Port Royal.
- Discouragement of speculation and significant purchase of land by foreign investors. Present zoning has designated the Bay Islands as urban areas. As such there are no restrictions on foreign land owernship or use. The impact has thus far been minimal with the exception of two islands off Roatan owned outright by foreigners.
- Increased pressure on the barrier reef from soil erosion, fishing, and sport dive boats anchoring on the reef. Major disturbed reefs on Roatan include Bodden Point, Calabash Point, Jennings Point, Camp Bay and Six Hut Point.
- A population growing beyond the carrying capacity of the island thereby increasing dependence on mainland sources of essential goods. This results in distortions in the economy and hardship for the poor.
- The need for uniform environmental management plans for the Islands of Utila and Guanaja.

RENARE - AN INSTITUTIONAL ANALYSIS

The administrative agency whose mandate is the management of living natural resources is Direccion General de Recursos Naturales Renovables (RENARE). Created in 1974, RENARE has two administrative units: Fisheries and Wildlife Management. The Fisheries Unit is divided into Offices of Statistics, Inspection, Registration, Promotion, Aquaculture and Applied Investigation. Of the approximately 150 people that work in the Fisheries Unit, only 15 are trained biologists. All of these offices, except Promotion, are described in the following sections.

The 1980 budget for RENARE was reduced from $1.25 million to $1.04 million, with the major portion allocated to fisheries. RENARE experienced administrative difficulties in 1980 with the appointment of three successive directors, each change accompanied by an administrative reshuffling.

Statistics

The Department of Statistics is responsible for the collection of data necessary to manage fish stocks. Sources of data are export and import statistics (the latter coming from the U. S.), catch statistics (forwarded from the industrial sector every 15 days), and periodic statistics collected by inspectors in local markets. The data collected are confined to generic or common name category, processed products, package by number and weight, and price.

Inspection

The Department of Inspection is responsible for collecting statistics, registration and enforcement of both wildlife and fishery legislation. At present there are only 27 inspectors in the country. Given their mission they are largely ineffective as a result of factors such as lack of training, the magnitude of tasks they have been given, insufficient budget, (most notably for vehicles and trip expenses) and decided indifference on the part of the government toward strict interpretation of regulations. These latter two factors are best illustrated by the those inspectors distributed on the three Bay Islands, the center of the industrial fishing sector. In the case of Roatan, the Inspector's budget consists of his salary and no resources to repair the motorbike required to make his biweekly inspections. These inspectors' efforts are limited to spot checks for size limitations and hygiene. In 1980 an estimated $8,450 in fines were levied by inspectors on the Bay Islands.

Registration

The Department of Registration is responsible for the annual registration of both artisanal and industrial fishermen and boats. At the industrial level separate licenses for lobster and shrimp are required and a combination license is available. Registration appears well enforced in the commercial sector. In the artisanal sector an estimated 50 percent of all fishermen are registered.

Aquaculture

Prior to 1977 there had been no coordinated attempt to develop a national aquaculture program. In 1977 an agreement was signed between AID and Honduras to initiate a three year pilot project which included construction of a research center, a hatchery and ponds; three years of technical assistance; and a training component. The objectives of the project were to provide the expertise required to make better use of the country's resources, assist in development of the country's poor rural areas, and provide technical assistance to those who request it. In 1980, a total of 11 professionals and technicians worked on the project with a budget of $60,000. The project has suffered from administrative problems, and further assistance is being delayed until efforts by the new GOH administration can be evaluated.

Applied Investigation

The Department of Applied Investigation was created in 1980 with the intent of providing technical assistance to both the Fishery and Wildlife Management Sections. Current projects include joint efforts with the Chinese

and Japanese Missions in fish preparation, and processing plus public education to modify existing attitudes towards fish consumption. Projects that were proposed to begin in 1981 suffered from several setbacks which included the accidental sinking of a boat donated by the Japanese to begin an exploratory fishing survey of the northern coast and delays in outfitting a boat in the Pacific to initiate a similar effort. A project for conserving Pacific marine turles was planned for 1981 and was to include public education and an egg recovery, hatching and release effort. A second project proposal, for the conservation of the manatee, is being managed from La Ceiba. The objective is to designate a management area between the Cuero and Salado rivers. This area, which is under intensive pressure from rice farming, is one of the few remaining areas where manatee populations are known.

As a result of intense pressure on the Bahia de los Micos from heavy fishing and irrigation effluent from banana and African oil palm plantations, a lagoon inventory has been initiated to provide basic information to formulate a lagoon management plan. It is hoped that resources will allow incorporation of other north coast lagoons into the management plan.

Legal Mandate

RENARE's mandate to manage living aquatic resources comes from Decree 154, approved and signed in 1959. Among its various stipulations, it allows for: management of all coastal and aquatic flora and fauna, licensing, gear restrctions, closing of seasons and fisheries, aqua- and mariculture activities. Legislation does exist to prevent fishing in nursery areas, nor to prohibit the dumping of toxic substances in the country's waters or the use of dynamite. At present it is illegal to hunt manatee, collect marine turtles and their eggs, harvest black coral from national waters and cut mangroves or other trees on the edge of rivers or coasts. Specific resources presently managed are: Lobster (5.5-inch tails or larger, no gravid females); Caribbean shrimp (seasonal closing of fishery); and curile and mangrove oyster (size restrictions) from the Pacific coast.

In 1980 Honduras declared a 200 nautical mile EEZ that gave the country sovereignty rights over the exploitation, conservation and administration of natural resources of the ocean floor, subsoil and overlying waters. An interministerial committee has been formed to assist in implementing the law. RENARE is responsible for enforcement in freshwaters and in the oceans out to the 200 mile limit utilizing its own inspectors, the merchant marine and the armed forces.

RENARE has two research stations, an agricultural laboratory and a marine laboratory in La Ceiba. The latter consists of little more than an empty house with a preferred seaside location. With the proper modifications it could be most suitable as a center for marine investigation. Five biologists work for the Department with a current annual budget of $80,000.

In 1978, a joint loan project of the IDB the EEC, and Honduras was initiated to organize and assist five fishing cooperatives. The four objectives of the project are:

- To establish a line of credit for the fishermen in the cooperative to acquire boats and equipment.
- To construct adequate landing facilities in La Ceiba, Tela, Trijillo and Puerto Cortes, and Coyolite-Amapala.
- To provide adequate processing, preservation and distribution facilities.
- To provide technical assistance to the cooperatives.

The loan, which amounts to $3.4 million, has been badly administered resulting in frequent delays. One result was the removal of the program from the Fisheries Unit of RENARE to a

position directly under the Secretariat of Natural Resources, from where it is presently administered.

ADMINISTRATION OF COASTAL RESOURCES

Legislation

Coastal resource management in Honduras is fragmented among a diverse array of agencies at different levels in the government hierarchy. This management effort is characterized by conflict of interest, lack of coordination, and differing levels of human and financial resources which too often result in weak programs and consequently degradation of resources.

Relevant legislation in the civil code defines the coastal zone as the area from where the waves first break to the highest sea level. The territorial sea begins at the lowest sea level and extends to 12 nautical miles. An EEZ is recognized extending to 200 nautical miles. No one is allowed to construct or place objects in the coastal zone without prior permission. This does not apply to the coastal fringe where development is primarily managed by the local municipalities with the exception cited below. Honduran nationals can own property up to the coastal edge but foreign nationals must take a minority position in lands within 50 kilometers of the coast. This does not apply to urban-zoned areas such as the Bay Islands.

Agencies

Government agencies and their respective legislation pertinent to coastal zone management include:

RENARE. Through this organization responsible for management of renewable resources, fishermen are allowed to place structures, boats and equipment in a 50 meter zone behind the high tide mark without impediment. Other pertinent legislation protects aquatic, river, coastal and marine flora and fauna by means of permits required for harvest. A permit is required to mine calcareous desposits from the coast, lakes and lagoons.

COHDEFOR. The corporation controls mangrove areas where permission is required to remove any tree. The extensive area of mangroves in the Gulf of Fonseca was declared a protected forest zone in 1961.

INA. As the agency responsible for agrarian reform INA administers the utilization of many agricultural lands and presently manages salt extraction from Honduran coastal zones, though without legal mandate.

DMHC. The agency is responsible for all mining and petroleum activity including coastal and outer continental shelf activity and the related environmental issues associated with mining.

IHT. The agency has the power to designate an area as a tourist zone, requiring that future development not despoil the particular quality of the area that justified the designation.

ENP. ENP is an autonomous agency created to administer the country's ports. It regulates the building of artificial stuctures in the coastal zone and is charged with enforcing legislation preventing ship discharges in ports or adjacent waters.

SECOPT. Public works administers the construction of large scale projects for public benefit, such as roads and power plants.

The Municipios. Each municipality has a certain degree of autonomy to develop the coastal zone within the constraints of the law.

Agents of Enforcement. These include each GOH agency's respective

inspectors; local police; customs agents; the merchant marine; and armed forces.

ISSUES AND RECOMMENDATIONS

Mangrove Management

The most illustrative example of management conflict is the mangrove problem in the Gulf of Fonseca. By law mangrove management is the responsibility of both COHDEFOR and RENARE, although no formal mechanism of coordination exists between the two. The principal need for utilization of mangroves comes from the salt producers, a sector managed by INA. The problem of coordination is compounded by the dependence of poor people in the area upon the mangrove as a source of fuel, construction material and tannin. The larger areas of clear cutting of mangroves for industrial salt production have been legal (from COHDEFOR and INA's perspective) while local harvesting, although illegal, is acknowledged as a social and economic problem that is difficult to address. The solution to these types of conflicts have been the formation of informal coordinating groups between agencies rather than creation of formal interministry councils.

The key to sustained mangrove management is the subsitution of solar energy for fuelwood in salt manufacture. The elements of a management program include a pilot project, an educational effort, and technical assistance and extension. The areas suggested for such a project would be the relative barren salt flats behind the estuaries that are similar to the locations utilized for marine shrimp production. Different methodologies should be tested to determine the best alternative to convey estuarine water to solar ponds (small, locally built pumps, windmills, etc.). Additionally the feasibility of utilizing these salt ponds as aquaculture facilities during the wet season should be evaluated. The potential for cooperative efforts needs to be studied. Once such efforts are demonstrated to be economically and ecologically viable, a public education and extension program should follow.

Watershed Management

As USAID already funds a watershed management plan in the headwaters of the Choluteca watershed it should integrate the remaining components of the watershed, namely, the intensely farmed coastal plain and estuarine area, into its management efforts. The issues that need to be addressed are the fate of pesticides and effects of their use in the Gulf, the degree to which irrigation is increasing the possibilities of salt intrusion in the Choluteca, and the effect that increased sedimentation is having on changing the Bay's existing circulation patterns and productivity. For example, loadings of pesticides and sediments from the Choluteca watershed have an indeterminate effect on the productivity of Fonseca estuary.

Coastal Zone Management

Presently in Honduras there does not appear to exist either the need or available resources for the creation of a national coastal zone management unit. Such a unit will have an important role to play as infrastructure develops, more areas of the coastal zone become accessible (most notably in the northeast coast), and interagency problems become more formidable. When coastal zone management becomes a necessity CONSUPLANE, as the national coordinating and planning agency, would appear to be the most approrpiate agency for consideration.

Gulf Management Plan. As a intermediate step in achieving coastal

resource conservation, a gulf management plan should be developed. Based on the assumption that the political climate will improve, such a plan would entail cooperation on a local, regional, national and international level. As difficult as that may seem, one must not underestimate the role of economics in regional cooperative efforts. The countries that border the Gulf of Fonseca benefit from it in many ways, mostly as a source of protein, salt, and exports and as an access to the Pacific. These shared interests favor possibilities for regional development and management.

Until such a time when more appropriate management steps can be taken, environmental issues such as those outlined above will require individual treatment by committees of technical personnel from relevant agencies. Every government institution with certain responsibilities in coastal management has a technical group, though few of these have an environmental capability. Where absent, an environmental scientist at the licenciatura or master's level should be added to the respective agencies' technical groups. This could be required through an additional article in the environmental law presently before congress and would entail very little additional monies in the agencies' budgets.

The northern coastal lagoons are one of the few remaining untapped natural aquatic resources in Honduras. As such, should be evaluated to both demonstrate the important role they play in adjacent coastal ecosystems and to show how they can be managed to serve as major sources of protein. Resource inventories should be followed by monitoring for 1-2 years to better understand the dynamics of these lagoons. This period should be followed by harvesting and implementation of management recommendations with th objective of determining an individua lagoon's maximum sustainable yield a sources of protein.

Constraints on Management. Under lying the problems encountered i coastal resource management is the lac of adequately trained personnel an supporting facilities.

Recommendations for Improving Man agement. A two-component process i recommended to build up existing or t construct new physical infrastructur for purposes of providing a marin research facility, and of supplying mechanism to send qualified candidate abroad to specialize in marin sciences.

The first component could consist o a four-way agreement involving a international development assistanc institution, private sector benefici- aries of marine research, RENARE, and the Universidad Nacional Autonoma de Honduras. The assistance institution could provide financial and possibly technical assistance to develop the facility; and RENARE/UNAH would provide counterpart personnel. The private sector could provide aid in the form of leasing available seaside facilities (Aqua Finca, Sea Farms) and of shiptime (Hybur Mariscos, Mariscos Agua Azul). An alternative would be to outfit the present seaside facility in La Ceiba managed by RENARE.

The second component would be the provision of five fellowships to Honduran natural science graduates to study marinesciences at the masters level at an appropriate institution in the region.

Only by creating a mechanism to train Honduran marine resource specialists can issues such as ineffective fisheries management, coastal environmental degradation, and fisheries development be adequately addressed.

VIII. WILDLANDS UTILIZATION AND MANAGEMENT

INTRODUCTION

This chapter discusses a number of concerns associated with the management of wildlands (natural areas) and their biotic resources:

- Legal and regulatory considerations.
- Responsible institutions and key activities.
- Utilization of wildlife resources.

The HCEP team draws a number of conclusions and formulates a series of recommendations to improve the management capabilities of Honduran institutions to appropriately address wildlands issues.

LEGAL AND REGULATORY CONSIDERATIONS

At this time laws pertaining to protection and management of wildlands are either on paper but not enforced or non-existent. Those that directly or indirectly pertain to wildlands are scattered among several different agencies and are generally not utilized in efforts to protect natural areas. A brief review of the relevant laws and legislation is included in Table VIII-1.

An environmental law which addresses the issue of national parks and wildland management was drafted in 1975. Since then several modified versions have been elaborated, and at this time two separate laws, both dealing with environmental protection, parks and wildlife have been proposed. The RENARE version is called the "Law for the Management of Wildlife and Environmental Resources." It proposes guidelines to derive more specific laws dealing with wildlife, wildlands, environmental protection. CONSUPLANE has also drafted a law entitled "The Basic Law for Environmental Management." It will also be used as a basis to elaborate more extensive legislation.

