

**ENVIRONMENTAL ASSESSMENT
FOR THE
NATURAL RESOURCES MANAGEMENT PROJECT 524-0314**

Prepared for:

United States Agency for International Development/Nicaragua

Submitted by:

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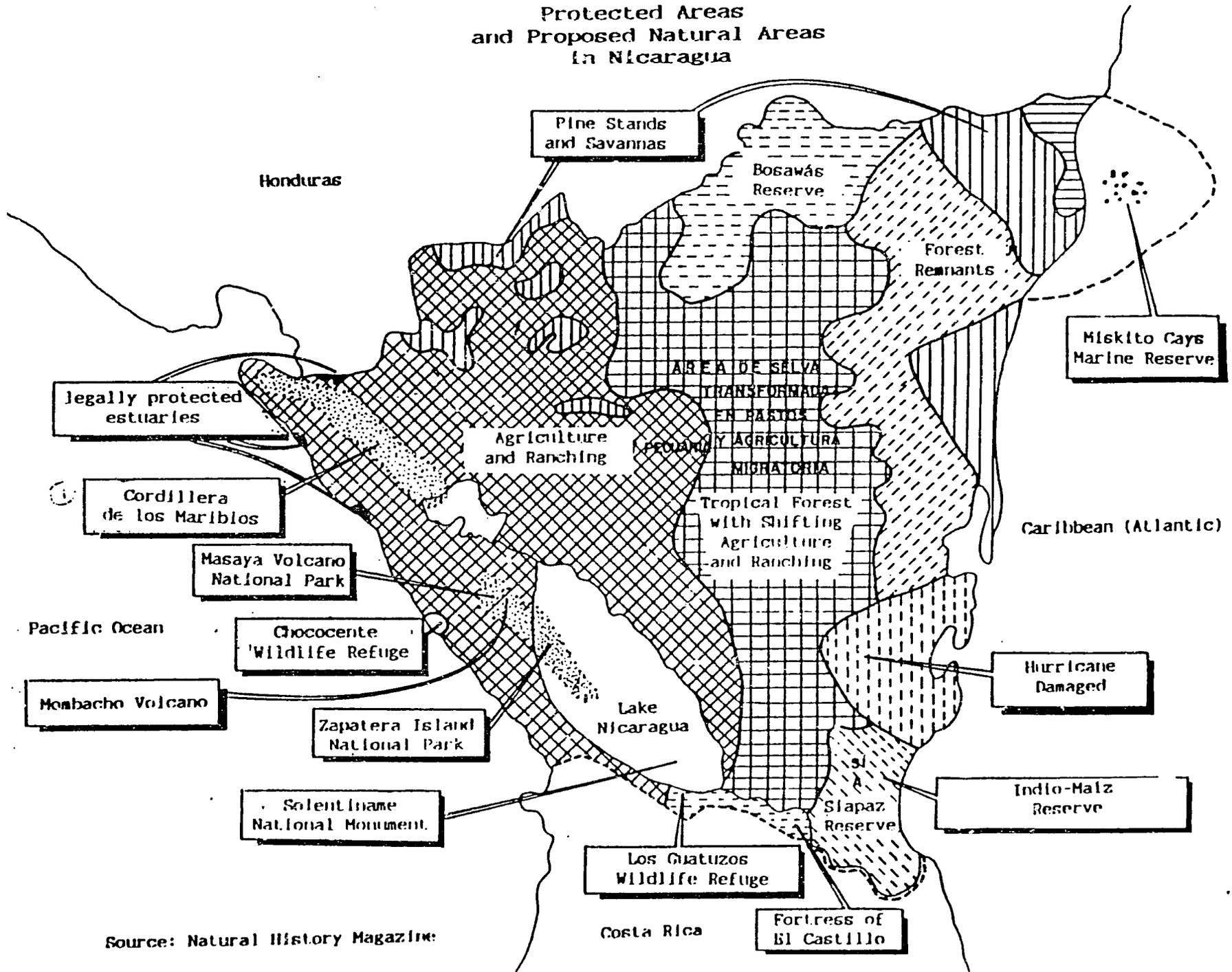
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Protected Areas and Proposed Natural Areas in Nicaragua



Source: Natural History Magazine

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ACRONYMS AND ABBREVIATIONS

A.I.D.	Agency for International Development (see also USAID)
APENN	Asociación de Productores de Exportaciones No-tradicionales de Nicaragua
BR	Bosawás Reserve (proposed)
CARE	Cooperative for American Relief Everywhere, International
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza
CCC	Caribbean Conservation Corporation
CDSS	Country Development Strategy Statement
CI	Conservation International
CIAV/OEA	Comisión Internacional de Asentamiento y Verificación/OAS
CITES	Convention on International Trade of Endangered Species of Fauna and Flora
CONAMOR	Comisión Nacional del Medio Ambiente y Ordenamiento Territorial
CORFOP	Corporación Forestal del Pueblo
CORNAP	Corporaciones Nacionales del Sector Público
DANIDA	Danish International Development Agency
DGPF	Dirección General de Planificación Física (INETER)
EAP	Economically Active Population
ECODE	Estrategia de Conservación para el Desarrollo (National Conservation for Development Strategy)
EPA	Environmental Protection Agency
FAO	Food and Agriculture Organization (UN)
FSLN	Frente Sandinista de Liberación Nacional
FY	Fiscal Year
GDP	Gross Domestic Product
GIS	Geographic Information System
GON	Government of Nicaragua
INCAE	Instituto Centroamericano de Administración de Empresas
INDERA	Instituto Nicaragüense de Desarrollo de las Regiones Autónomas
INEC	Instituto Nicaragüense de Encuestas y Censos
INETER	Instituto Nicaragüense de Estudios Territoriales
INPESCA	Corporación Nicaragüense de la Pesca
INRA	Instituto Nicaragüense de Reforma Agraria
IPM	Integrated Pest Management
IRENA	Instituto Nicaragüense de Recursos Naturales y del Ambiente
IUCN	International Union for Conservation of Nature and Natural Resources
MAG	Ministerio de Agricultura y Ganadería (formerly MIDINRA)
MCR	Miskito Cays Reserve (proposed)
MEC	Ministerio de Educación
MEDE	Ministerio de Economía y Desarrollo
MIDINRA	Ministerio de Desarrollo Agropecuario y Reforma Agraria (now MAG)
MINSA	Ministerio de Salud
MINVAH	Ministerio de Vivienda y Asentamientos Humanos
MIS	Management Information System
NGO	Non-Governmental Organization
NORAD	Norwegian Agency for International Development
NRM	Natural Resources Management Project (524-0314)

OAS	Organization of American States
OEA	(see OAS)
ONG	(see NGO)
OPG	Operational Program Grant
PA	Protected Area (National Parks and Similar Reserves)
PACA	Programa Ambiental para Centro América (CARE-TNC-CI Consortium)
PAFT	Plan de Acción Forestal Tropical
PAFT-CA	Plan de Acción Forestal Tropical para Centroamérica (regional)
PAF-OT	Plan de Acción Forestal y de Ordenamiento Territorial
PAS	Private Agricultural Services Project
PCEM	Programa de Control de Erosión de Managua
PCEO	Programa de Control de Erosión del Occidente
PEA	(see EAP)
PFCAM	Programa Forestal Campesino
PID	Project Identification Document
PP	Project Paper
PVO	Private Voluntary Organization
PY	Project Year
RAAN	Región Autónoma del Atlántico Norte
RAAS	Región Autónoma del Atlántico Sur
RENARM	Regional Natural Resources Management Project (596-0150)
ROCAP	Regional Office for Central American Programs (AID)
SAREC	Swedish Academy for Research
SF	Servicio Forestal (IRENA)
SI-A-PAZ	Sistema Internacional de Areas Protegidas por la Paz
SIDA	Swedish International Development Agency
SIRENA	Sistema de Información de Recursos Naturales
SPN	Servicio de Parques Nacionales (IRENA)
SPP	Secretaría de Planificación y Presupuesto
TFAP	Tropical Forest Action Plan (see also PAFT and PAF-OT)
TNC	The Nature Conservancy
UCA	Universidad Centroamericana
UN	United Nations
UNA	Universidad Nacional Agraria
UNAN	Universidad Nacional Autónoma de Nicaragua (León and Managua)
USAID	U.S. Agency for International Development
WCI	Wildlife Conservation International

EXECUTIVE SUMMARY

1. Introduction

The U.S. Agency for International Development (USAID), through the Agricultural and Rural Development Office (ARDO) in Nicaragua, requested that an Environmental Assessment (EA) be made of the Natural Resource Management (NRM) Project (524-0314) and the pesticides component of the Private Agricultural Services (PAS) Project (524-0315). At the recommendation of the USAID/N mission, the Environmental Assessment Specialist (EAS) participated with the design team on the development of the NRM project paper. ARDO had proposed that, with the collaboration of an EAS, the design team could prepare the final project paper with an absolute minimum of negative environmental impacts. As a result, the NRM Project has been formulated to address the critical mandates of the Foreign Assistance Act (FAA) Sections 118 and 119.

The PAS Project deferred the EA for its pesticide component to the EA for the NRM Project. The environmental assessment for the pesticide component identifies a preferred alternative, based on its analysis and recommendations governing the purchase and use of any pesticides under the components of both projects which relate to the use of pesticides.

The two environmental assessments were conducted during the design and project-paper development phase (12 May through 24 June, 1991) in accordance with A.I.D. Environmental Procedures (22 CFR CH. II, Sec. 216.6). During this time, the following field visits were made:

- Volcan Cosigúina, Estero Padre Ramos, and Delta del Estero Real on the Golfo de Fonseca
- Volcan Masaya, Volcan Mambacho, and Isla Zapatera
- Chacocente - Rio Escalante Wildlife Refuge
- Puerto Cabezas and the surrounding villages of Tuapi, Wawa and Karatá
- Bocay river valley from El Cuá and San José de Bocay to the end of the newly constructed road to Ayapal
- A helicopter flight was taken from Managua to the union of the Kukalaya river and the Puerto Cabezas road then down the river to Laguna Waunta and up the Atlantic coast over the Laguna Kukalya to Puerto Cabezas and parts of the continental shelf.

2. Environmental Issues

The principal environmental issues facing the NRM Project are:

- Destruction and degradation of tropical forests
- Resources piracy and depletion of marine and terrestrial biological resources
- Colonization of protected areas and their buffer zones
- Lack of sustainable management of primary and secondary tropical forests
- Lack of protection for legally declared parks and reserves
- Low productivity in agriculture and forestry

- Former resistance members and government refugee resettlement programs

The NRM Project will address these problems by means of several possible subprojects:

- Institutional strengthening of IRENA and policy dialogue
- Establishment of three fully operational protected areas with natural resources management programs in their buffer zones
- Environmental education
- Training of Nicaraguan personnel for park and reserve protection and management
- Intensification and diversification of agricultural systems in buffer zones
- Development of site-specific agriculture and agroforestry systems
- Research and development of management plans for sustainable use of primary and secondary tropical forests
- Development of ecotourism
- Village-level training and extension in agriculture and renewable natural resources utilization and conservation

In addition, the chief environmental issue regarding the pesticides component of the NRM Project is the development of safe and efficient pesticides use programs, especially for export crops. The pesticides component addresses this issue in the proposals to: (1) regulate and monitor the production of pesticides in Nicaragua; (2) provide and validate integrated pest management (IPM) technological packages; and (3) demonstrate that the IPM program is a preferred alternative to the traditional program based solely on pesticides use.

3. NRM Project Alternatives Considered

The NRM Project EA considered three alternatives:

Alternative I considers that the NRM Project, as designed, will have a very beneficial effect on the conservation and sustained use of both marine and terrestrial biological resources in Nicaragua.

Alternative II supports the proposed activities with some additions and a deferment on the capture of sea turtles in the Miskito Cays subproject and the collection and marketing of sea turtle eggs in the Chacocente Wildlife Refuge subproject. The deferment requires that both the Miskito Cays and the Chacocente subprojects submit detailed, written plans which specify a management and protection program for these animals to USAID/N for a specific ruling by A.I.D. Washington.

Alternative III refers to a "no action" scenario, which would contribute to the continuation of present patterns of deforestation, environmental degradation, loss of biological diversity and soil resources, and reductions in water quality and quantity, as well as socio-economic decline.

4. Pesticides Alternatives Considered

The EA for pesticides also considered three alternatives:

Alternative I finds that the pesticide and pest management component as designed in the NRM/PID and related activities under the PAS/PP would have the beneficial effect of increasing and stabilizing incomes and economic well-being of private agricultural producers of exportable crops.

Alternative II supports the proposed activities described in the NRM/PID and PAS/PP, with some additions governing the production and use of pesticides.

Alternative III is a "no action" scenario which would contribute to a continuation of the present pattern of environmental degradation and pesticide-related human health problems, as well as the rejection of potentially valuable export crops for international markets.

5. Mitigating Measures for the NRM Project

The mitigating measures proposed for the second and preferred NRM Project alternative include the following activities:

- Soil survey and land use potential mapping for the Bocay Valley settlement program, a GON program that will become a subproject
- Use of land use potential maps to delineate and assign individual farms
- Riparian zones and lowland use potential areas preservation
- A wildlife management program for game animal production
- Development of a logging cooperative for the Bocay Valley settlement program
- Fuel wood and saw timber production program
- Household food preservation program

6. Cost Estimate for Mitigating Measures

The costs for implementing the mitigating measures for Alternative II will result mainly from the soil survey and the preparation of the land use potential maps. These costs can be absorbed in the budgets of the PACA (Proyecto Ambiental para Centro America) consortium, IRENA (Nicaraguan Institute for Natural Resources and Environment), and by INRA (Nicaraguan Institute for Agrarian Reform) as part of the Government of Nicaragua (GON) settlement program. The logging cooperative should be self-sufficient after an initial start-up investment which can be incorporated into the PACA and IRENA budgets. Implementation of the riparian zones and low land use potential preserved areas, along with the wildlife management and wood lots programs, can be covered in the education, extension and training budgets for nongovernmental organizations (NGOs) and IRENA.

1.0 PURPOSE AND CONTENT OF THE ENVIRONMENTAL ASSESSMENT

The purpose of the environmental assessment is to provide the USAID/N mission, NRM project participants, and host country decision-makers with a study of possible environmental effects resulting from the implementation of the Project.

1.1 Natural Resources Management Overview

A.I.D.'s primary environmental objective is to promote sustainable resources management for the benefit of present and future generations. To achieve this goal, an environmentally sound approach is required. Accordingly, A.I.D. has three major environmental program areas with corresponding objectives: (1) sustainable production, (2) maintenance of natural ecosystems, and (3) meeting human needs. Among the issues of special concern are conservation of tropical forests and preservation of biological diversity, while attempting to improve the socio-economic well-being of the country population.

The goal of the Natural Resources Management (NRM) Project (524-0314) is to contribute to environmentally sustainable, broad-based economic growth in Nicaragua. The project purpose is to improve management of renewable natural resources and to protect biological diversity.

The proposed four-year project, to begin in FY 92, consists of a grant of US eight million dollars for the NRM component and a grant of US one million dollars for the pesticides component. The project will focus on arresting the severe environmental degradation and loss of biological diversity occurring in Nicaragua, by developing the means for realizing the long-term economic potential of the country's enormous biological resources. Specifically, IRENA will receive US\$3,204,800 for institutional strengthening and US\$287,600 for subproject development at Chacocente Wildlife Refuge. U.S.-based NGOs will be allocated US\$3,708,500 to coordinate two geographically focused subprojects. In year two of the project, IRENA will receive a grant in the amount of US\$499,100 to undertake curriculum development in the area of environmental education for the Ministry of Education (MEC).

1.2 A.I.D. Strategy for the Environment and Natural Resources

The U.S. Congress has acknowledged the need to support the environment and natural resources sector in Nicaragua. In this context, IRENA was specifically mentioned in the Report of the House Committee on Appropriations accompanying the Foreign Operations, Export Financing, and Related Programs Appropriations Bill for FY 91.

The NRM Project goal is in close agreement with A.I.D. policy on the environment and natural resources, which states that the central objective is to promote environmentally sound, long-term economic growth through the conservation and protection of natural resources and their management for sustainable yields.

Recently, the A.I.D. Administrator announced a new Agency initiative on the environment. This initiative defines an Agency agenda to guide future natural resource and environmental interventions. It also notes the growing prominence of natural resource management in supporting economic growth and sustainable use of the resource base. The initiative identifies

two areas of intervention which are global in nature and a third that is region-specific. Areas for global intervention are sound environmental and economic policies and institutional development. Region-specific interventions describe priority problem areas. For the Latin American and Caribbean (LAC) region, priority problem areas are: (1) sustainable agricultural production, (2) conservation of tropical forests and preservation of biodiversity, (3) watershed management, and (4) and coastal zone management.

The A.I.D. Regional Office for Central American Programs (ROCAP) is developing a specific regional environmental strategy for the 1990's. The draft strategy highlights *inter alia* economic and environmental policies for sustainable development, institutional strengthening for government agencies and NGOs, public participation and empowerment in natural resource issues, and human resource development and training. The NRM Project embodies this strategy in various components.

The USAID/N Country Development Strategy Statement (CDSS) is nearing final approval. The project will be in close agreement with the stated intent to foster the management of natural resources in a sustainable way so that resources form the basis for long-term growth. In addition, the project incorporates specific field components which focus on the Atlantic Coastal region and the north-central resettlement areas -- geographic areas highlighted in the CDSS.