RESPONSIBLE INSTITUTIONS AND KEY ACTIVITIES

Department of Wildlife and Environmental Resources

Although many institutions are legally related directly or indirectly to wildland protection and management, the RENARE's Department of Wildlife and Environmental Resources (DWER) has been the forerunner in assuming this responsibility. While many other governmental and non-governmental agencies have assisted in these efforts, RENARE has been the principal promoter and organizer of wildland planning and managing efforts. Activities carried out by other institutions in support of wildland conservation are outlined in Table VIII-2.

Structure and Organization. The DWER is one of the four major departments in RENARE which falls under the Ministry of Natural Resources. The Departments of Fisheries, Artisanal Fisheries, and Investigation comprise the rest of RENARE. DWER is organized into the following Divisions: Wildlands Management; Wildlife Management; Extension and Environmental Education; Environmental Management; and Inspection.

DWER's general goals are to:

- Formulate general policy related to the utilization and

TABLE VIII-1

LEGISLATION RELATED TO WILDLAND MANAGEMENT AND PROTECTION

LEGISLATION	RELEVANCE	ENFORCEMENT AGENCY	STATUS
Decree No. 103 COHDEFOR Law and Decree No. 85 Forestry Law	These laws describe both the forest harvesting role of COHDEFOR as well the forest management and protection activities of this agency. Watershed control is included as well as national parks although this was left in the Ministry of Natural Resources when the forest Sector of Natural Resources was reorganized into the semi-autonomous COHDEFOR	COHDEFOR	Watershed management and forest protection having not received nearly the emphasis that forest production has experienced. Many aspects of the law lay the foundations for sound wildland management (mangrove protection for example) but are seldom applied or complied with.
Decree No. 170 Agrarian Reform Law	The Agrarian Reform Law facilitates the redistribution of large land holdings. It has relocated many groups of campesinos and is also charged by law to promote their appropriate use of the land through education and technical assistance.	INA	INA has failed to incorporate environmental variables into their agrarian reform program. Campesino groups have been moved onto or near fragile ecosystems, technical training and extension have not been included in relocation programs and stabilization of migrating agriculturalists has not been achieved.
Decree No. 30 Superior Council for Economic Planning Law	This planning body includes among its priorities the promotion of sound land use planning, environmental management and protection of wildland areas.	CONSUPLANE	Although CONSUPLANE has been very progressive in its treatment of environmental and natural resource affairs, in reality it wields little power and is seldom considered by those agencies that are actually carrying out environmentally related projects.

TABLE VIII-1 (Continued)

LEGISLATION	RELEVANCE	ENFORCEMENT AGENCY	STATUS
Constitutional Law of SANAA	SANAA is charged with the study, creation and management of potable water systems for the country. They are also involved in protection of important watersheds and were at least in part responsible for protecting the La Tigra Cloud Forest before it was declared a national park.	SANAA	SANAA's vigilance of important watersheds has been deficient. They have also failed to actively petition for cooperation with other agencies impacting forest resources such as COHDEFOR and INA.
Decree No. 23 Vegetative Sanitation	This agency is involved in not only the control of importations of plants and animals but also that of and other agricultural chemicals.	The National Service for Sanitary Animal and Plant Production	In reality little is done to prevent both the introduction of exotic plants and animals nor to monitor the use of potentially toxic agricultural chemicals.
Decree No. 64 Mining Code	The Mining Code outlines standards for maintaining both human and environmental health in mining operations.	DMHC	Mines has not enforced any environmentally related legislation, especially in the case of the El Rosario mine near Lago Yojoa.
Ley Organica of the Honduran Institute of Tourism	Natural Resoures Protection if relates to tourism included in this law.	Honduran Institute of Tourism	Although tourism has participated in coordinated efforts to protect tourism related natural environments (Lago Yojoa for instance) they have not taken the initiative to promote environmental management themselves.
Anteproyecto de la Ley de Pesca - Fisheries and Decree No. 154 Fisheries Law	Besides managing both commercial and artisanal fishing, these laws also protect mangrove and coral ecosystems from destruction and contamination and protect some endangered species such as the	RENARE	Little has been done in the field to protect important marine habitat such as mangroves. Control of turtle egg collection and the killing of manatee has been attempted but success has thus far been limited.

TABLE VIII-2

WILDLAND CONSERVATION EFFORTS IN HONDURAS (EXCLUDING RENARE)

Agency	Efforts	Commentary
1. COHDEFOR	Has cooperated periodically with RENARE on the La Tigra National park, the Lago Yojoa Multiple-use Area and the Rio Platano Biosphere Reserve. They have recently established and are attempting to protect a large region of hardwood forest which is adjacent to the Rio Platano Reserve. They are involved in forest fire protection and forest management around the country.	COHDEFOR with field personnel in virtually every sector of the country has tremendous capability to assist in sound resource management. However, this has been of low priority for the agency and forest exploitation is by far receiving the greatest focus of attention. Their Watershed Unit has been almost disbanded and few activities of this nature are being carried out.
2. IHT and IHAH	These two agencies have both allied with RENARE on occasion to promote several wildland management projects. IHT itself is attempting to initiate an extensive environmental study of the Bay Islands while IHAH manages the Copan ruins and is attempting to survey the entire country for archelogical sites.	Neither of these agencies is well-versed in environment management, they are nevertheless willing supporters of related activities. While lacking political power, their efforts combined with RENARE's has been instrumental in promoting wildland protection.
3. CONSUPLANE	CONSUPLANE has attempted to incorporate the environmental variable into its elaboration of the country's current "Five Year National Development Plan." The plan includes not only guidelines for establishing an environmental watchdog agency but also supports the creation of a comprehensive wildlands system. They have recently drawn up a draft environmental protection law which includes general aspects of wildland management.	CONSUPLANE has a few ambitious and skilled professionals working on environmental issues but little actual power or influence among government agencies. If their status could be elevated they could become the guiding force in environmental affairs in the country.

TABLE VIII-2 (Continued)

Agency	Efforts	Commentary
4. UNESCO	The national MAB Committee was formed initially to facilitate integrative input from different governmental and non-governmental agencies. It is made up of representatives from a variety of institutions.	The MAB Committee provides a standing inter-institutional forum for collaboration on natural resources issues. Unfortunately, the group has been in active for the last year.
5. U.S. Peace Corps	Peace Corps has been involved in wildlands management efforts from their inception. Though once in a planning capacity volunteers are now doing field projects. There is one volunteer working specifically on wildlands at DWER and several others in the Department. Some 18 PCVs are working with COHDEFOR, mostly in social forest programs.	Peace Corps can provide technical assistance but only if there is adequate support for them from their host agency. RENARE could benefit from additional technical backstopping, but at this time does not have the capability to take on more personnel.
6. CATIE/WWF	The has supported the Rio Platano Project with a total donation of $50,000 thus far. The money is managed by the Wildland Management Unit at CATIE which serves as a liaison between RENARE and WWF. The Wildland Unit has provided technical support for several DWER projects and has organized several wildland management related workshops and seminars in which Department Personnel have participated.	The world Wildlife Fund is one of the few international conservation groups which is financially supporting what it advocates. It's contribution has kept the Platano Project moving. CATIE has also been instrumental in guiding DWER's wildland and wildlife strategy although they themselves are over extended and have not been able to devote the attention to Honduras that it deserves at this critical time.
7. Swiss Government	The Swiss Government has expressed interest in supporting wildland management in Honduras and has sent a team to study the current situation. The team proposed the following projects to be supported by $1,062,00 from the Swiss Government: - Creation of a separate Wildland Management Agency. - Development of La Tigra. - Development of Rio Platano. - Development of watershed study option in ESNACIFOR.	Lack of organization and conflicts of interests on the part of Honduran professionals involved in the proposal has left the offer tabled for the time being. It represents a tremendous opportunity for wildland protection in Honduras and should be utilized. However, Honduras must first determine how and who is going to manage these resources in the future.

appropriate management of wildlife and wildland resources.

- Plan and promote environmental conservation programs.
- Promote environmental education and extension activities including training exercises in environmentally related fields.
- Administer laws pertaining to the utilization and protection of the natural renewable resources managed by this department.
- Elaborate needed legislation pertaining to management of wildlands, wildlife and the environment.

Personnel and Resources. In 1980 the projected budget for DWER was $59,221 (U.S.). Of this, $36,050 was programmed for the zoological park managed by the Department. The actual amount slated for wildland management was about $39,000 which included a large percentage donated by international conservation groups.

Personnel involved in Department functions include:

Function	No. of Personnel Involved
Department Head	1
Management of sport hunting	1
Museum and taxidermy department	4
Sepentarium and venom extraction centers	3
Wildlife management	3
Extension and education	3
Wildland management	10
Wildlife and fisheries inspectors	35
Zoological park	23
Secretaries	2
Total	85

Most of the employees have not been formally trained in natural resource related fields although the Head of the Department does have a Master's Degree in environmental studies. Several Peace Corps volunteers and three nationals make up the technical staff (2 other Honduran biologists are working on their Master's Degrees outside of the country). Other promoters, technicians, and inspectors have been trained on the job and demonstrate varying degrees of environmental awareness.

Equipment is basic and vehicles, which are shared by the entire RENARE staff, are scarce. Only ingenuity and making do with what is available has permitted many wildlands and wildlife related activities to be carried out.

The meager financial resources available are often misused, occasionally from necessity rather than by choice. Such is the case with the zoological park, which consumes most of DWER's budget. Probably the best example of underutilization is the case of the wildlife and fisheries inspectors. From lack of training and motivation, most are doing a substandard job and some are actually causing more damage than good to the image of RENARE. The inspectors have the potential for providing adequate protection for the fauna of Honduras and for assisting biologists in the collection of invaluable baseline data. Thus far they have done neither and, without extensive training and motivation, will probably not do so in the future.

Departmental Strategy. In recognition of the importance of finances in a developing nation like Honduras, DWER has taken a pragmatic approach to natural resource protection and management. Although the maintenance of ecological integrity is the primary goal of the Department, management strategies stress utilization of resources in a rational manner. This ecodevelopment approach (sustained economic development which is both environmentally and culturally sound) is evident in many of DWER's activities

and projects; examples include the Rio Platano Biosphere Reserve and the commercialization of wildlife species. An approach of this nature must be based upon a solid understanding of the resource to be managed, frequently requring planning and research as prerequisites to the initiation of projects.

Environmental Education. Education is considered an important component in many of the Department's activities. Extensionists have carried out activities for decision makers (The First Honduran Seminar on Ecological Problems); for the general public (Earth Day 1981); with campesino groups (Environmental Education in the Rio Plateno); and for the Public Education System (First National Seminar on Environmental Education).

Environmental education programs, launched principally by RENARE in 1975, initially focused upon ecological concepts and theory. The medium of communication was a group of traveling extensionists that visited schools and community groups throughout the country presenting movies and informal talks. Current efforts are bringing DWER together with the Ministry of Public Education in a program of regional environmental education workshops for teachers. Recently a National Environmental Education Seminar was held. Recommendations and curriculum suggestions from both the seminar and the regional workshops are being adopted by the Ministry of Education.

Non-governmental efforts in environmental education are concentrated in two organizations. The first, is the fledgling Honduran Ecological Association with approximately 215 members. It was granted $25,000 from AID for program development. The Association is divided into four work groups: fauna, wildlands, environment, and environmental education. The first three groups collect information and develop programs for the last group to disseminate.

The Department of Biology of the National Autonomous University of Honduras, has grown from five students in 1975 to approximately 120 in 1981. There are 45 instructors and 15 teachers, of whom many are members of the Ecological Association. Although there are no specific classes in wildlife and wildlands management, facets of those subjects are at least superficially incorporated into more traditional biology, botany and ecology courses. There is a great interest, however, in implementing programs of this type if funding or technical assistance can be procured. A demonstration of the students' interest in such matters was the recent creation and rapid growth of the Association of Young Environmentalists of Honduras. This organization is a splinter group of a regional association of science students that recently held their annual meeting in Honduras and spent several days at the La Tigra National Park.

The advent of several different environmentally related non-government organizations in Honduras signifies a growing interest in sound natural resource utilization. A major problem though, is that "environment" is still in a sense an academic concept limited to use by students and a small cadre of professionals. While this is an important group, the program should be expanded to reach the general public, decision makers, and rural poor who form the group most in contact with the resources. Approaching decision makers to support intensive education programs is a necessary first step in gaining the institutional support needed to initiate an environmental awareness campaign that is truly national in scope. For reaching the general public, mass-media, such as television, radio, and newspapers, can be very effective but has not been utilized to any great extent.

Projects. In 1976 RENARE technicians drafted a plan for the first comprehensive survey for potential wildland units to be managed. The study was meant to collect basic natural and cultural data on several of

the more outstanding wildland areas, to assess their value as potential parks and equivalent reserves, and to develop priorities for protection and development. The survey stressed not only the creation of national parks, but also the formation of a complete wildlands system where each area is managed according to its resource characteristics. A representative program objective would be the conservation of samples of each major ecosystem and associated flora and fauna, in order to provide opportunities for research and education, commercial production of wildlife and plant resources, and recreation and tourism. Sixteen potential areas have been identified (Figure VIII-1).

The approximate land area proposed for protection at this time is 636,700 hectares or approximately 5.86 percent of the national territory. This area subdivides into the following groups:

- approximately 150,000 hectares of marsh, swamp, mangrove, lagoon or coral reef;
- approximately 351,000 hectares of areas with steep slopes unsuitable for agriculture;
- approximately 135,700 hectares of tropical rainforests for which ecologically and economically sound forestry and agricultural practices have not been developed.

With regard to the status of the survey, four areas have been extensively studied: Cusuco, La Tigra, Rio Platano, and Lago Yojoa. Several areas have been visited: all of the lagoons, Roatan, Pico Bonito, Santa Barbara, Celaque, and the Rio Cuero. Management plans have been written for three areas: La Tigra, Rio Platano, and Lago de Yojoa. Active site management is being carried out at La Tigra and the Rio Platano.

To this list of predominantly broadleaf forested areas should be added the legally declared pine and hardwood forest reserves of COHDEFOR. These reserves, in various stages of management and exploitation, when added to RENARE's proposed wildlands system, completes the coverage of major ecosystems in Honduras.

RENARE Wildland Management Case Studies

Two case studies are discussed below.

La Tigra Cloud Forest National Park. Several factors make it an ideal pilot national park: its importance in protecting Tegucigalpa's watershed, scenic beauty, ecological importance, and proximity to the capital. Natural and cultural resource investigations were carried out in 1977, and, with data gathered during the resource inventory, a management plan was written. The plan itself is unique in that it accommodates farmers and others living within the reserve and proposes utilizing them as park employees instead of expropriation. According to the management plan, such people would be involve in appropriate agricultural projects such as terracing and agroforestry and establishing nurseries to grow ornamental plants for sale to park visitors. Initial implementation of the plan has accomplished the following: environmental education programs were initiated in nearby grade schools and a visitor's center was created in the abandoned housing of the Rosario Mining Company which once operated in the area.