1.3 Commitment of the Government of Nicaragua

The new government has expressed a firm resolve to re-orient management of the country's natural resources to be a central feature of its platform. President Chamorro was an outspoken proponent of improved management of natural resources during the Central American summit held in Guatemala in June 1990. The president also promoted the Nicaraguan Natural Resources Institute (IRENA) to a cabinet-level position with the ministry status and nearly doubled the agency's funding in 1990. The revitalization of IRENA's capacity to promote sustainable natural resources management through policy development, empirically proven technology development and extension, and improved regulatory capability is the essential objective of the NRM Project. The completion of the National Strategy for Conservation and Development, supported principally by the Swedish International Development Agency (SIDA), to be completed by October 1991, will provide important direction. The GON natural resources strategy is at a key stage in its development. Discussions are underway and decisions will be made soon regarding the strategy and related policies, administrative structures, programs, and projects for the environmental sector in the country.

Currently, the best expression of the GON's emerging strategy is found in the "Proposal for the Use of Environmental Funds from the Agency for International Development for Nicaragua." Among the goals of the new environmental strategy are:

- Establish a land use planning and management system to ensure sustainable use of the natural resource base;
- Promote the rational and sustainable use of renewable natural resources;
- Control and manage watersheds to avoid soil degradation and loss, and prevent downstream contamination of water sources;

- Create a system of natural reserves and parks to ensure the protection of threatened habitats, maintenance of biodiversity, and support for such diversity;
- Control and prevention of environmental contamination; and
- Execution of an effective environmental education campaign.

1.4 Other Donor and A.I.D. Activities

USAID/N has several programs underway with direct and indirect implications for the NRM Project. The Commodities Support Project is procuring equipment for IRENA offices and providing guidance on project procurement. The Project's plant protection and integrated pest management component is shared with the Private Agricultural Services Project.

The Government of Sweden, through SIDA, has been a major supporter of the natural resources sector in Nicaragua, but the major part of this support has been directed at production forestry aspects. This support will continue, but there are indications that it will be at a reduced rate. The shift in GON policy to favor private ownership over state corporations will most certainly affect SIDA support to the state forestry corporation (CORFOP). There are indications that SIDA will expand its support in the conservation area. A recent draft of the SIDA natural resources country plan includes support to the SI-A-PAZ project and funding for a director and one vehicle for the Bosawás Reserve. SIDA is also responsible for the development of the National Conservation for Development Strategy (ECODE) and the Tropical Forest Action Plan-National Land Use Plan (PAF-OT).

In smaller efforts, SAREC (Sweden), NORAD (Norway), and Oxfam (Belgium) have worked in SI-A-PAZ. GTZ, Bread for the World, Greenpeace, Friends of the Earth, and lesser-known European NGOs have provided assistance to at least two conservation NGOs in Nicaragua, ABEN and MAN. CATIE and IUCN have projects in Nicaragua and can offer technical and training assistance to the NRM Project.

Oxfam/U.S. and the National Science Foundation (NSF) have supported research in the lowland forests of the Atlantic coast and the monitoring of recovery efforts of the rain forest which was flattened by Hurricane Joan in 1988. The University of Maine trains Nicaraguan students and has a forest inventory and management program for the RAAN and RAAS areas on the Atlantic Coast. Other U.S. universities with natural resource activities in Nicaragua are the University of Maryland, Ohio University, University of Wisconsin, Michigan State University, and the University of Miami. The South Florida Water Management District has seconded a staff person as Environmental Advisor to the President and will coordinate with IRENA on the policy and watershed management components of the NRM Project.

1.5 Project Activities

The NRM project design contains four components: (1) institutional strengthening and policy development; (2) protected area and buffer zone management; (3) environmental education; and (4) plant protection and integrated pest management. Together, these four components are designed to accomplish project purposes. Each component responds to a

distinct aspect of the current problematic situation in Nicaragua which prevents the country from managing renewable natural resources and protecting biodiversity. The rationale for each component and its objectives, activities, and outputs are discussed below.

1.5.1 Institutional Strengthening and Policy Dialogue

The institutional strengthening subcomponent will improve the administrative, management, and accounting capability of IRENA through technical assistance and training from a management consulting firm which will provide accounting and other management hardware and software. IRENA will become more effective and efficient in the collection and control of revenues generated by natural resource users and in the management of A.I.D. and other donor funds. Staff morale and performance will be improved through training and equipment acquisition, including two-way radios and vehicles.

The policy dialogue subcomponent will support policy formulation for environmental and natural resources issues by strengthening inter-agency consultation on policy, using the committees and groups centered around CONAMOR and IRENA. Policy dialogue will focus on the issues of deforestation, watershed management, pesticides, and protected areas using a participatory process similar to that used in the National Conservation Strategy.

1.5.2 Protected Areas Management and Buffer Zones Development

The activities to be executed under Protected Areas Management are the strengthening and development of local institutions, provision of financial support for both U.S.-based and local NGOs, infrastructure development, and ecotourism. Interventions will focus on three protected areas and their buffer zones. The Miskito Cays Reserve subproject targets the North Atlantic Coast and marine environment including the offshore islands -- a biologically rich and diverse area with special importance for sea turtles, shrimp, lobster, and native and migratory birds. The Bosawás Reserve subproject, on the northern border with Honduras, targets the largest intact remnant tropical forest north of the Amazon. The Chacocente Wildlife Refuge targets an important tropical dry forest remnant facing a Pacific Ocean beach used as a nesting area by sea turtles. This component focuses on the conservation of productive tropical forest and aquatic environments, the protection of biological diversity, and the improvement of social and economic conditions of persons living in and near these areas. Activities will include baseline surveys and needs assessments, identification and development of community-based conservation and development NGOs, applied research in marine and land resource harvesting (including sea turtles or their eggs), development of long-term management plans, training in wild land management and non-formal education and extension methods, and income-enhancing buffer zone activities targeting women.

1.5.3 Environmental Education

This component will develop a national environmental education strategy in conjunction with IRENA and other government and nongovernment entities.

1.5.4 Plant Protection and Integrated Pest Management

In combination, the NRM and PAS projects will address several problems related to plant protection and pest management: (1) pesticide residues above tolerable limits on agricultural products, (2) accidental poisoning of pest control workers, (2) environmental contamination by pesticides, and (4) the high cost of the pesticides needed to protect crops and control disease vectors with methods used in Nicaragua. The management structure of PAS will be used to make NRM funds and expertise from regional and central AID projects available to IRENA, the Ministry of Agriculture (MAG), and the Ministry of Health (MINSa). These agencies will be supported to establish programs for pest control technical assistance to farmers, research on IPM, training for decision-makers and pesticide users, pesticide registration, monitoring, and pesticide and IPM information.

1.6 Environmental Assessment of the NRM Project

The recommended environmental threshold decision and the Initial Environmental Examination (IEE) prepared for the Project Identification Document (PID) both recommended a Positive Threshold Decision. While it is recognized that the goal of this project is to provide positive environmental benefits to Nicaragua, the project does have the potential to significantly impact the environment.

Project activities recognized as having potential environmental impacts are the plant protection and integrated pest management component and the establishment of the system of parks and protected areas, especially in terms of the eventual opening of these areas to greater visitation via tourism development, and the need to carefully plan for impacts arising from the development of buffer zones around such parks and protected areas.

It was recommended that the NRM/EA focus on two specific subcomponents or activities within the Forest and Protected Areas Management Component. These were the biodiversity pilot projects and the buffer zone management subcomponents. Two of the other major project components -- institutional strengthening of IRENA and environmental education -- will not have direct environmental impacts and are excluded from this EA.

Because of these concerns, and the Positive Determination for the sub-projects, this EA was carried out pursuant to A.I.D. Environmental Regulation (22 CRF 216). The EA for the plant protection and integrated pest management component of the NRM Project and Private Agricultural Services (PAS) Project (524-0315) was also carried out during the NRM Project development phase and is attached to this study.

2.0 SELECTION OF PREFERRED ALTERNATIVE

This chapter identifies and discusses the three alternatives which serve as the basis for the environmental assessment. These alternatives are described, and each one is analyzed in terms of the overall effects its implementation would have in the long-run. The preferred alternative is defined, including recommendations for appropriate mitigation measures.

Because the NRM project is primarily a conservation and sustainable use project and was prepared jointly with this environmental assessment, the project is expected to slow down the current degradation of the environment and the destruction of renewable natural resources in Nicaragua.

2.1 Description of Alternatives for the NRM Project

Three alternatives are considered. The first one supports the project as described in the NRM/PP which was submitted to USAID/N on 24 June 1991. The second alternative recommends several additions and a deferment on the capture of sea turtles and the collection or marketing of turtle eggs. The third alternative considers no action, which means not funding the NRM Project as submitted to USAID/N.

2.1.1 NRM Alternative I

The NRM Project as designed will have a very beneficial effect on the conservation and sustained use of both marine and terrestrial biological resources in Nicaragua. Details of the interventions in and around the protected areas will depend on (1) plans developed by the GON, (2) technical assistance provided by U.S.-based NGOs, (3) implementation of interventions by local NGOs, and (4) the participation of local communities in project planning and implementation.

The broad parameters of interventions envisioned by the PP team are expected to have very beneficial effects on conservation and development of renewable natural resources in three important geographical regions and, furthermore, to promote sustained use of both marine and terrestrial biological resources. The project will help to limit the uses of resources located within protected areas (PAs) to research, monitoring, and low-impact, sustained-yield extraction of renewable resources. In the buffer zones, resource uses will entail more intensive use of land and more concentrated application of capital, labor and possibly agricultural chemicals. Here the project will extend resource-conserving practices for farming and resource extraction and facilitate development of social and economic infrastructure. By developing services and infrastructure in the buffer zone, the project will discourage the incursion of settlers and poachers into the protected areas.

2.1.2 NRM Alternative II

The second alternative supports the proposed activities with some additions and a deferment to achieve a more comprehensive conservation and sustainable use program. These changes would result in a less exploitive socio-economic environment by increasing local participation in environmental decision-making, expanding local economic opportunities, and

providing more effective protection for biological diversity, marine resources, riparian zones, and tropical forests.

Some project activities have a potential for adverse environmental impact. These include the construction of physical infrastructure in the buffer zones and physical interventions within the PAs, such as extraction of animals (especially sea turtles and/or their eggs) and forest products, and building trails, guard stations, or structures to facilitate education or tourism. Compliance with protected area restrictions is, at present, voluntary. PA guards do not have authority to halt unauthorized or illegal activities within the reserves. Thus, project interventions must be carefully planned and monitored to ensure that they do not provide access for settlers or persons who would extract resources using methods or intensity not authorized in the area's management plan.

Environmental assessment of the detailed designs for physical interventions will be necessary for each site, but need only be reviewed by ARDO of USAID/N.

This EA will defer judgment on the capture of sea turtles in the Miskito Cays subproject and the collection and marketing of sea turtle eggs in the Chacocente Wildlife Refuge subproject until more detailed plans are prepared by IRENA and/or the NGOs involved in these activities. The deferment here requires both subprojects to submit detailed, written plans which specify a management and protection program for these animals to USAID/N for a specific ruling by A.I.D./Washington.

Additional activities proposed in the second alternative are:

- Soil survey and land use potential mapping for the Bocay Valley settlement program, a GON program that the NRM project should participate in
- Use of land use potential maps to delineate and assign individual farms
- Riparian zones and lowland use potential areas preservation
- Wildlife management program for game animal production
- Development of a logging cooperative for the Bocay Valley settlement program
- Fuel wood and saw timber production program
- Household food preservation program

Alternative II will be in compliance with Sections 118 and 119 of the Foreign Assistance Act, specifically addressing the protection of tropical forests and the preservation of biological diversity.

2.1.1.1 Soil Survey and Land Use Potential Mapping in the Bocay Valley

The parcels assigned to individual beneficiaries of the GON settlement program in the Bocay river valley should be suitable for sustainable production. Sustainable production should be defined based on the productive potential of the land (e.g., soil fertility and topography). The basic information for this definition should come from a basic soil survey and development of a land use potential map which can also be used as an entitlement map. A rapid survey of the

50,000 hectares allocated for settlement should be carried out placing special attention on soils, topography, rocky outcrops, and riparian zones. The end result of this task will be the identification of more or less homogeneous areas which are suitable for sustained use production of annual and/or perennial crops versus forestry and livestock production. This same map can also be used to monitor agricultural achievement, environmental status, and socio-economic well-being of project beneficiaries.

2.1.2.2 Use of Land Use Potential Maps to Delineate and Assign Individual Farms

The utilization of a soil survey to prepare land use potential maps must proceed with the delineation of individual parcels in the Bocay Valley settlement program. The objective of this activity is to identify similar areas within the settlement area that can be utilized in a sustainable manner with similar levels of management. This will allow the extension service and training coordinators to focus their efforts on areas that are more suited for different production activities such as annual crops, permanent crops, livestock grazing, timber production and/or complete protection (e.g., riparian zones which will be managed for fish and game production with access to all beneficiaries).

Once homogeneous land capability areas have been identified, the land can be rationally divided into units of similar value and can be targeted for site-specific extension activities at a savings of time, money and effort.

It is important to realize that these settlers do not represent a homogeneous group of farmers but a group of former resistance fighters with different abilities and production interests. Some will want to produce perennial crops, while others will be more interested in livestock production and forestry. Therefore, the land use potential map will also provide a means to match beneficiaries with preferred production activities and thus insure greater success of the program as well as fewer failures among individual settlers.

2.1.2.3 Riparian Zone and Preserved Areas

Riparian zones and areas with low land use capability should be mapped and preserved in the Bocay valley settlement program. Maintaining stream corridors and preserved areas within the settlement area will enhance biological diversity and maintain more tropical forest. They will allow higher animal populations and, in some cases, the existence of these riparian corridors will make the difference in the presence or absence a given species.

It is recommended that a buffer strip of 10-20 meters be preserved along stream corridors which constitute riparian zones. These zones can provide several economically valuable services such as maintaining water quality and stream flow for fisheries, household water, recreational use, and navigation as well as provide habitat for game and other animals. Other areas of low land use capability (e.g., rocky outcrops and steep slopes) will provide additional wildlife habitat for economically valuable species such as deer, small animals, iguanas, and birds while maintaining a higher degree of biodiversity and forest cover in the settlement area.

2.1.2.4 Wildlife Management Program for Game Production

The Bocay valley settlement project has the opportunity to maintain a high degree of biological diversity and significant areas of tropical forest within the buffer zone of the Bosawás reserve. A wildlife management program in concert with the riparian zone and preserved areas program would not only provide a continuous supply of meat to the beneficiaries--enhancing their economic well-being--but would also maintain a high degree of biological diversity and preserve significant areas of tropical forest.

A wildlife management program which included alligators, caimans, and iguanas on the Atlantic coast as well as deer, small animals and birds in the Bosawás and Chacocente, would provide a continuous supply of meat to beneficiaries in support of their economic well-being, and would maintain a high degree of biological diversity while preserving significant areas of tropical forest.

2.1.2.5 Logging Cooperative for Bocay Valley Settlement Program

A significant opportunity exists to increase the success of the GON Bocay Valley settlement program and relieve pressure on the Bosawás reserve. Generally forests are cleared by colonists simply to establish their right to farm the land they clear. The forest itself has no intrinsic value to the colonist. In the case of the Bocay settlement program, colonists will have the legal right to the land without having to destroy the existing forest. Consequently, the project has a unique opportunity to demonstrate to farmers the value of their forested areas as sources of game, natural products, recreation, etc., as well as a source of additional income from managed commercial forests on their farms.

It is recommended that the Bocay Valley subproject develop a commercial logging and saw timber cooperative for settlers to develop and harvest the forest resources that will be on the parcels given to the beneficiaries of the GON settlement program. This cooperative would assist in clearing of designated agricultural lands and providing start-up capital for settlers, which would alleviate pressure on the native forests and biological resources being protected in the Bosawás Reserve. By using the land use potential maps, the logging cooperative can also insure the preservation of riparian zones and preserved areas. The cooperative should be formed with the proviso that it be allowed to clear/log no more than 50 percent of individual farm surface area and abide by the riparian and preserved areas designation of the land use potential maps.

2.1.2.6 Household Food Preservation Program

During numerous field trips, it was noted that not one single house visited had any preserved foods. For example, three households on the Atlantic Coast had no preserved foods nor did household members have any knowledge of how to preserve foods. At the time of the visit to the Atlantic Coast (30 May to 3 June), there were so many mangos lying under the numerous trees in the villages that pigs would not even eat them. In spite of the fact that the field team was served a delicious cooked mango dish for dessert on three occasions, the host claimed to have no way of preserving the excess mango production for the off-season.

The recommendation is made that the subprojects in all three areas develop 4-H clubs or their equivalent in the buffer zones. Such an organization would not only involve women and children in food preservation and home economics but also would be an important means to carry out extension services and environmental education and training programs.

2.1.2.7 Fuelwood and Saw Timber Production

In three villages in the Miskito Cays area, the scarcity of saw timber for local village construction activities and cabinet-making was a major concern. In Chacocente, fuel wood cutting in the refuge was a serious problem. It is strongly suggested that fuel wood and saw timber production be included in the environmental education, training and extension packages developed for the buffer zones of these two sites.

2.1.3 NRM Alternative III

The third alternative would contribute to the continuation of the present patterns of deforestation, environmental degradation, loss of biological diversity and soil resources, and reductions in water quality and quantity.

2.2 Description of Alternatives for the Pesticides Component

The PAS Project deferred the EA of its pesticides component to that of the NRM Project. The EA for the latter project indicates a preferred alternative based on its analysis and recommends additions governing the purchase and use of any pesticides under the components of both projects that relate to the use of pesticides. The principal environmental issue facing the pesticides component of the two projects is the development of safe and efficient pesticides use programs, especially on crops for the export markets.

The EA regarding pesticides considered three alternatives:

2.2.1 Alternative I

The Pesticide and Pest Management component as designed in the NRM/PID and related activities under the PAS/PP would have the beneficial effect of increasing and stabilizing the incomes and well being of private agricultural producers of exportable crops. This would be achieved by supporting the testing of agricultural exports for pesticide residues, the training of farmers and professionals in pesticides use and IPM, and the distribution of information on pesticides and IPM.