In 1980 the 7,500 hectare zone was officially declared a national park. One hundred thousand dollars from COHDEFOR was promised for development of the project and DWER organized several interinstitutional seminars and meetings on the park. However, in 1981 the money from COHDEFOR had still not been received and communications between the two agencies had almost stopped. The 1981 budget for La Tigra was a mere $6,000. Lack of funding, coupled with a lack of trained technicians, is causing the project to stagnate. Management activity in the zone

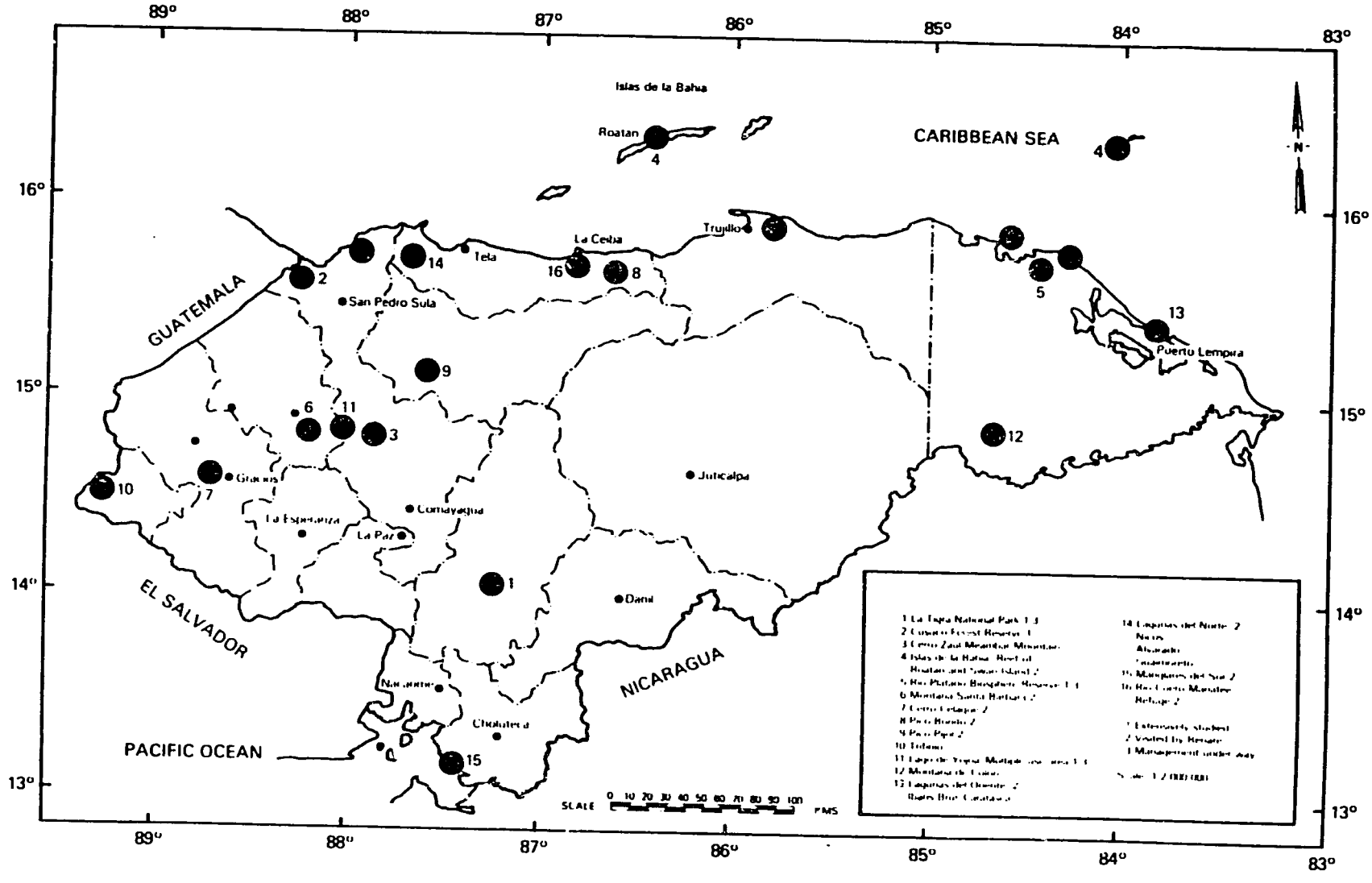


Figure VIII-1. Potential wildlands management units.

has not ceased completely, but it is nowhere near the appropriate level for a newly created pilot national park with a management plan to implement. Degradation of this important resource continues as farmers clear forest vegetation and COHDEFOR itself attempts to construct communication towers in the heart of the park. Agricultural extension programs were slated to be initiated in 1981. However, no other major activities are planned in the near future.

Rio Platano Biosphere Reserve. The 180,000 hectare Rio Platano watershed was initially investigated by an interdisciplinary team of DWER professionals in 1977, supported by technical assistance from the Wildlands Management Unit of CATIE, Turrialba, Costa Rica. The combination of primary rainforest and extensive archeological sites and two indigenous groups warranted the inclusion of the Rio Platano area in UNESCO's Man in the Biosphere (MAB) Program as a reserve. MAB seeks to establish and appropriately manage representative samples of major global ecosystems. These areas will not only protect genetic resources but can be utilized as experimental grounds for determining man's impact upon the environment and methodologies for mitigating negative effects. Biosphere reserves can also accomodate human populations, especially if they are demonstrating environmentally sound lifestyles.

The management plan for the Rio Platano Biosphere Reserve includes baseline natural and cultural data, a zoning scheme (cultural zone, buffer zone, special use zone and core or "natural" zone) and reserve management programs. The draft plan was reviewed by several agencies as well as the indigenous inhabitants of the reserve. The resultant document is now being implemented. A resident of the region has been hired as the Reserve Director and is assisted by a small team of forest guards. A Reserve headquarters has been built as well as a small structure in the interior for use scientists and guards.

In 1980 the area was legal declared a protected Biosphere Reser by the government. World Wildlife Fu has donated $20,000 annually to t effort and CATIE and UNESCO continue provide technical support when neede RENARE meanwhile has budgeted $4,6 for the project in 1981.

The development of the site appea to be moving ahead despite logistica technical, and financial problems However, as outside pressure fr logging interests and migrating agri culturalists mounts, management an protection of the region will be a muc more formidable task. Also, if inte national funding were to be cut off, i is doubtful that the project coul survive. Future plans call for in creased vigilance, especially in th upper watershed where encroachment i most likely to occur, and for enviro mental education and extension work t continue. Scientists from othe nations have expressed interest i utilizing the Reserve and some group have already begun studies. The Ri Platano Project appears in general t be in fairly sound condition - if onl for the time being.

UTILIZATION OF WILDLANDS RESOURCES

Medicinal Plants

Although in its infancy, the collec tion and industrialization of wil plant species for medicinal purpose appears to hold great promise. Con sidering that over 25 percent o today's medicines are derived fro tropical plants and that the tropica forests in Honduras have received onl cursory study, it is reasonable t assume that many potentially useabl plants occur there.

The government has been investigat ing several species and has begun t

cultivate and process the Calajuala (Polypedium leucotomos), used in cancer research. Rural people rely heavily upon dozens of medicinal plants for a variety of maladies and can often assist ethnobotanists in identifying potential plants for assaying medicinal properties.

Faunal Resources

From both an ecological and economic perspective, Honduran faunal resources are of exceptional value. Responding to the diversity of life zones, a wide array of species ranging from the magnificent quetzal to the manatee find suitable habitat within the nation's borders. And the geographic location of Honduras - the bridge between North and South America - is manifested in the interesting mix of temperate and tropical species; for example, monkeys and white tailed deer share the same woodland. The region is also the temporary home of many migrating species, including the white-winged dove and the green turtle (Chelonia mydas). Species listed include 112 mammals, over 700 birds and 196 reptiles and amphibians. Of these roughly thousand species, 27 species are considered to be in danger of extinction (Table VIII-3). Habitat destruction, especially in the rainforest, and overhunting represent the major threat to these species.

Source of Protein. Although proposed by CONSUPLANE, no comprehensive nationwide survey on the utilization of wildlife as a food source has been carried out. In rural areas wild animal species are an important protein supplement to the diet of the rural people (Figure VIII-2). Even in urban areas it is not uncommon to find wildlife such as iguana, armadillo and to find sea turtle eggs sold in local markets. Some of the other more preferred species for food include: white-tailed deer, collared and white-lipped peccary, paca, tapir, manatee, chachalaca, curassow, blue-winged teal, green and scarlet macaws, white-winged dove, rabbits, squirrels, monkeys, several turtle species and a variety of fish and shellfish. Hunters who use small caliber rifles often wound animals allowing them to escape (resulting in wastage of much meat). Although, some hunters comply with hunting regulations, many do not, and the regulations and seasons themselves are often based on insufficient baseline data.

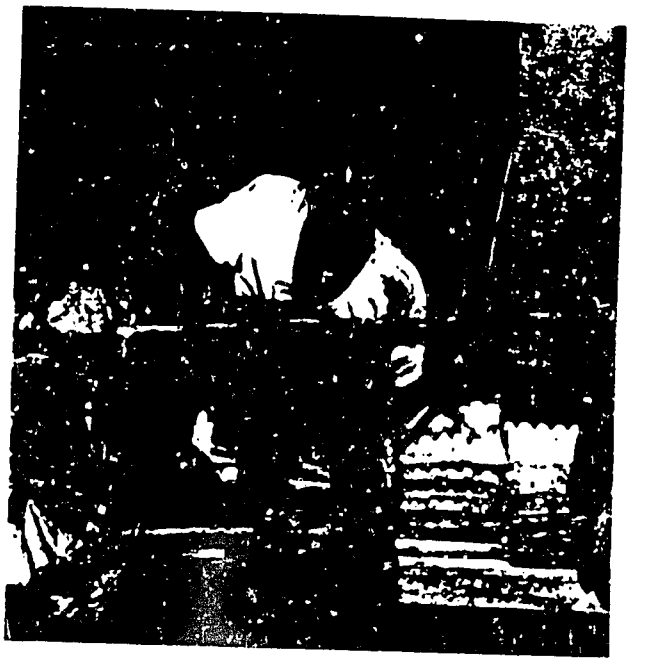


Figure VIII-2. Wild animals such as iguana are used as a source of protein by local people. Sometimes illegal harvesting of wildlife presents a dichotomy of values and generates disagreement as to appropriate management policies *(Courtesy of P. Dulin).*

Of major concern is the collection of sea turtle eggs on both coasts. Although a percentage of the eggs collected are consumed by the rural poor, a greater portion is shipped to the major cities for sale as "bocas" which are served with drinks in bars. During certain periods of the year a single turtle egg may bring up to 75 cents.

Sport Hunting. Sport hunting is generally carried out by North Americans coming to Honduras to hunt

TABLE VIII-3

THREATENED OR ENDANGERED HONDURAN WILDLIFE SPECIES

Species	Habitat
Giant anteater (*Myrmecophaga tridactyla*)	Tropical rain forest
Ring-tail cat (*Bassariscus sumichrasti*)	Tropical rain forest Montane rain forest
Grison (*Galietis allamandi*)	Tropical rain forest
River Otter (*Lutra annecteus*)	Tropical rain forest
Jaguar (*Felis onca*)	Tropical rain forest Montane rain forest (Can live in other zones but generally not found there in Honduras)
Howler Monkey (*Alouatta villosa*)	Tropical rain forest Cloud forest
Ocelote (*Felis pardalis*)	Tropical rain forest Montane rain forest
Margay (*Felis wiedii*)	Tropical rain forest Montane rain forest and cloud forest
Manatee (*Trichechus manatus*)	Atlantic coastal lagoons and river mouths
Tapir (*Tapirus bairdii*)	Tropical rain forest Montane rain forest
Brocket deer (*Mazama americana*)	Tropical rain forest
Quetzal (*Pharomachrus mocinno*)	Cloud forest and Montane rain forest
Harpy eagle (*Harpia harpyja*)	Tropical rain forest
Scarlet Macaw (*Ara macao*)	Tropical rain forest
Yellow Lored Parrot (*Amazona xanthchlora*)	Bay Islands

TABLE VIII-3

THREATENED OR ENDANGERED HONDURAN WILDLIFE SPECIES (CONTINUED)

Species	Habitat
Wedged-tailed sabrewing (*Campylopterus curvipennis*)	Tropical rain forest
Crested guan (*Penelope purpurascens*)	Tropical rain forest
Great Curassow (*Crax curassow*)	Tropical rain forest
Banded tiger heron (*Tigrisoma fasciatum*)	Lowland tropical wetlands
Solitary eagle (*Haliaetus solitarius*)	Tropical rain forest
Crested eagle (*Morphnus guianensis*)	Tropical rain forest
Carey (*Carey caretta*)	Coastal zones
Green Sea Turtle (*Chelonia mydas*)	Coastal zones
Hawksbill sea turtle (*Eretmochelys imbricata*)	Coastal zones
Pacific Ridley Sea Turtle (*Lepidochelys olivacia*)	Coastal zones
Leather back (*Dermochelys coriacea*)	Coastal zones
American crocodile (*Crocodylus acutus*)	Coastal zones in lagoons swamps and rivers.

white-winged doves in the Choluteca area. The dove hunters represent an annual income averaging approximately $800,000 to the country of Honduras in the form of airline tickets, hotels, and services. Their bag limits are regulated to some degree, and relatively extensive data have been collected on the doves and dove hunting. National hunting clubs, while concentrating on food species, periodically pursue trophy animals such as jaguar,

puma, and ocelot. Foreign hunters are also known to occasionally hunt these rare animals. The hunting clubs do present a point of focus for wildife extension work and for the collection of hunting related data. Destruction of habitat, uncontrolled hunting, and heavy pesticide use in some areas contribute to reduction in wildlife population.

Pet Trade. Legal export of exotic wildlife species is economically significant in Honduras. In 1979, a variety of animals with a street value of at least $420,000 were shipped out of the country, mostly to the United States and Holland. Export taxes on these species amounted to approximately $47,000 (U.S.), but the money is not earmarked for conservation activities. Little revenue trickles back into wildlife management programs. Although allowable export of some species is based upon studies of population dynamics, many other species are exported without a determination of impact of reduction of their numbers by harvesting and exportation. Also, it is certain that illegal shipments of rare or endangered species such as cats and macaws still occur. Dealers in exotic animals receive high prices for their sales, those that actually procure the game receive relatively little compensation for their efforts.

While exportation of rare or endangered species is banned, it is not illegal for residents to keep them as pets in their homes. Macaws, monkeys, kinkajous and occasionally cats, such as margays and ocelots, are seen in private homes, hotels and businesses.

Skins and Furs. Although the ban on imports of products made from endangered species into the United States has limited the exports of skins, there is still a high demand for spotted cat, lizard, crocodile, and cayman skins in the European market. In 1979, legal exports of cayman and crocodile totaled about 1900 skins.