2.2.2 Alternative II

Alternative II supports the proposed activities described in the NRM/PID and PAS/PP, plus some additions. It addresses the regulation and monitoring of the production and use of pesticides and proposes to provide and validate IPM technological packages and demonstrate that the IPM program can be a preferable alternative to a traditional control program based solely on pesticide use.

2.2.3 Alternative III

Alternative III, a "no action" scenario, would contribute to the continuation of the present pattern of environmental degradation and pesticide-related human health problems, as well as the rejection of potentially valuable export crops for the international markets.

The pesticide and pest management EA is attached to the NRM/EA.

2.3. Assessment of Alternatives

As a logical framework, a set of criteria was developed to determine which of the considered alternatives should be implemented. The criteria were then applied to each of the alternatives to select the one which is the most sound. Based on A.I.D. policy, the following set of criteria was used:

- Sustainability of resource use,
- Conservation of tropical forests,
- Preservation of biological diversity, and
- Socio-economic development.

2.3.1 Criterion One: Sustainability of Land Use

The sustainability of renewable natural resource use is one of the priorities of current A.I.D. environmental policy. A comparison of the three alternatives under consideration reaches the following conclusions.

Under Alternative I, no special consideration is being given to soil capabilities and thus to land use sustainability.

Under Alternative II, a consideration of the physical limitations of the environment for agricultural production in all three buffer zones will prevent the utilization of areas not suited for agricultural production. The inclusion of the soil survey and land use potential mapping requirements in the cooperative agreements will force CCC, IRENA, INRA, and PACA to look at the land use capabilities and take actions accordingly.

Alternative III would contribute to a continuation of the present patterns of deforestation, environmental degradation, loss of biological diversity and soil resources, and reductions in water quality and quantity.

2.3.2 Criterion Two: Conservation Of Tropical Forests

A.I.D. regulations call for the conservation of tropical forests and tropical forest remnants.

Under Alternative I, while the establishment of the PAs will protect a large piece of tropical forest in the Bosawás, a piece of seasonally dry tropical forest in Chacocente and

mangrove forests, and remnants of tropical pine savanna on the coast of the Miskito Cays, it does little to protect the remnants of forest in the buffer zones of these subprojects or to reduce the need for poaching fuel wood and saw timber in these PAs.

Under Alternative II, the riparian zone and preserved areas program and the logging cooperative for the Bocay Valley subproject, along with the wildlife management program and the fuel wood and saw timber production program in all three buffer zones, will demonstrate the value of tropical forest to project beneficiaries while reducing their need to poach fuel wood and saw timber from the PA.

Alternative III leaves potential beneficiaries with no technical assistance and thus contributes to the degradation and destruction of tropical forests in all three subproject areas.

2.3.3 Criterion Three: Protection of Biological Diversity

A.I.D. regulations pertaining to the preservation of biological diversity are similar to those for the protection of tropical forests. The presence of biological diversity is linked to the maintenance of habitat, much of it forested.

While the protection of biological diversity is provided by the the support and development of the three PAs in Alternative I, no special effort is made for it in their buffer zones. In fact, the development of services and infrastructure in these areas may well increase the cutting of fuel and saw wood and marine and terrestrial animal poaching.

In Alternative II, the protection of riparian zones and other preserved areas of low productive potential, as well as the wildlife management program for game animals, would protect wildlife habitat and maintain more biodiversity than Alternative I. Even the logging cooperative in the Bocay valley would protect habitat by adhering to the land use potential maps designation of areas to be preserved. Fuel wood and saw timber production will provide more forested habitat and thus increase biodiversity in the Chacocente and Miskito Cays buffer zones.

Under Alternative III, biological diversity will continue to decline in all three subproject areas as the increasing population of Nicaragua attempts to satisfy its need for agricultural, marine, and forest products in an unsustainable manner.

2.3.4 Criterion Four: Socio-economic Development

Improving the socio-economic conditions of project beneficiaries, and thus contributing to the social and economic development of the country, is a principal objective of A.I.D. and the NRM Project. However, the effect will be ephemeral if the transformation brought about by project activities is not sustainable.

It is critical that the Bocay valley settlers receive land which is appropriate for their production interests and is capable of sustainable agricultural production. Under Alternative I, the real possibility exists that farm parcels in the Bocay valley will be laid out by simply applying a straight edge to a map. In this case, it is certain that many farms will be made up entirely of, or will contain, large percentages of land with low land use potential. These farms will have serious limitations to agricultural production, will not be sustainable, and will eventually

deteriorate to a point where they will be abandoned. The NRM/PP makes no real effort to provide fuel wood and saw timber for the participants in the three protected areas and their buffer zones. The PP also makes no effort to protect riparian zones which would enhance wildlife for food in the buffer zones of the three subproject areas or addresses the development of a food preservation program, e.g., a 4-H type program which would include children in project activities.

Alternative II provides for the above shortcomings with the recommended additional activities which can be included in project activities as they are being formed in the NGO proposals.

Under Alternative III, the socio-economic condition of the protected areas and their buffer zone inhabitants would continue to decline as they attempt to meet their food, fuel wood and shelter needs by the present unsustainable mining of potentially renewable marine and terrestrial natural resources.

2.4. Identification and Rational for the Preferred Alternative

Application of the criterion developed for this evaluation consistently shows that Alternative II is the best option for achieving A.I.D. and corresponding NRM Project goals. Alternative II, therefore, is the preferred alternative. **The major recommendation of the EA is that Alternative II be implemented.**

The incorporation of the additional activities and the inclusion of more detailed plans on the management and conservation of sea turtles and their eggs, as recommended in Alternative II, will clearly enhance the long-term sustainability and the improvement of the socio-economic well-being of protected areas and buffer zone inhabitants. The use of the soil survey and land use potential maps to develop land based on its capabilities is the only rational way to bring about sustainable development and conserve a healthy environment for present and future generations of Nicaraguans. The protection of biological diversity and the conservation of marine resources and tropical forests with protected areas management and buffer zone development will save valuable resources for the future. Riparian zone preservation will prevent the deterioration of water quality down stream while preserving habitat for the preservation of biodiversity and game animals. It will also reduce erosion and protect fisheries for the both present and future benefit. This will improve the chances for the long-term conservation of renewable natural resources in Nicaragua.

The preferred alternative obviously has additional economic costs. However, development projects which are environmentally sound are also economically viable in the long-term, and the savings derived from good planning activities, plus the value of the resources protected, greatly outweigh the additional costs. Because this EA can be used in the project design being developed by the NGOs, additional costs are expected to be absorbed by the NGO proposals.

3.0. DESCRIPTION OF THE AFFECTED ENVIRONMENT

The NRM Project will operate in three PAs during the four-year life of the project (FY 92-96): the Miskito Cays Reserve, the Bosawás Reserve and the Chococente Wildlife Refuge, plus the buffer zones surrounding these PAs. The three areas are a cross-section of representative lifezones across the country, ranging from the Pacific Coastal beach and hills, through the northern central highlands, and down onto the Atlantic coastal plain and out onto the continental shelf.

3.1. General Overview

Nicaragua is located in the middle of Central America, bounded on the north by Honduras and on the south by Costa Rica, with the Pacific at its western shore and the Caribbean to the east.

With a total land area of circa 135,000 square kilometers, Nicaragua is the largest country in Central America and is comparable in size to New York state. It is easily divided into four geographic regions: (1) a broad Atlantic coastal plain, the most extensive on the isthmus and covering 65 percent of the country; (2) a central interior highland that surpasses 2400 m elevation along the Honduran border; (3) a narrow Pacific slope interrupted by a chain of some 25 volcanos, ranging from extinct, water filled craters to very active ash and cinder ejecting cones; and (4) the great rift lakes, the largest bodies of fresh water in Central America.

The Pacific region, originally dominated by tropical dry forest, was converted to agriculture beginning almost immediately upon the arrival of Spanish colonists because of its relatively high soil fertility. With the exception of relict forest patches along the coast and around the lower slopes of several of the more inaccessible volcanos, the region is currently characterized by a mix of exotic grass savannas, cultivated land, and degraded scrub land. The Central region originally contained extensive pine and oak forests interspersed with cloud forests in the higher elevations of the northern part, with tropical humid forests to the south. Most of the latter has been replaced by cultivated land and pasture and the remaining forests at higher elevations are under threat by settlement schemes.

The vast and relatively flat Atlantic region is subdivided into pine savannas and coastal wetlands in the north and lowland tropical forest to the south. The region has seen markedly little human induced perturbation, but the agricultural frontier—located at its western boundary and slowed in its eastward movement by years of civil unrest—can be expected to increase its momentum in the near future.

Lakes Managua and Nicaragua, and the marshlands in between, form the fourth geographic region of importance. This wetland complex covers over 9,000 km², where once was found great reservoirs of fishery and water resources. Unfortunately, Lake Managua has become seriously polluted by chemical and organic effluent from the capital and surrounding farmlands, and the fisheries of Lake Nicaragua appears to have been seriously overexploited.