Tourism and Recreation

Natural areas represent an important element in future tourism development in Honduras. Both foreign and national vacationers are attracted to the beaches and coral reefs of the Caribbean coast and to the Bay Islands. Improper development, particularly in the Bay Islands, detracts from the aesthetic appeal of coastal areas and threatens offshore reefs.

Given adequate infrastructure and management, Lancetilla Botanical Gardens, the La Tigra National Park in the cloud forest, and such lowland rainforest areas as the Rio Platano Reserve could become important tourist attractions. Interest groups include bird watchers, orchid enthusiasts, and those attracted by wilderness experiences. The appeal and economic value of natural resource-based tourism continues to grow as development pressures result in conversion of wildlands to agricultural use.

Education

Wildland areas provide unique outdoor laboratories where people can learn from first experience about the environment in which they live. Environmental education in parks and wildlands has globally been accepted as one of the most efficient means of promoting an awareness and active participation in resource management and protection. In a country such as Honduras where natural resources are playing such a key role in development, a major thrust of educational programs should be directed toward understanding the environment and man's role in managing it.

CONCLUSIONS AND RECOMMENDATIONS

- Create an Environmental Coordinating Committee. A centralized

coordinating body should be created to guide, monitor, and evaluate the diverse natural resource efforts in the country. This multidisciplinary team would work closely with environmentally related programs and serve as a communications link between them. They would establish an environmental data bank which would gather and disseminate all relevant information related to natural resource management in Honduras.

- Integrate Wildlands Into Land-use Planning. Wildlands should be recognized as an integral component of a regional development planning strategy. Wildlands provide such goods and services as water, fuel construction materials and protein in support of the agricultural and urban-industrial sectors.

- Implement a National Environmental Education Campaign. A concerted effort on the part of both governmental and non-governmental agencies to establish a national environmental education campaign should be initiated immediately. Steps would include: drafting an environmental education strategy; and organizing and implementing programs. The campaign should focus upon four major target groups: decision makers, students, the general public and rural people. The orientation of the program must be very pragmatic emphasizing solid and appropriate solutions to major natural resource problems.

- Formulate Wildlife and Wildland Management Laws. A first step toward achieving adequate protection of wildlands and wildlife is to establish a legal mandate. Such laws must clearly define procedures for incorporating values concerning natural systems into development planning.

- Restructure the Wildlands and Wil life Managing Agency. DWER co tinues to be burdened with expensi and time consuming tasks such managing the zoological park, t museum, and the environmental mon toring program it will never fulfi its management mandate.

  Two alternatives for restructu ing are suggested here: establi DWER as a separately budgeted pr gram; or establish in COHDEFOR separate Department of Parks a Wildlife which would also inclu their watershed unit, and soci forestry and extension program The latter arrangement would ideal from an ecodevelopment pe spective since it would emphasize integration of social and ecologic concepts into the planning and ma agement of wildland areas. F either alternative, it is importa that adequate long term fundin equipment, and personnel needs included in the restructuring of t Department.

- Conduct a National Wildlife Inve tory. A national inventory of wil life species is needed which ident fies population numbers, range ecology, population dynamics a utilization by people. Such inventory would provide a firm ba upon which to plan future wildli research and management policies a practices. Priority studies whi build upon the inventory resul should focus upon endangered sp cies, species of commerical val and key habitats. Wildlife inspe tors, besides enforcing wildli laws, should be trained in extensi and environmental education a should also be capable of assisti biologists in the collection data. Also, vigilance agains illegal hunting practices would stepped up considerably.

IX. WATER SUPPLY AND WASTE MANAGEMENT

INTRODUCTION

This chapter reviews environmental problems and the human health consequences of pollution in Honduras. Consideration is given to water resources and supply, wastewater collection and treatment, agricultural and industrial pollution, air quality, and solid waste management. A review is made of each of the above areas, evaluating available data and practices to arrive at recommendations for action. These recommendations are particularly tailored to the economic and technical realities of the country.

Honduras is divided into 18 departments with 283 municipalities and 20,792 communities. In 1980, the population was estimated at 3,691,030 persons, of whom 34 percent were living in urban centers and the remaining 66 percent in rural areas. Those percentages are expected to change to 51 and 49 percent, respectively, by the year 2000. According to the latest official census (1974) there are 13 urban areas with a population greater than 10,000 persons. The major urban centers are Tegucigalpa, San Pedro Sula, La Ceiba, El Progreso, Choluteca and Puerto Cortes. San Pedro is also the major industrial center of the country, having all major industry, with the exception of Honduras' only refinery at nearby Puerto Cortes.

WATER RESOURCES

Relative to its land area and its small population, Honduras has abundant water resources. The information that follows describes the specific use of water by each given sector in ea individual watershed and compares with the available water to complete water balance approach. The availab water is almost exclusively surfa. water. There are virtually no data the quality and quantity of groun water. Tables IX-1, 2, and 3 summari water supply, use and demand data f. Honduras.

Water Use

Domestic Supply. The supply situa tion for 1978 is shown in Table IX-: The increase in piped water use sinc the 1974 census was only 1.75 percent In cities, only piped water is likel to receive any treatment to render i potable, indicating that virtually al of the rural residents use water tha is not disinfected. This figure i important in reference to the infan and general mortality rates in th rural areas which are shown in a late section.

In 1974, total human water consump tion in the country was 116,576,60 cubic meters, giving a per capita con sumption of 38.97 cubic meters pe: year. By 1978 this amount increased t 155,864,500 cubic meters and is ex pected to reach 227,378,600 cubi meters by 1983.

Agricultural Use. Irrigation systems were not used in Honduras until the end of the last century. Irrigation started with private systems used in banana plantations and later was extended to use on sugarcane. It was not until 1957 that the government had its first system. Even now, out of the 54,450 hectares under irrigation, 36,000 hectares belong to private banana and surgarcane companies.

TABLE IX-1. DOMESTIC WATER SUPPLY FOR THE HONDURAN POPULATION (1978)

Service	Population: Urban Zone		Population: Rural Zone		Total
Piped water	859,400	(72.64%)	545,000	(24.18%)	1,404,800
Wells	57,600	(4.87%)	1,157,900	(51.32%)	1,215,500
No service	266,100	(22.49%)	552,700	(24.50%)	818,800
					3,439,100

Source: CONSUPLANE (1979)

The potentially irrigable surface area is about 400,000 hectares of which only 13.6 percent is currently under irrigation. If fully utilized, the area currently under irrigation would require a flow of 55 cubic meters per second during a period of six months. Due to serious problems in the irrigation systems, the maximum degree of utilization is now estimated at 30 percent.

During the period 1974 to 1978, the irrigated area increased by 2,950 hectares. This is significantly below the increase that has been registered in other Central American countries. However, projections call for an increase up to 76,930 hectares under irrigation by 1983, which would require an increase in irrigation water from 847.7×10^6 in 1978 to $1,181.6 \times 10^6$ cubic meters per year in 1983.

In addition to irrigation water, agriculture also requires water for animal consumption. These requirements, in cubic meters per year, are estimated for the following years as:

1974	21,530,600
1978	24,486,400
1983	30,128,200

Industrial Use. There are only a few large industries in the country, which means that industrial demand is low, reaching 5.8 percent of the total demand in 1978. The types of industries include:

- A planned pulp and paper mill near Tocoa which will not be a factor in industrial demand until after 1983.
- El Mochito mine in the vicinity of Lake Yojoa, which is discussed separately in the section on industrial pollution, and which has a net production of water due to the water that is released with the minerals.
- Small thermoelectric plants. The largest one at La Ceiba has a usage rate of 6 cubic meters per minute when working. Since it recirculates water, net usage is low.
- The oil refinery at Puerto Cortes uses a very small amount of water (60-70 gallons per minute).
- Eight sugar mills which are large water users.

The figures for total industrial water demand in cubic meters per year are then:

1978	63,549,300
1983	82,989,300

TABLE IX-2. WATER USE/DEMAND BY WATERSHED (M^3/YEAR)

Watershed number	Caribbean	1978	1983
19	Motagua	3,597,600	5,224,200
21	Cuyamel, Tulian and others	4,715,200	6,912,400
23	Chamelecon	206,200,800	278,436,600
25	Ulua	487,306,400	615,961,800
27	Lean, Nutria, Cuero and others	3,434,800	7,919,900
29	Cangrejal	7,912,800	10,016,200
31	Paploteca, Balfate and others	986,400	1,232,200
33	Aguan	141,439,800	167,587,600
35	Sico-Paulaya	765,200	984,000
37	Plantano and Sigre	113,900	163,700
39	Patuca	14,991,000	26,841,600
41 and 43	Warunta and Cruta	234,200	329,500
45	Cocoa or Segovia	2,011,800	3,120,600
	Total Caribbean	873,709,800	1,124,730,100
	Pacific		
46	Lempa	5,932,700	10,821,800
52	Goascoran	2,035,500	2,818,100
54	Nacaome	7,482,000	35,048,600
54-A	Agua Caliente	2,055,300	3,089,700
56	Choluteca	188,764,000	326,929,700
58	Negro and Sampile	10,475,800	16,836,700
	Total Pacific	216,745,300	395,544,600
	Bay Islands	956,300	1,556,700
	Amapala	191,300	282,140
	Total for the Nation	1,091,602,700	1,522,113,600

Source: CONSUPLANE (1979)

TABLE IX-3. WATER DEMAND 1978-1983 BY FUNCTIONAL SECTOR (M^3/YEAR)

	1978		1983	
	Total	Percent	Total	Percent
Human consumption	155,864,500	14.3	227,378,600	14.9
Animal consumption	24,486,400	2.2	30,128,200	2.0
Industrial use	63,549,300	5.8	82,989,300	5.5
Irrigation	847,702,500	77.7	1,181,617,500	77.6
Total	1,091,602,700		1,522,113,600	

Source: CONSUPLANE (1979)

This demand is essentially located in the Choluteca, Ulua and Chamelecon watersheds.

Other Uses of Water. The recreational use of water is virtually nonexistent in Honduras. Navigational uses are also few due to the wide variations in the flow of the rivers.

Water Balance

The water balance figures given in Tables IX-2 and 3 are a comparison of water demand with water availability. It is considered that the available water is equal to the surface runoff with a 75 percent recurrence, based on average measurements taken for at least five years. CONSUPLANE in the 1979-1983 National Development Plan gives a very detailed water balance, by subregions and by month of the year, for each of the watersheds previously mentioned.

Aguan River. There is no actual or expected future water deficit in the total watershed or in any of the subregions. Even in the worst case, the supply is twice the demand for 1983.

Chamelecon River. A deficit appears in the lower reaches during April and May, corresponding to the end of operation for the sugar mills. The projected 1983 deficit is 37,291,000 cubic meters spread over March, April and May. CONSUPLANE has proposed to use groundwater to cover the deficit and to start evaluating the possibility of a dam in the upper reaches. This dam could also help to solve the flooding problem in this watershed.

Choluteca River. This is the most critical watershed in the country. By 1978 two out of its three subregions were operating at a deficit. By 1983 this deficit is expected to reach 36 percent. The main causes for the deficit are the high demands of Tegucigalpa, three sugar mills, and the irrigation district at San Juan de Flores. Problems are compounded by poor watershed management. Proposed solutions to the problems are to:

- Reuse water at the sugar mills
- Improve irrigation efficiency
- Improve long range demand projections
- Build a multiple use reservoir to cover the demand up to the year 2008

- Implement a program of watershed management.

Nacaome River. This watershed will show a 19 percent deficit by 1983 if the proposed new irrigation systems are implemented. CONSUPLANE has proposed to use groundwater to cover this difference.

Patuca River. There are significant amounts of water available, and no deficits are predicted.

Sico-Paulaya River. Current and future requirements are insignificant relative to the amount of water available.

Ulua River. Water availability is not expected to be a problem. The current flooding problem should be solved once the El Cajon project is completed.

Other Rivers. Water deficits are expected to occur in the following irrigation districts: San Juan de Flores, Selguapa and Flores. Proposed solutions are:

- Increases in irrigation efficiency
- Construction of some small dams
- Improved watershed management.

INSTITUTIONAL FRAMEWORK

Pollution Control

Mining. Article 244 of the 1950 Mining Code requires mining enterprises to filter or treat their toxic wastes or wastewaters before discharging them into a receiving water. It suggests the use of ponds as an appropriate technology and sets the total solids concentration that may be discharged as 2,000 milligrams per liter.

Articles 130 and 149 of the same code set civil and criminal responsibility on the head of an enterprise which " . . . . discharges poisonous or toxic substances into rivers, lakes, or creeks, provided that these substances may cause serious damages to third parties."

The enforcement agency is the General Directorate of Mines and Hydrocarbons (DMHC). As shown later in the case of Rosario Resources Corporation, these provisions are loosely enforced.

Industrial. There is no clearly defined government agency or law to regulate wastewater discharges from the industrial sector. The Sanitary Code (Decree No. 75, January 5-6, 1967, Articles 77 and 78) contains a general prohibition against air pollution and other dangers. The Police Law (Decree No. 7, February 8, 1906, articles 310 and 314) contains general provisions for the protection of potable water sources. In reality, none of these are enforced.

Municipal. The municipal sector does not have a regulating agency. The Public Health and Social Assistance Ministry is charged under the Sanitary Code with general environmental sanitation, including potable water supply and wastewater disposal. However, their function is not to regulate these matters, but to help improve water and wastewater management in cooperation with SANAA and the municipalities.

Water Supply and Sewerage

Ministry of Public Health and Social Assistance (MSP). The MSP through its Environmental Attention Directorate, and it eight Sanitary Regions, takes actions concerning:

- Water supply in rural towns of less than 500 persons
- Urban water supply in collaboration with SANAA
- Latrine programs in rural towns of more than 50 persons and in marginal urban areas
- Final disposal of solid wastes
- Food control
- Vector control (disease).

The most important program is the Basic Sanitation Program, dedicated to:

- Supplying potable water in appropriate quantity and quality
- Disposal of human waste
- Construction of sanitary and storm sewers
- Sanitary improvement of housing
- General sanitation education.

The objectives of the program are to:

- Offer better health protection, in particular to diminish mortality attributed to waterborne diseases.
- Create a positive change in the sanitary habits and attitudes of the population.
- Reduce the cost of treatment of waterborne disease as well as the cost due to the number of lost work and study days.

These objectives are to be implemented through the following measures, essentially the responsibility of the Environmental Attention Directorate:

- Increase the construction of wells and aqueducts in the marginal urban zones, and insure that they are properly operated and maintained.
- Construct new water supply systems and improve existing ones in urban areas, insuring that water quality is adequate.
- Provide sanitary latrines or similar disposal methods to the residents of urban areas.
- Construct new sewer systems and improve existing ones in urban areas, and assess the need for treatment of wastewater.
- Cooperate in control of air, water and land contamination by implementing legislation and performing research.
- Coordinate and promote programs and activities of the institutions that are responsible for the handling and use of pesticides.

To meet these and other obligations, in 1978 the Ministry had 209 persons working in its basic sanitation program. These included 60 sanitary inspectors and 121 extensionists--too few people for the task. Projected programs and funding for the period 1979-83 are as follows:

- National Health Services Program, $19,642,500
- Basic Sanitation Program-AID, $2,018,000
- Basic Sanitation Program-UNICEF, $637,500
- Basic Sanitation Program-Swiss Government, $385,000

National Autonomous Aqueduct and Sewer Service (SANAA). SANAA was created as an autonomous and decentralized agency by Legislative Decree No. 91 of April 26, 1961, with the general objective of promoting the development and operation of aqueducts and sewers. To accomplish this objective SANAA has the authority to plan, build and operate reservoirs, pipelines, treatment plants and distribution systems. It can also design, build and operate storm and sanitary sewers. In 1980, SANAA had expenses totalling $15.8 million, of which $11.25 million were capital expenditures and $4.65 were operational expenses. Its major activities during the year were:

- Planning and design of water supplies for 240 rural communities
- Planning and design of potable water supplies for nine urban communities
- Planning and design of immediate improvements for 12 urban and rural aqueducts
- Planning, design and building improvements to the sanitary sewer system of Teguicigalpa
- Building of 60 rural aqueducts through the SANAA-CARE-COMUNIDAD program

In accordance with the policies set by the current national health plan, SANAA is giving priority to the rural areas while still giving adequate attention to the urban zones. This policy is amply justified by the

mortality figures given in a later section. Implementation is based on cooperative programs with IDB, CARE, and AID to plan and construct aqueducts in the rural areas.

These programs involve the local communities, through the provision of labor in the construction of their respective aqueducts. SANAA expects to build 120 aqueducts per year with these programs.

The water supply and wastewater disposal situation for Tegucigalpa are handled separately from the above mentioned programs through the Master Plan, a IDB-financed plan to build 30 kilometers of main distribution lines and to design the first stage of the proposed potable water supply.

SANAA has approximately 800 employees, including 34 sanitary engineers. This does not include the personnel working with the Master Plan, with the IDB-AID-CARE-COMUNIDAD project, and with the Three and Four Cities projects. Staffing level is considered satisfactory, although a larger proportion of professional and technical level staff is advisable.

Local Governments. The local governments of 282 municipalities, which are supported by the Directorate of Municipal Technical Assistance of the Government and Justice Ministry, deal with their own water supply and sewers in coordination with SANAA and MSP.

Muncipal Autonomous Bank. The entity finances the public works projects of the municipalities.

WASTE MANAGEMENT CONCERNS

Solid Waste Management

Institutional Structure. Although the institutional structure exists to address solid waste management activities, the operating functions of institutions are not well defined This makes action-oriented, operational activities difficult to achieve. This is particularly true for the Ministry of Public Health. General planning responsibilities in the health aspects of solid waste management reside in CONSUPLANE, in particular the Health Department, which is a part of the Social Planning Directorate. This department coordinates the preparation of the five-year National Health Plan, which provides the national goals and objectives in the management of solid wastes. Implementation of the objectives is the responsibility of the agencies that follow.

Solid waste operations are the responsibility of the different municipalities. The Environmental Sanitation Regulations define solid wastes and regulate solid waste management systems.

Technical assistance and control of the municipal solid waste management systems are the responsibility of the Directorate for Municipal Technical Assistance (DATM) and the Ministry of Public Health. DATM is concerned primarily with the proper administration of the systems, and to this effect offers seminars and short courses to public officials. MSP, through its Directorate for Environmental Sanitation, has as its responsibilities:

- Administrating programs and projects
- Participating in the health planning process
- Obtaining funds for specific projects
- Preparing criteria and regulating environmental matters
- Collaborating in the selection and training of personnel.

The Health Regions are charged with performing specific functions to implement the above responsibilities, directing and coordinating the field work, and participating in the planning for their specific areas.

Financing of muncipal solid waste management systems is the function of

the Municipal Autonomous Bank. This institution provides financing of activities that contribute to municipal development. The Bank also provides technical review of all projects for which funding is requested. Part of the Bank's financing comes from the municipalities themselves, since they must do their banking at this institution. It also obtains loans from external sources for all types of municipal public works. The Bank is associated with the Executive Branch through the Government and Justice Ministry.

Current Situation in the Country. The best available data on solid waste management systems in Honduras presents a situation of reasonable coverage and collection but of poor final disposal practices. The relatively low garbage pickup coverage of 70 percent in Tegucigalpa is due to the extremely difficult task of providing collection in the economically marginal areas of the city, where the crowding and steep slopes makes it almost impossible to use mechanical equipment (Figure IX-1).

Figure IX-1. Spontaneous housing development in steep slope and marginal areas is a serious concern for development planning. Unplanned housing not only encroaches onto agricultural lands but presents water supply, waste disposal, sanitation, and land degradation problems that are difficult to address *(Courtesy of D. Pool).*

TABLE IX-4. PHYSICAL COMPOSITION OF SOLID WASTE (1979, Tegucigalpa)

Component	% Composition
Organic matter	58
Inert matter	13
Paper	18
Metal	4
Glass and others	7

The only available solid waste composition data are for Tegucigalpa, and are shown in Table IX-4. The per capita generation is low (less than one kilogram per day) compared with the United States (2.2 kilograms per day). this can be explained by the lower level of material consumption and in particular by the limited use of non-returnable containers and excessive packaging in Honduras. These figures are typical of Latin American cities. The organic matter in the garbage is mostly human food waste. The probable low heating value precludes controlled incineration for energy production as an alternative for final disposal and for the same reason pyrolysis is ruled out. However, compost produced from this garbage is likely to have a higher nutrient content than in the United States. This would favor composting as an alternative treatment from a purely technical stand point, although the economics remain to be worked out.

Garbage is collected using a variety of vehicles. Visits to several cities indicated that the only working compactor trucks were those of Tegucigalpa. San Pedro Sula and other cities are mainly using open trucks which are under contract with the municipality to pick up the garbage in specific areas. Since these vehicles are not usually covered on the way to the disposal site, a significant amount of the garbage is lost along the way.

As opposed to some Latin American cities (Bogota or Mexico City, for example), there does not seem to be appreciable separation of or recycling of garbage either in the collection or final disposal phases. With the exception of Tegucigalpa, which operates a sanitary landfill, the final disposal method used is open dump burning. The dump at San Pedro Sula was burning during a site visit and there were a large number of vultures and flies in the area. Some children were separating items from the garbage before it was burned. Without question the dump is a health hazard. At La Ceiba the dump was not burning, but the vultures and flies were also present in large quantities. This dump had an inordinate amount of putrescible matter which created a significant odor. Fortunately, it is located at a considerable distance from the city, in a scarcely populated area. It is also very small, since its size is controlled by the flooding of the adjacent river. At the time of the visit, a flood had occurred recently and had washed away most of the garbage. This open dump burning method is also used in Roatan, part of the biggest tourist complex in the country. However, due to the small size of the population and apparent frequent burning, there was relatively little accumulation.

As observed at several cities, the general solid waste situation in the country can be summarized as follows: garbage is generally stored reasonably well at the point of origin, and it gets picked up with adequate frequency. however, transportation in open trucks scatters some of it; and final disposal (except at Tegucigalpa) constitutes a health hazard and an air and periodic water pollution source.

Water Supply and Liquid Waste Management

Human waste disposal is a serious environmental problem facing Honduras today. As stated in the National Health Plan:

> "Health conditions are the worst among the 22 Latin American and Caribbean countries. The country has the third worst general mortality rate (11.81 per 1000) and the third worst infant mortality rate (98.53 per 1000 live births) . . . waterborne disease continue to be the most important cause of deaths."

These statistics are more signficiant when the urban and rural areas are differentiated:

	Urban	Rural
General mortality	9.0	16.5
Infant mortality	85.6	127.2

These figures roughly correlate with the figures for urban and rural sanitation and water supply that are given below. As a cause of death, waterborne diseases accounted for 12.4 percent of all deaths in 1972 and 12.2 percent in 1976, indicating essentially no improvement in sanitation.

In 1978 the water supply coverage was calculated as 51.2 percent for then entire country, being 91.3 percent for the urban area and 30.3 for the rural sector. It was estimated that 26.6 percent of the population had domestic interconnections: 51.9 percent in the urban area and 13.4 in the rural. Approximately 43.5 percent of the urban and only 0.1 percent of the rural population had sanitary sewers. Sanitary latrine usage was 18.3 percent for the rural population and 6.2 percent for the urban and marginal zone residents.

In 1979 SANAA was in charge of 102 aqueducts and the sewer system of Tegucigalpa. The muncipalities were operating some 460 aqueducts and 33 sewer systems. There are a few sewage treatment plants, generally located in newer urban developments. It was possible to locate one on the outskirts of San Pedro Sula on the road to Puerto

Cortes. Although an attempt was being made to operate the plant properly by use of the trickling filter method, it was producing an effluent of very poor quality. This was due to the total absence of a secondary clarifier. Without this tank it is impossible to obtain an effluent of even marginal quality.

The overall quality of the water supply system is low. According to CONSUPLANE, in 1978 the water systems had deficiencies such as high turbidity and coliform counts, unreliability of service, and low pressure. The majority of the systems did not have any treatment and disinfection was done only in some of the major cities. Operation and maintenance practices were antiquated and very few operators had adequate training. Finally, a significant number of aqueducts were operating beyond their design capacity. Observations indicated that this situation has not changed appreciably since 1978.

Case History in Wastewater Treatment: Tegucigalpa. The untreated wastewaters from Tegucigalpa are discharged to the Choluteca River in the vincity of Barrio Chile. A site visit indicated that the pipeline is broken in many places as it goes along the river. The wastewater coming out was observed to have a greenish color. There are indications of some industrial discharges from textile factories and a chemical industry into the sewers.

In view of these waste water problems the Master Plan is recommending a wastewater treatment plant for the city. Information obtained at the Master Plan Project Office indicates that two plants are planned, one to be located 2.5 kilometers from the urban limits on the Choluteca River and a second one to be built near the confluence of Choluteca and San Jose Rivers. The first plant would handle up to 75 percent of the estimated year 2010 flow and the second plant would handle the other 25 percent. The first stage of the first plant was projected to be completed by 1985, but due to the high investment required, this date will be postponed. The second plant is projected for 2005.

The recommended treatment system is a carrousel-type activiated sludge system preceded by screens and a grit chamber. No disinfection is contemplated. Sludge handling is to be done by aerobic digestion, use of a thickener and then a combination of drying beds and a filter press.

The cost of the treatment, including construction of both plants, is as follows:

1980-1990	$31,464,400
1990-2000	26,942,650
2000-2010	34,722,250
	$83,129,300

Based on the available information which is incomplete, the HCEP team does not believe that such an investment has been properly justified. The reasons are as follows:

- A secondary treatment plant will be needed mainly to remove oxygen demanding substances from sewage in order to prevent low dissolved oxygen values in the receiving waters. This is necessary for the preservation of higher forms of aquatic life. It has not been shown whether the river even supports fish or other forms of aquatic life upstream of the existing outfall.
- Neither the actual quality nor the desired quality of the receiving water have been determined, making it impossible to establish the required level of treatment for whatever use the river is going to have.
- The composition of the sewage has not been properly characterized as a basis for treatment system design.
- No disinfection is provided. The proposed plant would therefore

not protect the health of the people who use the river downstream.

- Three alternatives were considered, all variations of the activated sludge process. Even assuming that secondary treatment was necessary, simpler and cheaper processes such as trickling filters and ponds were not analyzed. The activated sludge process is highly efficient, but requires very specialized operational knowledge that is not presently available in the country.
- Any activated sludge system requires huge amounts of energy. It is estimated that the two plants would require 7,260 KVA by the year 2000. Even with cheap electricity from El Cajon available, this represents a very large operational expense (roughly $4.2 million/yr, assuming electricity costs $0.05 per Kilowatt-hour).

A detailed review should be made of the planning logic before any more money is invested in this project.

Institutional Assessment. SANAA is a technically sound organization, but it is now handling only a small part of the aqueducts and only the Tegucigalpa sewer system. The muncipalities, with the exception of San Pedro Sula, do not have the engineering and technical expertise to properly operate and maintain their water and sewage systems. The work by the MPS has been mostly involved in building small aqueducts and the sanitary latrine program. In view of this dilution of effort, it would be more appropriate to have just one agency, SANAA, responsible for all water and wastewater matters in the country. This would require the transferring of personnel from other agencies and an augmentation of staff, but would provide for a more coordinated effort in the improvement of public health matters.

Training Capabilities. The Universidad Nacional Autonoma de Honduras offers a six-year, approximately 260 credit hour program leading to the Bachelor's degree in civil engineering. Besides including the usual civil engineering course work, the curriculum includes two sanitary engineering courses, one in potable water treatment and distribution and another one in the design of physical facilities for sewer systems. This is sufficient for a civil engineer, but not enough to acquire the specialized knowledge required to design and operate the water and wastewater plants that will be needed in the future. Graduate training in sanitary engineering is not available in Honduras. However, engineers receive this training at universities in the United States, Mexico or Brazil.

An excellent source of training is the Pan American Health Organization through its short courses held in Lima, Peru, at Centro Panamericano de Ingenieria Sanitaria (CEPIS) or in specific countries. A regular program is available and special courses can be designed and offered. These courses to date have covered mainly the fields of water supply and solid waste management.

There does not seem to exist a short course capability in sanitary engineering in Honduras. It is recommended that such a capability be developed, probably including the University, SANAA and CEPIS, or a foreign university.

OTHER SOURCES OF POLLUTION

Mining Pollution

Lake Yojoa and its watershed constitute one of the most diverse and productive ecosystems in Honduras. In spite of this uniqueness, there exist the problems of deforestation in the watershed, and significant pollution in

the lake. Fish kills were observed in 1976. Two studies, performed in 1976 and in 1978, have tried to explain the reasons for these kills and their findings are presented here (Del Cid, 1976).