3.1.1 Flora and Fauna

A curious feature of Nicaraguan biodiversity is its apparent impoverishment when compared to that of some neighboring countries. Although the country has not had a detailed vegetation map prepared, detailed agroecological studies, based in part on soil and climate data, suggest that there are 10-12 biogeographic life zones in the country.

The native vertebrate terrestrial fauna of Nicaragua has not been extensively studied. In round figures, Nicaragua's vertebrates include 750 birds, 600 reptiles and amphibians, 200 mammals, and 100 freshwater fishes for a total of 1650 vertebrates. Although the fauna is diverse, the numbers are not in keeping with what one might expect from the largest country in Central America. One contributing factor to this reduced biodiversity is that Nicaragua lacks the widely varied topography, heavy rainfall, and high mountains that characterize its more biologically diverse neighbors. Lower mountain ranges trap less precipitation and offer fewer variations in habitat and ecosystems.

With lower mountains and broad coastal plains offering fewer barriers to species movements, Nicaragua has fewer endemic species than some neighboring. It can, however, lay claim to the largest tropical rain forest in Central America, the most extensive sea-grass beds in the Western Hemisphere, the widest extent of continental shelf and coral reef in the Caribbean, and largest lakes in Central America. The mangroves along the Atlantic coast are some of the most extensive in the region. The mangroves in the Gulf of Fonseca are among the most economically important and productive resources on the Pacific coast.

In addition the human population level is still relatively low in comparison with other Central American countries. The urban population density in some areas (parts of Managua) may exceed 1,000/km² and average above 200/km² in heavily urbanized departments. The rural population in many areas is less than 7/km², greatly reducing the human pressure on rural and wildland areas. This creates an opportunity to establish effective management of existing wildlands while competition for these resources is reduced.

This situation is changing rapidly. The cessation of warfare has opened areas of previous conflict to resettlement. Efforts to demobilize Resistance and Sandinista soldiers are focusing on land distribution as a short-term solution because the battered economy is not capable of creating immediate employment or income for thousands of former soldiers and their families. One effect of demobilization and resettlement programs is an expansion of the agricultural frontier in an attempt to solve political and socio-economic problems. Unfortunately, an expansion of the agricultural frontier is not a long-term solution to the problem. Expansion promotes agricultural efforts on lands that cannot sustain intensive cropping and support cattle grazing on lands that would be more productive managed as forest. Nicaragua already has vast areas of once-valuable forests that today are used for low-productivity extensive grazing.

The rate of deforestation has accelerated dramatically in the past 12 months. During the period of conflict, deforestation in Nicaragua dropped from the 1979 level of 100,000 ha/year to roughly 20,000-30,000 ha/year. With the end of the conflict, deforestation was expected to rise rapidly as bottled-up demand for land was released. The anticipated figure for the 90-91 dry season was 150,000 ha deforested, but recent calculations by INRA place the figure at 200,000 ha. This suggests an urgent need to strengthen and expand natural resource

conservation and management efforts, especially the national parks and reserves, before the forest resource is destroyed.

3.1.2 Demography

The population of Nicaragua, estimated at 3.5 million in 1989, experiences an average annual growth rate conservatively estimated at 2.9 percent. The fertility rate of 5.0 births per female, a relatively high birth to death ratio of 39:8 per 1000, and the fact that 50 percent of the population is currently less than 15 years of age, suggest that the country population can be expected to reach 5.3 million by the year 2000. Natural population growth was offset by a negative net out-migration due to the armed conflict during the 1980's. Nearly 250,000 Nicaraguans were displaced to refugee camps in Honduras and Costa Rica, and internally to the major cities of the Pacific slope. Another 100,000--primarily the most skilled and trained--emigrated to the United States during this period. With the end of the war, repatriation of displaced persons and voluntary emigrants will add significantly to the demographic equation.

Although Nicaragua is the least densely populated of the Central American republics, with an average of 24 inhabitants/km², population distribution is highly skewed, with nearly 80 percent of the population located on the Pacific slope and 64 percent in the large cities (50% in Managua alone), making it the most urbanized country in Central America. The civil war did not only halt the historical migration from the Pacific and central departments to the Atlantic slope, which had been occurring since the 1950's, it actually caused a total reversal of this internal migration pattern. The depopulation of the rural Atlantic region during the past decade has resulted in the fact that less than seven percent of the population is currently located on the Atlantic slope, an area with about 60 percent of the total land surface of the country.

The ethnic distribution is 69 percent Mestizo, 17 percent white, nine percent black, and five percent Indian. The black and Indian population (largely Miskito, Sumu, Rama, and Garifuna) are linguistically and culturally distinct from the Mestizo/white majority, and this population is centered on the Atlantic coast. The physical isolation of these peoples from the power center on the Pacific side has caused an economic and political disenfranchisement of the inhabitants that has only recently been addressed by designation of the Atlantic departments of Zelaya and Rio San Juan as politically autonomous zones (RAAN in the north, RAAS in the south). The limits to political empowerment to the zones is not clear, and there is disagreement as to whether regional government authority extends to natural resources and resource policy.

3.1.3 Economy

Nicaragua has consistently ranked behind the other Central American republics in terms of GDP. The Nicaraguan economy has been on a downward spiral since the devastating earthquake of 1972 destroyed much of Managua. Despite a large influx of international assistance, the capital was never adequately rebuilt nor the damaged economic infrastructure restored. The decline continued during the years of a guerrilla war, culminating with the Sandinista triumph in 1979. Economic deterioration became even more accelerated over the past ten years as a result of counter-revolutionary activity, trade embargoes, and a centralized economic strategy that brought state control to approximately 50 percent of the agricultural and industrial sectors.

The Sandinista government was not able to rebuild from the decapitalized condition of the 1979 national economy. By 1988, GDP had declined to US\$2.1B, per capita income was US\$610, and real economic growth was estimated at minus eight percent. The economy has been unsustainably supported during the past decade by European socialist countries, through payment of artificially high prices on commodity exports, imports of oil and industrial needs at less than world prices, and nearly \$10B in loans, credits, and grants. External debt, nearly all of which is public, is currently estimated at between six and seven billion dollars.

Agriculture dominates the economy, accounting for 86 percent of the export earnings and 44 percent of labor force participation. However, production of both the principal export commodity crops (banana, coffee, sugar, meat, seafood, cotton) and basic food grains (corn, beans, rice) has fallen annually since 1983.

3.1.4 Land Use

Land use patterns vary by geographic region. The Pacific slope with its volcano-enriched soils has traditionally served as the country's breadbasket, even though over the past three decades, much of the land previously dedicated to small grain production for domestic consumption was transformed into large-scale commercial agriculture--primarily cotton, sugarcane, and cattle for export. The traditional red bean production area in Carazo was converted to shadeless coffee. The Central Highlands, while sparsely populated, have been utilized chiefly for permanent crops such as coffee, while the broad Atlantic lowland (with characteristically poor soils) was the relief valve for the landless and economically deprived sector from the Pacific corridor until the recent civil war.

From 1960 to 1980, Nicaragua experienced the highest rate of deforestation in Central America, with 1000 km² converted to scrub and pasture annually. Forest cover dropped from 54 to 38 percent of the country's land surface, while area under cultivation increased from 10 to 13 percent and pasture land increased dramatically from 14 to 29 percent. In the last decade, in large measure due to the economic and social disruption caused by the armed conflict, the deforestation rate diminished greatly, though to what level is not known. Since cessation of fighting, pent-up demand for land has expanded the agricultural frontier, resulting in a deforestation estimate for the 1990-1991 dry season of 200,000 ha. Forested land remains near the 1980 level at 35 percent, productive arable land has been reduced to between 9 and 11 percent (89% of which is in the dry Pacific region), and permanent crops cover only one percent. Land converted to pasture has increased to 43 percent of total land surface, but most of it is degraded and unsuitable for grazing.

3.1.5 The Contra Settlement Program in the Bosawás

When the truce between the Nicaraguan army and the Contras was achieved after an eight-year civil war, one condition was that Contra soldiers would receive land, a promise which was repeated by the new President, Violeta Barrios de Chamorro. Among the areas mentioned was that down river from San Jose de Bocay in the northern Jinotega province. As a result, the population of the town of San Jose de Bocay has swelled in the last year or so, and according to the principal mediator between the Contras and the Ministry of the Interior, Juan Arauz (also known as Comandante Siete Leguas), there are currently some 1,480 demobilized Contras around San Jose de Bocay which, including their dependents, number around 6,000 persons.

The government commission in charge of resettlement arrived in San Jose de Bocay at the beginning of June 1991. The commission is composed of five individuals from INRA. According to commission members, they expect to complete their three-month investigation and return to Managua in September 1991. In addition, MAG recently sent an agronomist to join in efforts in the region.

Within the Bosawas itself, according to J. Arauz, there are some settlers, but they are few and have little effect on the forest. The soil appears to be fertile enough so that the slash and burn cycle of farming can be carried out with just two plots, one to work and one to leave fallow, alternating every year between the two. Difficulty of access has meant that these settlers almost never have a cow and because of lack of start up capital rarely have pigs and chickens.