The lake receives the discharges from the Rosario Resources Corporation's mining and refining operation (Figure IX-2). This company is engaged in the production of zinc, lead and silver. There are two sources of effluents from its operations, one from the ore refining operation and the other from the mine itself. The tailings from the refining operation are passed through a settling pond (built in 1971) and then discharged to Jutal/Raices creek which feeds into the lake. The mine effluent, containing inorganic salts and the solid wastes resulting from the mineral extraction, is discharged to the same creek through the Raices tunnel. In 1975 this flow was 0.45 cubic meters per second. Data collected by Del Cid (1976) indicates the following characteristics of the tailings pond effluent:

pH	11.4	
alkalinity	992.0	mg/l
Sulfate (SO_4)	68.0	mg/l
Total Dissolved Solids (TDS)	788.0	mg/l
Total Solids (TS)	808.0	mg/l
Chlorine (Cl^-)	190.0	mg/l
Calcium (Ca)	492.0	mg/l
Sodium (Na)	11.0	mg/l
Potassium (K)	2.6	mg/l
Copper (Cu)	10.6	mg/l
Lead (Pb)	3.34	mg/l
Zinc (Zn)	3.90	mg/l
Silver (Ag)	0.69	mg/l
Manganese (Mn)	0.01	mg/l
Arsenic (As)	0.01	mg/l
Cadmium (Cd)	0.01	mg/l
Chromium (Cr)	0.01	mg/l
Iron (Fe)	0.01	mg/l

The figures for cyanide are not given since the samples were improperly preserved. However, the author estimates a value of 67 milligrams per liter (mg/l) going into the pond. Even

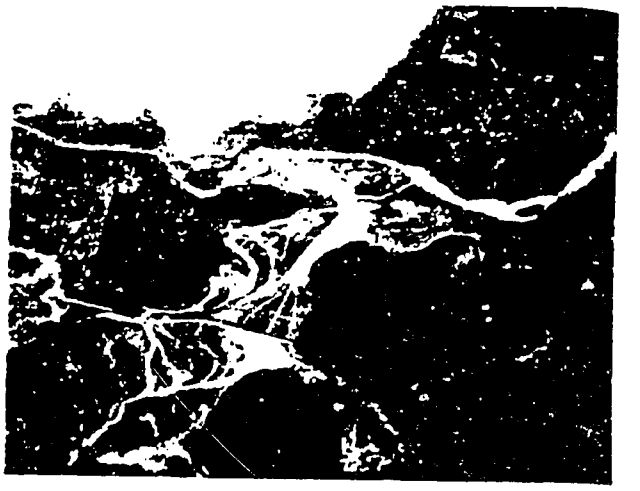


Figure IX-2. Environmental pollution is an ever-growing concern in Honduras. In this photograph, improperly contained mine tailings at El Mochito escape downstream affecting people and fish and wildlife resources *(Courtesy of J. Dickinson).*

assuming a signficant oxidation at the pond, this value is well above the recommended value for the preservation of aquatic life (0.005 mg/l), according to USEPA 1976). Together with the high concentrations of copper and lead the cyanide estimate almost guarantees that the creek will not have higher forms of life such as fish. Due to the length of the creek (9 kilometers), some of the toxic elements will settle and/or will be oxidized before reaching the lake. There are enough data to evaluate the fate of any toxic material.

The study by Landine (1978), although biased (the introduction includes the statement that" . . . it is not necessary to be very concerned about pollution control in the mining and hydrocarbons sector.") contains more recent information on the quality of the wastewaters. It is stated that since the silver concentrate was no longer produced, cyanide usage at the mill had dropped to 10 percent of the former level. Still, in 1977 the tailings pond effluent contained 5.20 mg/l of cyanide, 8-11 mg/l of copper, 1-3 mg/l of lead, 0.3-2.0 mg/l of zinc and 0.04-0.6 mg/l of silver. The flow was approximately 3.6 cubic meters per

minute. The mine water, at a flow of 34 cubic meters per minute, contained 0.01-0.06 mg/l of copper, 0.01 mg/l of cyanide, 0.2-1.5 mg/l of lead, 0.6-0.8 mg/l of zinc, 0.5-0.6 mg/l of iron and 0.1-0.3 mg/l of manganese. The total dissolved solids concentration was 500 mg/l and the pH 8. In 1978 a new pond was under construction but it has not been possible to obtain data on its removal efficiency or its effect on the quality of the effluent.

It is important to comment on an observation made by Landine to the effect that the best fishing in the lake was near the entrance of Jutal Creek. This observation was used to imply that since the fish were alive, there was no problem with the water coming down in the creek. This is the same argument that was used in Minamata Bay, Japan, where mercury from a nearby industry had accumulated up through the food chain over many years to cause the biggest incident of human poisioning by mercury known to date. The El Mochito mine has been operating since 1948. It would be very useful to determine the behavior of heavy metals and cyanide in the lake ecosystem with special emphasis on food chains leading to people.

Air Pollution

There are no laws or regulations concerning air pollution in Honduras. A proposed law was submitted to the Council of Ministers recently but it was not considered due to its technical complexity. A new draft is being prepared to give RENARE general jurisdiction on the issue with the intent of preparing a detailed set of regulations afterwards. RENARE is the only agency that is currently taking crude air pollution measurements, using very simple instruments and procedures.

No precise air quality measurements are made. RENARE is now beginning to take simple measurements of settleable particles in the Tegucigalpa area, is planning to measure sulphur compounds and has a program planned for inspecting visual emissions from industry. This problem of air pollution caused by the transportation sector is increased by the lack of any emission control in vehicles and by the topography of the area. The industrial sector does not seem to make a significant contribution to the problem in Tegucigalpa, but this is not the case in San Pedro. A constant haze was observed during a visit to this city, and specific problems were observed such as emissions from a large cement plant. In other parts of the country the industrial air pollution problem is highly localized and commonly not of major importance.

Estimates of air pollutants emitted in Honduras show that the burning of wood constitutes the major air pollution source in the country. Activities generating smoke include the burning of firewood and burning associated with shifting agriculture and pasture management. It is not known whether wood smoke constitutes a significant health problem.

At this time air pollution should not be considered as a problem in Honduras. However, several standardized measurements should be taken to develop a data base that will allow for a better evaluation of air quality. This can take the form of various simple measurements, such as settleable particles, which can be taken regularly in order to determine whether air pollution is indeed increasing and the periods of the year in which the problem is worst. Likewise, the MSP should start collecting data on health problems that could be associated with air pollution.

Industrial Pollution

It has not been possible to obtain any data on either the flow or quality of wastewaters from the industrial sector. It is believed that the problem is of significance only in San Pedro Sula, where most of the industry in the country is concentrated.

The only oil refinery in the country is located at Puerto Cortes and operates at a level of about 10,000 barrels of crude oil per day. The only wastewater treatment at the refinery consists of a separator which, if properly designed and operated, should remove 70-80 percent of the oil. Given the small discharge volume this treatment is probably adequate.

Coffee processing is a major industrial activity that is dispersed over 13 of the 18 departments of the country and should be given consideration for future pollution control activities. Information obtained at IHCAFE indicates that there are about 45,000 coffee processing plants or beneficios in the country handling an average of 35-110 bags of coffee per year. Incidents have been reported of cattle deaths downstream from beneficios, in particular during the dry season. Some beneficios discharge to potable water sources. A rough extrapolation using data from Colombia indicates that the amount of Biological Oxygen Demand (BOD) being discharged per year into the surface waters of Honduras is roughly equivalent to that produced by a city of 450,000 persons. IHCAFE should be supported in an evaluation of the nature and magnitude of the human and animal health problems potentially caused by coffee beneficio effluents.

RECOMMENDATIONS

- Formulate and Implement Water Quality Standards. At the present time there are no water quality standards for Honduras. Any future water pollution control program must rest on such standards. It is recommended that as a first step, CONSUPLANE should establish a list of designated water uses for the MSP. The permit system would include both municipal and industrial dischargers.

- Map and Monitor Groundwate Resources. There is very litt available information on groun water. There is a need for mappi the aquifers and determining the safe yield. An estimate, howev rough, of groundwater usage b hydrological basins is also nede in order to complete the wate balances that are previousl mentioned in this report. RENARE an appropriate agency to comple this task.

- Improve Institutional Coordinati of Wastewater Treatment. Respons bility for water and wastewate treatment is now divided amor agencies and programs. Bette planning and uniformity of servic can be obtained by centralizing th responsibility in a single agenc in this case SANAA. Particul emphasis should be given to a rur sanitation program to provide basi human excrement management and safe supply of water.

- Conduct Feasibility Studies c Wastewater Treatment System fc Tegucigalpa. The cost of operatir the proposed facilities is also major concern. The propose Tegucigalpa wastewater treatmer plants should be complete reevaluated before any money i invested in their actua construction plan.

- Develop and Implement Training i Sanitary Engineering. The Nation Autonomous University should estab lish a short course capability i all areas of sanitary engineering with particular priority given t water treatment, plant operation an solid waste management. This can done as a joint venture with CEPI or a foreign university.

- Evaluate Contamination from Minir Activities. An extensive samplin of heavy metal and toxic compound (in particular cyanide) in fis

tissue in Lake Yojoa should be done in the immediate future. The discharge from El Mochito mine has been going on for too many years and a strong probability exists of serious toxic problems (Figure IX-2).

- Provide Additional Funds or Other Forms of Support for Special Projects
  - The proposed research program on coffee processing wastewaters at IHCAFE should be funded.
  - Very few nonreturnable containers are in use in Honduras today. A law should be passed banning or limiting their future use in the country.
  - A program should be developed to fund equipment for sanitary landfills.

- Monitor Industrial Air Pollution. Although industrial air pollution does not constitute a major problem at this time, an air quality monitoring network should be established. This can be a simple system consisting of containers to collect settleable matter. It would serve to indicate whether the problem is increasing and if it is worst at certain periods of the year.

- Enact Basic Air Quality Legislation. In order to prevent future problems, a few basic laws should be passed to regulate the emissions of the transportation sector. Restrictions should also be imposed on the size of industrial stacks and the burning of pasture should be controlled during appropriate meterological conditions. The proposed increase in the use of firewood as an energy source should be reevaluated, in particular as it applies to its use in Tegucigalpa. The burning of fields and forests during the dry season constitutes an important source of air pollution, causing an increase in human health-related problems, and the closing of airports due to poor visibiilty. More stringent regulations and control of such burning is needed near urban areas and other population centers.

BIBLIOGRAPHY

AGRICULTURE

Anderson, D. 1977. Problems and constraints with the public sector in Honduras. Study report prepared for USAID/Honduras. 77 pp.

BIRF, BID, and AID. 1978. Estudio del sector agropecuario/rural - Vol. II. Documentos de trabajo. Informe No. 971-HO.

Betancourt, J., and P. Dulin, eds. 1978. Plan de uso multiple - Lago de Yojoa, Segunda Fase, Proyecto Interinstitutional - COHDEFOR, RENARE, CATIE, FAO, UNPD.

CONSUPLANE, 1978. Plan nacional de desarrollo - sector agropecuario; ordenamiento del medio ambiente.

CONSUPLANE, 1980. Direccion General de Estadisticas y Census.

FAO, 1977. Honduras - informe al gobierno de Honduras sobre los suelos de Honduras. 92 pp.

Glick, D. 1980. Rio Platano biosphere reserve case study. Ann Arbor, Michigan. 120 pp.

Hart, R.D. 1979. Agroecosistemas. CATIE, Turrialba, Costa Rica. 209 pp.

Holdridge, L.R. 1962. Mapa ecologico de Honduras. Tropical Science Center, San Jose, Costa Rica.

ICAITI. 1976. Estudio de las consecuencias ambientales y economicas del uso de plaguicidas en la produccion de algodon de centroamerica. Guatemala. 335 pp.

INA. 1978. Resumen de datos generales del sector reformado - Depto. de Planificacion - Seccion de Estadistica e Informacion. 35 pp.

INA, CONSUPLANE, ST-C.P.A. 1980. Propuesta sobre medidas a tomar por el gobierno provisional para acelerar el proceso de reforma agraria.

INA. 1980. Plan operativo anual y presupuesto 1981. 182 pp.

Kramer, J.M., and J. Arcaleo, 1980. Management of the Choluteca River Watershed: Supplement 1 to the Natural Resources Management Project Paper. USAID, Honduras.

MAB. 1981. Draft environmental profile of Honduras. Prepared by Office of Arid Lands Studies, University of Arizona, Tucson. 110 pp.

Martinez, J.L. 1977. Escuelas agricolas de Honduras, oferta y demanda de recursos humanos a nivel medio y superior. USAID, Honduras.

Ministerio De Economia. 1980. Comercio exterior de Honduras - 1978 - Tomo II. Direccion General de Estadistica y Censos, Tegucigalpa.

Myers, N. 1981. The hamburger connection: How central America's forests become North America's hamburger. Ambio 10(1):3-8.

Shane, D.R. 1980. Hoofprints on the forest: An inquiry into the beef cattle industry in the tropical forest areas of Latin America. Prepared for Office of Environmental Affairs, Dept. of State, Washington, D.C. 205 pp.

SRN. 1977. La perdida de los recursos naturales y la erosion en Honduras. Working paper prepared for the Minister of Natural Resources. 56 pp.

SRN. 1979. Memoria (booklet describing ministry organization and programs).

SRN. 1980. Bibliograpia agricola de Honduras 1977-79.

USAID/ROCAP. 1966. Honduras - National inventory of physical resources of Central America and Panama. 32 pp and 32 maps (A.I.D./RIC GIPR No. 5).

USAID. 1976. Honduras - Small farmer technologies. 85 pp.

USAID. 1978. Agriculture sector assessment for Honduras.

USAID, SRN, and CONSUPLANE. 1978. Complacion de los estudios basicos del diagnostico del sector agricola. Tomo I, II.

USAID. 1979. Revised environmental procedures and presently acceptable actions. Department of State - Airgram.

USAID. 1980. Land reform loan/grant PID - USAID/Honduras.

FORESTRY

Banco Interamericano de Desarrollo (BID). 1980. Contrato de Prestamo No. 625/SF-HO Resolucion DE-112/80.

Cliff, E.P. 1980. Assessment of forest resource development in Honduras. Prepared for USAID Teguciagalpa, Honduras.

COHDEFOR. 1979. Plan nacional de desarrollo forestal. Departmento de Planificacion, Tegucigalpa, Honduras.

COHDEFOR. 1980. Informe anual de proyecto viveros y reforestacior Distrito forestal Copan C.O.L.

COHDEFOR. 1981. Control industrias d aserrio. 1980. Departamento d Produccion, Teguciagalpa, Honduras.

Drake, P. 1979. Institution suppor project-marketing final report Prepared for CIDA/COHDEFOR Tegucigalpa, Honduras.

FAO. 1968. Survey of pine fores Honduras. FAO/SF:26-HON 50. Unite Nations Development Program. Food an Agriculture Organization of the Unite Nations, Rome, Italy.

Flores Rodas, J.G. 1980. Analisis de primer sexenio de la Corporacio Hondurena de Desarrollo Forestal COHDEFOR, Tegucigalpa, Honduras.

Hernandez, R. 1981. Segundo proyect de credito agropecuario - component forestal. COHDEFOR, Tegucigalpa Honduras.

Hopkins, D. 1981. Forest resourc development study - Honduras. Prepare for USAID Honduras, Tegucigalpa Honduras.

Hudson, J.M., J. Guevara and W Rodriguez. 1981. Diseminacion natural de seminas de Pinus cocarpa en Honduras e implicaciones para la regeneracior natural. Escuela Nacional de Ciencias Forestales. Corporacion Hondurena de Desarrollo Forestal. Articulc Cientifico 3. Siguatepeque, Honduras.

Merkel, A.L. 1981. Stumpage valuation recommendations and examples. Prepared for USAID, Tegucigalpa, Honduras.

Murray, G.F. 1981. Mountain peasants of Honduras: Guidelines for the reordering of smallholding adaption to the pine forest for USAID/Honduras. Tegucigalpa, Honduras.

Rael, E.A. 1981. Range management study. Prepared for USAID, Tegucigalpa, Honduras.

Romero, E. 1981. Multiple use land management. Prepared for USAID/ Honduras, Tegucigalpa, Honduras.

Roper, J. 1981. Proyecto bosques latifoliados for Departamento de Bosques, COHDEFOR/CIDA. Tegucigalpa, Honduras.

Sowles, K. 1981. Review of marketing practices by COHDEFOR. Prepared for USAID, Tegucigalpa, Honduras.

Troensegaard, J. 1980. Pautas para la ordenacion forestal en Honduras. For Gerencia de Bosques de COHDEFOR. Oficial Forestal FAO Hon/78/005.

United States Agency for International Development (USAID) (1) 1980. Environmental design considerations for rural development projects. Washington, D.C. 20523.

USAID (2) 1980. Forest resource development 522-0172. Project Identification Document (PID).

USAID (3) 1980. Development assistance in forestry: An aid policy background paper. Agency for International Development, Washington, D.C. 20523.

Yerkes, V. 1981. Effectiveness of utilization in current Honduras forest industry and proposals for improvement. Prepared for USAID, Tegucigalpa, Honduras.

WATERSHED MANAGEMENT

Dulin, P. 1979. Natural resources conservation and watershed management in Roatan - Bay Islands, Honduras. COHDEFOR, Tegucigalpa, Honduras.

FAO. 1979. Anuario de productos forestales. Rome, Italy.

FAO. 1978. Proyecto de defensa contra inundaciones y riego en el sur de Honduras. Informe final. Vols. 1 and 2. Proyecto TCD/HON/031. Tegucigalpa, Honduras.

Kramer, J.M. and J. Arcaleo. 1980. Management of the Choluteca River Watershed. Supplement to the natural resources management project paper (Project No. 522-0168). USAID, Tegucigalpa, Honduras.

Michaelsen, T. 1981. Ordenacion de cuencas hidrograficas y control de la erosion. Informe al Gobierno de Honduras. PNUD-FAO, Rome.

Programa de Catastro Nacional. 1979. Manual de uso potential de la tierra. Convenio USAID/CONSUPLANE No. 522-T-024. Tegucigalpa, Honduras.

SECOPT. 1979. Informe del plan maestro para el desarrollo integral Y control de inundaciones en el valle de sula. Informe principal. HARZA-CINSA, San Pedro Sula, Honduras.

Secretaria de Recursos Naturales. 1979. Estimaciones economicas anuales relacionadas con la erosion de los terrenos inclinados de la region del litoral Atlantico y La Ceiba, y con las Inundaciones provocadas por el exceso de lluvias de noviembre de 1976. Tegucigalpa, Honduras.

United Nations Development Program. 1978. Desarrollo integral de la region del Valle del Aguan. Project No. HON/77/005/A/01/DI. Project paper. Tegucigalpa, Honduras.

USAID. 1975. National Cadaster Program. Project Paper (Project No. 522-T-024). Washington, D.C.

USAID. 1980. Assessment of forest resource development in Honduras. USAID. Tegucigalpa, Honduras.

USAID. 1979. Fuelwood and Alternative Energy Sources Project. Regional Office for Central American Programs (ROCAP), Washington, D.C.

Wouters, R. 1980. Results of an Erosion Research Project in the Watershed "Los Laureles". COHDEFOR, Tegucigalpa, Honduras.

COASTAL RESOURCES

Caballero, H.L. 1976. Monografia de las costas de Honduras. Interegional seminar on the development and management of resources of coastal areas. Berlin, Ed. Szekielda and Brever.

Carr, A.F. and L. Giovannoli. 1950. The fishes of the Rio Choluteca Drainage of South Honduras. Occ. Papers of the Museum of Zoology, Univeristy of Michigan No. 523.

Cid, O.F. Del 1976. Impacto ecologico del mineral El Mochito. Division de Ingenieria Ambiental, Direccion General de Minas e Hidrocarburos, Secretaria de Recursos Naturales.

Cruz, G.A. 1980. Lago de Yojoa. Departamento de Ecologia. Direccion General de Recursos Naturales Renovables, Secretaria de Recrusos Naturales.

Data Atlas (Draft). Planning a marine conservation strategy for the Caribbean region, IUCN/UNEP/CEPAL.

Davidson, W.V. 1979. Historical geography of the Bay Islands Honduras. Southern U. Press.

Economist Intelligence Unit. 1977. An evaluation of the mangrove forest resource in the Gulf of Fonseca, Republic of Honduras. London, U.K.

Estadisticas Pesqueras. 1978. Secretaria de Recursos Naturales, DIRENARE, Honduras.

Estadisticas Pesqueras 1979 (Draft). Secretaria de Recursos Naturales, DIRENARE, Honduras.

Estaditicas Pesqueras (Draft) 1980. Secretaria de Recursos Naturales, DIRENARE, Honduras.

FAO. 1965. Forest map of Honduras. Pine Forest Survey Project FAO/UNDP.

FAO. 1980. Honduras Fishery Country Profile. FAO/FID/CP/HON Rev. 1.

Guidicelli, M. 1979. Programa para la investigacion y la evaluacion comercial de los principales potenciales pesqueros maritimos de Honduras. WECAF/FAO No. 23.

Grupo Tecnico. 1981. Propuesto proteccion y desarrollo de los manglares del Golfo de Fonseca, Honduras. COHDEFOR/RENARE/CONSUPLANE.

Heibig, K.M. 1971. Areas y paisajes del noreste de Honduras. Banco Central de Honduras, Tegucigalpa.

Honduras 1971. Area handbook for Honduras. American University.

Hu, S.C., O.T. Lu and M.N. Lin. 1978. Estudio morfometrico sobre Los Curiles. Serie De Pesca No. 6, DIRENARE, Tegucigalpa.

Informe Annual. 1980. Direccion General de Recursos Renovables, Tegucigalpa.

Landine, R.C. 1978. Environmental engineering in the mining sector for the Direccion General de Minas e Hidrocarburos.

Lin, S.Y. 1956. Los recursos pesqueros de las aguas interiores. FAO/56/11/8725, Rome, Italy.

McBirney, A., and M. Bass. 1969. Geology of the Bay Islands, Gulf of Honduras in Tectonic Relations of Northern Central America and the Western Caribbean. The Bonacca Expedition, American Association of Petroleum Geology, Memoirs, II.

Memoria. 1979. Empresa Nacional Portuaria, Puerto Cortes, Honduras.

Natural Disasters. 1980. Natural disasters in the wider caribbean area: An overview. UNEP/CEPAL/WG.48/JNF-13.

NEDECO. 1979. Ocean port in the Gulf of Fonseca, Final Report I. Empresa Nacional Portuaria de Honduras.

NMFS. 1981. The fisheries of Honduras 1980. Foreign Fisheries Analysis Division, National Marine Fisheries Service/NOAA/DOC, Washington, D.C.

NMFS. 1976. The loster fishery of Honduras. Office of International Fisheries, National Marine Fishery Service/NOAA/DOC.

Plan Operativo Annual-Sector Pesca. 1980. Secretaria Tecnica del Consejo Superior de Planificacion Agricola.

Proyecto Tournasal. 1975. A technical and economic feasibility study of the Tournasal-Copan-Roatan project. Robert Nathan Associates, Inc.

Rathun G., and J. Powell 1979. Honduras Manatee Survey, 28 February, 25 March, 1979. Trip Report.

RIO Platano Draft. Plan de manejo. Reserva de la biosfera, Rio Platano.

TAMS. 1979. Dredging of harbor basin and access channel of the port of San Lorenzo. Final report.

WECAF (Western Atlantic Fisheries Commission) 1975. An assessment of crustacean resources of the western central Atlantic and northern southwest Atlantic. WECAF Studies No. 2, FAO/UNDP.

World Bank. 1980. World bank assists petroleum exploration in Honduras. Bank News Release No. 80/111.

WILDLANDS

Aguilar, W. 1981. Plan de manejo de La Tigra parque nacional. RENARE, Tegucigalpa.

Betancourt, J., Wild, K., Hansen, D. 1979. La Tigra - Honduras. Beneficios publicos por intermedio de la conservacion de los recursos naturales. Parques Vol. 4, No. 2 USPS, Washington, D.C.

COHDEFOR. 1980. Memoria COHDEFOR 1979. COHDEFOR.

CONSUPLANE. 1979. Plan Nacional de Desarrollo. CONSUPLANE, Tegucigalpa.

Carr, A. 1950. Outline of a classification of animal habitats in Honduras. Bulletin of the American Museum of National History, Vol. 94, Art. 10.

Cruz, G. et al., 1978. El Rio Platano. RENARE, Tegucigalpa.

EIU. 1977. An evaluation of the mangrove forest resource in the gulf of Fonseca, Republic of Honduras, C.A. Economist Intelligence Unit, London.

Espinal, M. Lista de algunas plantas medicinales de Honduras. MNR, Tegucigalpa.

Glick, D., 1980. The Rio Platano - A Case Study. Integrative Studies Center, University of Michigan, Ann Arbor.

Goldman, C., 1972. El Cajon project - Ecology. ENEE, Tegucigalpa.

Gonzalez, J. 1980. Comercializacion de animales silvestres en Hondruas. RENARE, Tegucigalpa.

Hellie, R. and Glick, D. 1976. Inventarios de areas potenciales para un sistema nacional de areas silvestres en Honduras. RENARE, Tegucigalpa.

Holdridge, L. 1962. Mapa Ecologico de Honduras: Organization of American states.

IUCN 1980. World Conservation Strategy. Gland, Switzerland.

Klein, D. 1977. Los Mamiferos de Honduras. RENARE, Tegucigalpa.

Klein, E., and Purdy, P. 1976. Observaciones preliminares sobre la familia Psihacidae en Honduras. RENARE, Tegucigalpa.

Labastille, A. 1973. An ecological survey of the proposed Volcan Baru National Park, Panama. IUCN/WWF, RENARE, Panama.

Marcus, M. 1981. Aprovechamiento de fauna silvestre y avifauna de la reserva de la biosfera Rio Platano. RENARE, Tegucigalpa.

Meyer, J., Et al. 1969. Clave de los anfibios y reptiles en Honduras. UNAH.

Miller, K. 1979. Planning national parks for ecodevelopment. Instituto de la Caza Fotografica y Ciencas de la naturaleza, Madrid, Spain.

Monroe, B. 1968. A distributional survey of the birds of Honduras. Orntithological Monographs No. 7. The American Ornithological Union.

Myers, N. 1979. The Sinking Ark. Pergamon Press, London.

Myton, B. Clave de los mamiferos de Honduras. UNAH.

Purdy, P. 1978. Estudio sobre las palomas migratorias. RENARE, Tegucigalpa.

RENARE - 1977. Reporte de los recursos naturales y culturales de La Tigra. RENARE, Tegucigalpa.

RENARE 1980. Informe Anual. RENARE, Tegucigalpa.

Renare 1980. Plan de Manejo - el Rio Platano. Renare/CATIE, Tegucigalpa.

Udvardy, N. A Classification of the Biogeographical Provinces of the World. IVCN Occasional Paper No. 18, Morges, Switzerland.

UNEP. 1976. Exploratory Study of the Environmental Situation in Central America. Mexico City, UNEP.

USAID. 1980. Honduras Country Development Strategy Statement. USAID, Washington, D.C.

USAID. 1980. Honduras Project Paper: Natural Resources Development. USAID, Washington, D.C.

WATER SUPPLY AND WASTE MANAGEMENT

CMDC. 1980. Programa para el desarrollo integral del sistema de desechos solidos. Cleaning Department.

CONSUPLANE. April 1979. Estudio del Sector Abastecimiento de Agua y Saneamiento.

CONSUPLANE. 1979. Plan Nacional de desarrollo: Recursos hidricos (1979-1983).

Del Cid, J., J. Rodriguez, and R. Hederra. 1980. Informacion sobre desechos solidos en las ciudades de mayor poblacion de Honduras. Presented at PAHO/WHO Workshop on Solid Wastes, Guatemala City, Guatemala.

Del Cid, J. 1976. Impacto ecologico del mineral El Mochito. DGMH, SRN, Tegucigalpa.

EHCAFE. 1980. El Cafe en Estadisticas, Volumen III.

Geiber, 1981. Notes for a series of lectures in air pollution given at various meetings throughout Honduras.

Geiger, 1980. Informe 1: Inspeccion de las emisiones visuales de industrias, planes del proyecto, Renare, Tegucigalpa.

SANAA. 1980. Plan Operation-1981.

USEPA. 1976. Quality Criteria for Water. Washington, D.C. p. 65.

APPENDIX 1

LIST OF PERSONS CONTACTED DURING THE FIELD STUDY

AGRICULTURAL SECTOR

Rosa America de Aguilar	Planning - INA
Lopez Emily de Alvarado	Librarian, Centro de documentacion e Informacion Agricola (CEDIA)
Ed Baker	Capital Development Officer, USAID/Honduras
Froyland Castaneda	Director, National Forestry School, Siguatepeque
Emilio Coto	Agronomist, Standard Fruit Co., La Ceiba
Emilio Crespo	Agricultural Planning Livestock Consuplane
Salomon Giron	Director, Div. Recursos Naturales, Catastro
Jorge Gonzales	Director Research, Standard Fruit Co., La Ceiba
Celso Goseco	Nematologist, Siatsa, La Lima
Jorge Guevara	Agricultural Planning, CONSUPLANE
Miguel Mejia	Manager, Jardin Botanco - Wilson Popenoe, Lacentilla
Reynaldo Munoz	Division of Credit, BANADESA
Charles Oberbeck	Agricultural Development, USAID/Honduras
Marciano Rodriguez	Agronomist, Siatsa, La Lima
Luis A. Rojas	Agricultural Extension, SRN
Julio Roman	Dean of Admission, Panamerican Agricultural School, Zamorano
Roberto Salas	Agronomist, Faculty, Panamerican Agricultural School Zamorano
Michael Schwartz	Agricultural Economist, USAID/Honduras
Braulio A. Serna	Director, Agricultural Planning, CONSUPLANE
Le de Ton	Horticulturist, Siasa, La Lima

Roberto Villeda	Advisor, CONSUPLANE
Paul Wackerbarth	U. S. Embassy
Julio Cesar Zepeda	USAID Coordinator for Natural Resources Project - Management of Rio Choluteca Watershed.