The INRA commission will work in conjunction with MAG and IRENA, but INRA appears to have the final word on where and how large the resettlement land grants will be. The planned strategy of the INRA commission is to carry out an agricultural census from San Jose de Bocay down the Bocay river to the mouth of the Wina river and from the approximately 100 meter altitude at the river up to an altitude of 300 meters on both sides of the river. The area, blocked out on a map at the INRA commission office, contains approximately 50,000 manzanas of land for agricultural resettlement. While this number is only an estimate at present, it is expected that the land will be sufficient to settle 2,000 demobilized Contras with 25 manzanas each.

The INRA plan involves a long narrow area stretching from San Jose de Bocay to the mouth of the Wina river, but half of this area, from the mouth of the Tapal river to the Wina river, is located within the proposed Bosawas reserve.

Many of those expecting lands are not farmers but may be speculators interested in what they consider "spoils of war," and it is expected that many will sell or abandon their lands as soon as they have received title. Whether or not they are farmers, and if so, whether or not they are interested in working the land, there will undoubtedly be higher interest in those lands with access to road transportation than those which lack this access. The park lands are those down river with minimal access to services and transportation, and are also precisely those which will be of less interest to the demobilized Contras.

3.2 Protected Areas and Buffer Zones

The long-term objective of fostering environmentally sustainable natural resource use is to support broad-based economic growth. This does not happen automatically. Indeed, considerable resource degradation tends to occur when resource exploitation is spontaneous and uncontrolled. At the same time, destructive uses squander potentially valuable resources such as timber, gums, resins, fruits, nuts, and marine and terrestrial fauna.

In order to bring biodiversity protection and rural development into harmony, the project has selected three key sites to develop and implement techniques for integrating PAs and their buffer zones. Buffer zones are the areas adjacent to parks and reserves that serve as a transition between the natural environment inside the reserve and the human-altered landscape outside.

The criteria for selecting proposed PAs were: (1) biodiversity, (2) urgency, and (3) sustainability, with the hope of also identifying opportunities for developing and testing innovative techniques and methods. The three selected sites are the Bosawas Reserve, the Miskito Cays Reserve, and the Chacocente Wildlife Refuge.

3.2.1 Miskito Cays Reserve Subcomponent

The Miskito Cays Reserve is proposed as a protected area for the marine and coastal region in the northeast part of Nicaragua. The area is biologically rich, including lowland forests, coastal lagoons, freshwater wetlands, mangrove forests, shallow waters of the continental shelf, sea-grass beds, coral reefs, and coralline islands. The varied biodiversity encompasses commercially important shrimp, lobster, and finfish, plus sea turtles, manatees, migratory waterfowl, porpoises, parrots, and many other wildlife species. The proposed PA includes nearly 1,000,000 ha of marine (80%) and terrestrial and coastal environments (20%). The aquatic ecosystems are especially important, supporting major harvests of shrimp, lobster, turtle, and fish. The rich resource base has attracted many exploiters, and today resource piracy and over-harvesting is threatening both the livelihood and way of life of the indigenous Miskito people as well as the biodiversity and long-term productivity of the resource base.

An indigenous Miskito NGO, MIKUPIA, has been formed to lead the conservation and development efforts in this area. In focusing support on strengthening the institutional capacity of this NGO, the subcomponent will develop a mechanism for implementing activities and gain a local institution capable of carrying on activities after the end of the project.

A.I.D./LAC has funded a grant to the Caribbean Conservation Corporation (CCC) for the first year of a biodiversity conservation project focusing on the Miskito Cays. The NRM Project will help to fund a continuation of the project through the fourth year. The detailed description of this subcomponent is contained in the CCC proposal to A.I.D. and the Cooperative Agreement between A.I.D. and CCC. A brief description is included here.

This subcomponent would re-establish Miskito control over traditional natural resources through the creation and management of the Miskito Cays Reserve and related sustainable development of the rich biological resources of the area. The purposes of the subcomponent are to protect productive coastal and marine ecosystems, conserve biological diversity, and improve Miskito social and economic conditions. The specific objectives are to establish a Miskito Cays Reserve, protect the natural resources of the reserve and its buffer zones, involve local communities in the development and management of the overall area, identify and promote sustainable resource uses, and strengthen a local NGO to carry on the programs after the initial project ends. There are four primary activity areas: needs assessment, NGO development, reserve management, and buffer zone management. The activities will be integrated to make maximum use of synergistic relationships, economies of scale, and limited resources.

Needs assessment will use participatory techniques to involve local communities in identifying specific needs and designing programs to address those needs. The needs assessment will be supported with inventories and other results from applied research into the status, dynamics, and productivity of the resource base. NGO development activities will focus on strengthening MIKUPIA as an institution capable of designing and implementing conservation

and development programs. Reserve management will focus on protecting the natural resources. Activities will involve training for reserve and NGO staff, equipment and infrastructure, protection and enforcement, research and monitoring, and education. The buffer zone management will focus on environmentally sustainable development programs. Activities will involve women's clubs, environmental education with materials in the Miskito language, resource management for sustained yield, alternative harvesting technologies, resource tenure and usufruct studies, community outreach, and feasibility studies (shrimp and fish processing, ecotourism, etc.).

3.2.2 Bosawás Reserve Subcomponent

The Bosawás Reserve is a site of roughly 710,000 ha of tropical forest in the northern part of the Central Highlands. The proposed area encompasses Cerro Saslaya National Park (11,800 ha), but would increase the area under management nearly 60 times. This would create the largest single protected area in Nicaragua and in Central America. The area is largely unstudied, but the few reports available indicate that habitat abounds for jaguar, harpy eagle, and other spectacular Central American fauna. In migratory birds alone, the area shelters more than 100 species during the northern winter.

Once protected by its geographical remoteness and broken topography, the Bosawas today is a forest under threat. The ever-present demand for new agricultural lands, held in check by the military conflict of the past decade, has been released in recent months. Calculations by Swedish forestry advisors indicate that the 1990-1991 dry season exceeded all previous records for deforestation: 200,000 ha.— much of it in the Bosawas region. Ironically, the settlers are not even interested in the forest; it is viewed as an obstacle that must be cleared and burned to prepare the land beneath for crops.

Concerned over the deforestation threat, the destruction of natural resources, and the decline in rural well-being, the Programa Ambiental para Centro America (PACA, a consortium of U.S.-based NGOs), submitted an unsolicited proposal to USAID/N to develop a field-based conservation and development program for Bosawas. Working in close cooperation with IRENA, local organizations, and buffer zone communities, the proposal would link protection work in the reserve with development work and environmental education in the buffer zone. A.I.D. provided the consortium with written comments and indicated a willingness to receive a revised proposal. If the revised proposal is accepted by A.I.D., it would be funded through this project. The accepted proposal would constitute a detailed description of the subcomponent. A brief description is included here.

The subcomponent would stabilize expansion of the agricultural frontier in the Bosawas region through establishment of the Bosawas Reserve and development of environmentally and economically sustainable activities for the buffer zone and reserve. The purpose of this subcomponent is to protect productive tropical forest environments, conserve biological diversity, and improve the social and economic conditions of persons in the Bosawás region. The specific objectives are to establish a Bosawas Reserve, protect the natural resources of the reserve and buffer zone, halt deforestation, involve local communities in the development and management of the overall area, identify and promote environmentally sound alternatives to resource destruction, and strengthen local NGOs or other organizations to carry on the program after the initial project ends.

There are four primary activity areas: needs assessment, NGO development, reserve management, and buffer zone management. The activities will be integrated to make maximum use of synergistic relationships, economies of scale, and limited resources. The needs assessment will involve local communities in identifying their roles and responsibilities *vis a vis* the environment and in defining their socio-economic aspirations. The community assessment work will be preceded by resource inventory and survey work to provide an informed basis for community decisions. Training and other techniques to encourage participation will be integral parts. NGO development will focus on identifying one or more community organizations (or helping to create new ones) which can implement conservation and development activities. Reserve management efforts will focus on protecting the natural resources of the Bosawas. Activities here will include field surveys and inventories, determination of boundaries, marking of trails and borders, hiring and training staff, procurement of materials and equipment, construction of protection and administration infrastructure, monitoring, and education. The buffer zone portion will promote environmentally sustainable programs. Its activities will include agroforestry, women's clubs, agricultural extension work, applied research in farming methods, integrated pest management, pesticide safety and first aid, and feasibility studies of non-timber extraction strategies for the native forest.

3.2.3 Chacocente Wildlife Refuge Subcomponent

One of the greatest spectacles imaginable is the arrival of female sea turtles to lay their eggs in the sand on the beaches of Chacocente. Established to protect the remnant dry forest and shelter the nesting turtles, Chacocente Wildlife Refuge is a unique site in Nicaragua. Two species of sea turtles nest on the beaches. The forests within the refuge form what is probably the largest block of dry forest remaining anywhere on Nicaragua's Pacific slopes.