FORESTRY SECTOR

Alberto Eguigurems	General Manager, COHDEFOR
Manuel Hernandez	International Programs Coordinator, COHDEFOR
Ramon Zuniga	Head, Planning Department, COHDEFOR
Carlos Pineda	Head, Department of Forestry, COHDEFOR
Danilo Escoto	Production Department, CODHEFOR
Jose Flores Rodas	Director, Plan Comayagua
Julio Barahona	General Manager, FIAFSA
Leonel Guillen	Forest Management, CORFINO
Jorge Palma	Forest Planning, Consuplane
John Wilson	Director Forestry Programs, CIDA
John Roper	Technical Advisor Broadleaf Project, CIDA
Manuel Munez	Director Forestry Programs, FAO
Jan Troensegaard	Forestry Technical Aid, FAO
Ricardo Reyes	Regional Director Industry Forestry, FAO
Marc S. Scott	Head, Office of Environment and Technology, USAID
Russell W. Hawkins, Jr.	Office of Environment and Technology, USAID
Froyland Castaneda	Director, ESNACIFOR

WATERSHED SECTOR

Scott Loverne	Principal Consultant, National Cadaster Program, PCN (Tegucigalpa)
Jose Flores Rodas	Coordinator, Comayagua Forest Management Plan, COHDEFOR (Tegucigalpa)
Peter Lara	Director, U. S. Peace Corps (Tegucigalpa)

Nick Metes	Associate Director for Natural Resources, U. S. Pe Corps (Tegucigalpa)
Froylan Castaneda	Director, National Forestry Sciences School, (Siguatepeque)
Jose Bucarey	Professor for Watershed Management National Forest School (Siguatepeque)
Jose Soto	Director, University Center of the Atlantic Littora Region - Curla (La Ceiba)
Jose Ramon Aguilar	Coordinator of Forestry Careers, Curla (La Ceiba)
Jorge Gonzales	Head of Research, Standard Fruit Company, (La Ceiba
Roberto Ronchietto	Coordinator, Integrated Rural Development Project c Santa Barbara, Organization of American States (Tegucigalpa)
Jose Luis Palomo	Coordinator, Integrated Rural Development Project c the West, Ministry of Natural Resources (Tegucigalp
Roberto Ruiz	Coordinator, Choluteca River Watershed Managment Project, Ministry of Natural Resources (Tegucigalpa
Nelson Agudelo C.	Professor of Ecology, Pan-American Agricultural School (El Zamorano)
Jan Horbaczewski	Soils Consultant, National Cadaster Program, PCN (Tegucigalpa)
Jose Abarca U.	Meterologist, National Cadaster Program PNC (Tegucigalpa)
Pedro Menendez	Coordinator, Integrated Rural Development of the Ja Aguan (Tegucigalpa)
Peter Vaux	Ecology Consultant, Ecological Research Laboratory, El Cajon Project (Santa Cruz E Yojoa)
Jan Bauer	Consultant, Watershed Management Section, COHDEFOR (Tegucigalpa)
Juan Molina	Coordinator, Scocal Forestry System, COHDEFOR (Tegucigalpa)
Miguel Sabillon	Coordinator, Forestry Protection, COHDEFOR (Tegucigalpa)
John Roper	Consultant, Broadleaf Forest Project, COHDEFOR (Tegucigalpa)
Conrado Volkart	Coordinator, Fuelwood Project, COHDEFOR (Tegucigalp.

Roger Cano	Siviculturist, Fuelwood Project, COHDEFOR (Tegucigalpa)
Manuel Hernandez	Coordinator, External Assistance Office, COHDEFOR
Santiago Carias	Coordinator, Broadleaf Forests Project, COHDEFOR (Tegucigalpa)
Sigfrido Salagado	Head, Northwest Forest District, COHDEFOR (San Pedro Sula)
Hector Sanchez	Coordinator, Intergrated Watershed Management Projec of the Northwest, COHDEFOR (San Pedro Sula)
Riboberto Romero	Head, Watershed Management Section, COHDEFOR (Tegucigalpa)
Arnulfo Cruz	Watershed Specialist, Watershed Management Section, COHDEFOR (Tegucigalpa)
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COASTAL RESOURCES SECTOR

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Napoleon Ramos	Minas e Hidrocarburos, SRN
Sigfrido Sandoval	Minas e Hidrocarburos, SRN
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Alan and Kern Hydes	Hybur Mariscos, Roatan
Albert Jackson	Mariscos Agua Azul, Roatan
Rafael Molina	Promarsa, San Lorenzo
Ralph Parkman	Sea Farms De Honduras, Choluteca
Jim Radawski	Doc's Dive Shop, Roatan
Wayne Toyo Fuku	Research Manager, Aqua Finca, San Pedro Sula

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APPENDIX 2

WOODS OF HONDURAS

LIST OF SPECIES BY UTILIZATION CATEGORY

NOTE: Not all woods species in Honduras are in this list.

CATEGORY A: Woods Currently Merchantable in Honduras or Elsewhere.

I. HIGH VALUE WOODS

Woods suitable for furniture and cabinets; decorative veneers and plywood panelling and moudlings; and similar. Woods well recognized in world markets.

Caoba (*Swietenia macrophylla*)
Cedro (*Cedrela mexicana*)
Cortes (*Tabebuia guayacan*)
Granadillo (*Dalbergia tucurensis*)
Laurel (*Cordia alliadora*)
Nogal (*Junglans olanchana*)

II. LESS VALUABLE WOODS

Woods suitable for utility and better uses; lumber; utility veneers and plywood, panelling and mouldings. Wood generally marketed under recognized trade names; some requiring effort.

Carbons (*Guarea* spp.)
Cipres
Guannacaste (*Enterolobium cyclocarpum*)
Guapinol (*Hymenaea courbaril*)
Liquidambar (*Liquidambar styraciflua*)
Macuelizo (*Tabebuia rosea*)
Pinus spp.
Rosita (*Hyeronima oblonga*)
Sangre Real (*Virola koschyni*)
San Juans (*Vochysia ferrugines*)
Santa Maria (*Calophyllum brasiliense*)
Varillo (*Symphonia globulifera*)

III. GENERAL UTILITY WOODS

Woods currently merchantable; many requiring marketing promotion before acceptance in World Trade.

1. Processed in Honduras

Aceituno (Negrito) (*Simarouba glauca*)
Aguacates (*Pearsea* spp.)
Almendro, Amargoza (Andira inermis) (*Andira* spp.)
Higo, Higuello, Higuero, Higueso, Amete De Montana (*Ficus* spp.)
Hormigo (*Platymiscium dimorphandrum*)
Indio Desnudo (*Bursera Simaruba*)

Barba De Jolote (Pithecolobium arbareum)	Jobo (Spondias mombin)
Barrenillo (Croton glabellus)	Masica (Brosimum alicastrum)
Bellota (Roble) Quercus skinneri)	Nance (Pepenance) (Byrsonima crassifalia)
Bilihuete (Billy, Webb, Chichipate) Sweetia panamensis)	Paleto (Dialium gianense)
Cedrillo (Ciruelillo) (Mosquitoxylon jamaicense)	Sangre Blanca (Pterocarpus offincinalis)
Ciruelo De Montana (Astronium graveolens)	Cedro Espino (Zanthoxylum belisense)
Sombra De Ternero (Cordia nitida)	Ceiba (Ceiba pentandra)
Tambor (Jacaranda copaia)	Cincho, Chaperno (Lonchocarpus latifolius)
Tango (Zollernia tango)	Cuero De Toro, Manteco (Chaetoptelea mexicana)
Caimito, Selillon, Zapote, Zapotillo (Chrysophyllum mexicana)	Cumbillo (Narunjo) Guayabo (Terminalia amazonia)
Zapoton (Calocarpum mammosum)	Guayabon (Terminalia lucida)
Guaco (Hernandia sonora)	Zorra (Schizolobium parahybum)

2. Processed Elsewhere

Caimito	Chrysophyllum mexicanum
Coco-Mama	Quararibea fieldii
Come Negro (Naranjillo)	Pera barbellata
Guacimo (Yaya)	Leuhea seemannii
Hichoso	Brosimum spp.
Hueso De Pava	Zuelania guidonia
Kerosen	Tetragastris panamensis
Manteco	Ampelocera hottlei
Tapa Tamal	Alchornea Aff. latifolia
Tontolo	Protium sessiliflorum

CATEGORY B: Woods Having Potential for Commercial Use

Achotillo	Sloanca faginea
Cacho De Venado	Eugenia spp.
Guayabillo	Psidium molle
Capulin	Trema micrantha
Cirin, Manampu	Miconia spp.
Ciruelo	Spondias purpurea
Huesito	Homalium racemosum
Joco Mico	Vitex spp.
Lechon	Sapium spp.
Lechoso	
Lloron	Saurauia laevigata
Majao, M. Blanco	
Cola De Pava	Cespedesia macrophylla
Cuajada	Dendropanax Aff. arboreus

Cucaracho	*Pithecolobium* spp.
Cupania	*Cupania* spp.
Encinos	*Quercus* spp.
Fruta De Pava, Guatuso	*Hasseltia* spp.
Fruta Funi	? *Chimarrhis*
Guama	*Inga* spp.
Guarumo, G. Colorado	*Pourouma aspera*
Guayabillo	*Psidium molle*
Manchado	*Billia hippocastanum*
Mano De Leon	
Quiebra Muela	*Ternstroemia* Aff. *megalotychia*
Ramon	*Trophis* Aff. *racemosa*
Salamo (Urracho)	*Calycophyllum candidissimum*
Selillon	*Pouteria izabalensis*
Sombra De Armada	*Schoepfia schoeberi*
Tejo	*Ilex guianensis*
Tiliacease	
UVA	*Coccoloba* Aff. *tuerckheimii*

APPENDIX 3

ETHNIC GROUPS OF HONDURAS

In the period 1714-1716 Franco Velasquez enumerated 25 different ethnic groups in Honduras. The majority of the groups that once comprised the indigenous population of Honduras no longer exist, having long been assimilated into the ladino population or annihilated. A brief description of those groups remaining today follows.

Jicaque

The Jicaque (also spelled Xicaque and known by the name Tolupan or Turrupan) numbered 9,699 people in 1945, the last time an official census was made of the indigenous population of Honduras. Today their number has been estimated by one source to be 5,679 inhabitants, and as high as 35,000 by the Comite Nacional de Tribus. These people live principally in the Department of Yoro but are also found in the Department of Francisco Morazan. The Jicaque are divided into 21 tribes by geographic location and speak Spanish as the predominant language. Although the Jicaque are for the most part an acculturated people closely resembling the ladino population, there remains one isolated group near the region of the Montana de la Flor that has maintained the traditional culture and language intact. Their language 'Tol' has been linked to the Subtiaba language, which was spoken in the southern part of Nicaragua, and to the Tequistlateca language spoken in southern Mexico. The Jicaque and the Paya are the two indigenous groups in Honduras that theoretically have title to their land.

Lenca

The Lenca were one of the larger groups of indigenous people in Honduras at the time of the Spanish Conquest. In 1945, they numbered 49,378 people and were found in the Departments of Intibuca, Lempira, Santa Barbara, La Paz and Comayagua. These people today are almost totally acculturated, having lost their language as well as traditional culture.

Chorti

The Chorti of Honduras numbered 7,950 people in 1945. Today they are primarily located in the Department of Copan within the Municipio de Copan Ruinas which is 15 kilometers from the Guatemalan border. Their culture remains somewhat intact. These people as well as Chorti from the neighboring Department of Chiquimula in Guatemala account for more than 33,000 speakers of the Chorti language. This language belongs to the Maya family and is closely related to the Chol and Chontal languages spoken in the states of Tabasco and Chiapas of southeastern Mexico.

Paya

The number of Paya living today has been estimated at 900-1,200 people. They are found principally in the Department of Olancho in the communities of Culmi, Pueblo Nuevo, Subirana, Santa Maria, and El Carbon. In addition there are small hamlets of Paya near the port of Trujillo in the Department of Colon. In actuality

there are few pure Paya left, largely a result of miscegenation with Misquito Indians and other groups. The genetically purer Paya are found along the course of the Rio Platano in the Department of Gracias a Dios. Their number is estimated to be only 17. They speak a language which is related to the Chibcha stock. Archaeological evidence shows that the Paya formerly inhabited a much larger area of Honduras which included the Rios Guampu, Aguan, and Patuca, as well as the Bay Islands of Utila, Roatan, and Guanaja.

Sumo

As of 1977 there were 300-400 Sumo in Honduras living halfway up the course of the Rio Patuca in the communities of Crautara, Yapuguas, Guapinol and Crausirpe. This compares to the 8,000 or so Sumo who live in Nicaragua. The Sumo of Honduras live principally as agriculturalists augmenting their diet with game and fish. In addition they sell chicle, latex de tuno, and to a small degree placer gold. In spite of heavy missionization the traditional language is still spoken, as is Spanish and the language of their neighbors the Misquito. The Sumo and Misquito languages, along with the Matagalpa of Nicaragua, belong to a linguistic group known as Misumalpa (also Misulua) which is related to the Chibcha stock.

Misquito

As of 1974 there were close to 15,000 Misquito in Honduras comprising 80 percent of the population of the Department of Gracias a Dios. These people are distinguished by an extensive history of trading as middlemen between the English and various indigenous groups of the interior such as the Paya and the Sumo. The Misquito at one time were allied with the English against the Spanish Crown and have been involved with English pirates and smugglers over the years. There appears to be an affinity for the English even to this day. Aside from their own language the Misquito prefer to speak a patois of English rather than Spanish. The Misquito today are a product of years of miscegenation. In the 17th century a shipwrecked cargo of black slaves from a boat that went down near Cabo Gracias a Dios was accepted into their community.

Garifunas

One last group that bears mentioning is not so much an indigenous group of Honduras as it is the remnants of groups from other parts of the world that found their way to Honduras in the 18th century. The Carib or Garifuna, as the people prefer to call themselves in Honduras, number approximately 20,000 - 30,000, and are found scattered in villages along the north coast in the Departments of Gracias a Dios, Colon, and Atlantida. By the end of the 17th century the Carib Indians had been all but routed from the important islands of the Lesser Antilles with the exception of Dominica and San Vicente which were being fought over by the English and the French. In 1675 a shipwrecked cargo of black slaves landed on San Vicente and was eventually absorbed into the native population. San Vicente was later evacuated by the English in 1795 as a result of increasing hostility shown to the European community, and the Garifuna were relocated on Roatan in Bay Islands of Honduras. Today there remain nearly 400 Garifuna in the Bay Islands (Punta Gorda). Some of these first Roatan Garifuna ere moved out by the Spanish in the 19th century and resettled on the northern coast of Honduras where their survivors are found today. In addition to Spanish and a patois of English, the Garifuna speak a language which is a mixture of Arawak and African dialects.

Each of these surviving groups contributes to the rich cultural diversity

of Honduras. Their physical and cultural survival has been prejudiced by the inaction of present and past governments in protecting their interests, particularly against encroachment on their lands by ladinos (see following section). These groups have preserved in some areas systems of agriculture which can serve as models for more viable sustained yield small farm systems.