The ruggedness of the coastal landscape has helped to protect these resources until relatively recently, but continued growth in the human population is increasing the pressure on Chacocente's resources. Hunting, fuelwood harvesting, clearing for agricultural use, gill-net fishing, wildfire, and grazing are ever-present threats to the resources. Collecting and selling turtle eggs is a traditional source of income, but an increase in harvesting intensity is threatening the survival of the turtles themselves.

The purpose of this subcomponent is improve the management of the Río Escalante-Chacocente Wildlife Refuge (Chacocente) to protect biodiversity and encourage the sustainable utilization of the renewable natural resources of the region. A secondary purpose is to improve the socio-economic status of the human populations in and around the Chacocente Refuge through promotion of practices and methods for agriculture, agroforestry, and resource harvest which take into account the carrying capacity and sustained yield limits of the resources. The specific objectives are to ensure protection of the resources and ecosystems of the refuge, to develop effective protection for the sea turtles and the nesting females, to promote sustainable resource use among local communities, and to improve the integration of refuge and buffer zone.

The subcomponent will include three primary activity areas: infrastructure and equipment, community outreach, and training. Infrastructure activities will include needed maintenance and improvements for the ranger cabin and biological station, installation of a pump and pipe to bring fresh water to the compound, purchase of a 4-wheel drive vehicle for patrol and outreach

work, purchase of a motorcycle for ranger patrols, marking and signing of borders, installation of radio equipment, and feasibility studies for using wind and solar energy. Community outreach activities will focus on the local communities and their relationship to the resources in the refuge. IRENA staff and consultants will conduct key studies of resource utilization, agricultural techniques, soils, the local rural economy, and particularly turtle egg exploitation. Training activities will prepare the staff for increased levels of responsibility, particularly in enforcement and extension. Rangers will receive training in wildlife laws, enforcement, field work, communications, and public relations. Technicians will study field techniques, public relations, extension and environmental education techniques, and park management. Supervisory and research staff will receive park management, finance and administration, environmental education, and public relations training.

3.3 Plant Protection and Integrated Pest Management

Agricultural yields in Nicaragua are severely constrained by weeds and pests. Methods for protecting the crop plants involve the heavy (and costly) use of pesticides under conditions which sometimes endanger farm workers. The protected crops are likely to have pesticide residues so high that they may sometimes be unacceptable in importing countries. Thus, to protect their crops, producers take both health and financial risks. Similarly, MINSA, to protect the population from vectors of malaria, yellow fever, and other diseases, uses large quantities of insecticides. Workers applying pesticides to stop the spread of disease are at risk of poisoning, and environmental contamination can occur. It is highly desirable to use the minimum quantities of pesticides possible to achieve plant protection and disease control goals.

NRM and PAS project activities in plant protection and pest management should enhance the effectiveness of farmers' plant protection investments, reduce the level of pesticide residues on agricultural products, increase the safety of pest control workers, and enable producers of export crops to monitor pesticide residues so as to foresee any problems with acceptability of their products. For a full discussion, see the EA for Plant Protection and Integrated Pest Management which is attached to this EA.

3.4 Institutional Background

IRENA has the legal authority to establish and manage national parks and reserves, but lacks the staff, equipment, and administrative systems to manage the two proposed reserves. The project proposes a very practical approach: pairing US-based NGO's with the reserves to facilitate field-based technology transfer and administrative support. Targets for the technology transfer will be IRENA itself and the local community organizations and NGO's.

The PACA Consortium has considerable experience with terrestrial park and buffer zone activities. The Caribbean Conservation Corporation has a developed track record concerning marine and coastal research and management. These NGOs bring the additional advantage of having made a long-term commitment to the protected areas, an important consideration for continuing the development of local NGOs through pairing or partnering.

4.0 ENVIRONMENTAL CONSEQUENCES

This chapter describes key field observations and their environmental significance, identifies and provides a background discussion of major issues, analyzes the environmental consequences of each of the three alternatives, and defines mitigating measures.

4.1 Key Field Observations

A variety of field trips provided many instructive examples of natural resource utilization and abuse in Nicaragua. The site visit to Chacocente and the Miskito Cays accented the problematic use of sea turtles and their eggs. The trip to Volcan Consiguina and surrounding estuaries emphasized the importance of the shrimp industry and the almost-complete destruction of mangrove forests for use by the tannin industry. The trip to the Bocay Valley on the western side of the Bosawás reserve showed the effects of the expansion of agricultural frontiers at the expense of tropical forests. The helicopter flight along the Atlantic coast permitted an overview of the mangroves around several lagoons and clearly demonstrated the patchiness of the coastal forests which are, in fact, islands in a vast plain of seasonal wetlands.

Observations made during the field trips to Chacocente and the Atlantic coast suggest that pressures from poverty and resources piracy have produced a competitive atmosphere as regards marine resources extraction. At Chacocente, local people observed taking turtle eggs from the three turtles that arrived on the beach one night indicated that they had nothing and needed to eat and/or sell all of the eggs they could collect. The rationale was that if they did not take all of the eggs laid by the turtles someone else, probably an outsider, would. At Puerto Cabezas, 71 sea turtle shells were counted in 200 m of beach called Bocanita but also known as Matadero de Tortugas.

Based on these short field trips, it is not possible to determine if the two examples are representative of the attitudes of the local people concerning the exploitation of sea turtles on both sides of the country. However, a reasonable interpretation is that the attitudes observed reflect a desperation born of ignorance, poverty, and a lack of control by the people over their locally available renewable natural resources. Unfortunately, the exploitation of sea turtles for meat in the Miskito Cays and sea turtle eggs at Chacocente to satisfy short-term needs can lead to the over-exploitation of these animals, possibly driving them to local extinction. Local people need to, and will, exploit available natural resources in order to survive. The critical issue is what form this exploitation will take. Will it be for short-term survival or will exploitation be developed for long-term, sustainable yield resource utilization, which will be available for future generations to use and enjoy.

A summary of problems observed in the field relating to land use and the exploitation of other renewable natural resources includes:

- Agricultural practices inappropriate for the land use capabilities
- Lack of implementation of basic measures to protect riparian ecosystems
- Lack of knowledge of basic soil conservation measures
- Placement of gill-nets at the mouth of streams
- Collection of all eggs laid by turtles at Chacocente

- 71 sea turtle shells counted on 200 m of beach in Puerto Cabezas
- Catastrophic destruction of mangroves along Estero Real

These problems result principally from lack of knowledge and inadequate systems for establishing land use capability and renewable resources conservation and management.

4.2 Conservation and Protection Issues

The conservation of renewable natural resources is believed to be essential for the achievement of sustained development. Sustainability of benefits obtained from the resource base over time, in the form of goods and services, depends on the maintenance of the productive capacity of the ecosystems that provide them. This applies to all forms of resource utilization (agriculture, forestry, fisheries and other marine resources). Present natural resource utilization patterns in most developing countries are threatening these resources. The pressures from rapidly expanding population, poverty, inequitable concentration of resources, and political uncertainty have led to the application of shortsighted economic and resource management policies. These pressures can destroy natural resources, generating more poverty and actually narrowing the possibilities for future economic growth and development. Thus, the general issues are how to alleviate human pressures on the environment and, in so doing, provide for its conservation and protection.

4.2.1 Tropical Forests

Tropical forests protect the soil against erosion, help to prevent flooding, regulate the hydrologic cycle, and generally protect the environment, wildlife habitat, and thus biological diversity. They are the "bank" of genetic resources that presently have economic, environmental, and health value which will increase dramatically in the near future. The identification and analysis of all activities which encourage or result in deforestation in the three subproject buffer zones is an issue which must be addressed in the buffer zones of all three subprojects.

4.2.2 Riparian Zones

Riparian zones can provide several economically valuable services such as maintaining water quality and stream flow for fisheries, household water, recreational use, and navigation in addition to providing habitat for game and other animals. Other areas of low land use capability (e.g., rocky outcrops and steep slopes) can provide additional wildlife habitat for economically valuable species such as deer, small animals, iguanas, and birds while maintaining a higher degree of biodiversity and forest cover in the settlement area.

Protection of stream corridors (i.e., riparian zones) has proved to be a very efficient means of controlling the main disorders in the hydrological cycle caused by poor natural resource management, and in maintaining the quality of the aquatic habitats (Dickinson, 1989). Many beneficial effects are achieved by the presence of these buffer strips at the land-water interface:

- Filtration of a high proportion of the sediments carried by runoff from agricultural land,
- Reduction in the erosion of river banks and sides,

- Buffering of the peak freshets which cause flooding,
- Control of accelerated eutrophication in bodies of water,
- Safeguarding the productivity of fishing activities down stream, and
- Maintenance of high biological diversity in the corridor, both aquatic and terrestrial components, due to the intrinsic diversity of habitants which characterizes interfacing ecosystems.

Several parameters determine the efficiency of riparian buffer strips. Wider strips are required for steep slopes. The efficiency of a buffer strip is greater when plant diversity is high, which is a characteristic of most integrated systems. This is because the diversity of growth patterns and root systems produces a greater filtering effect. At the same time, higher diversity of habitat structure results in increased species abundance and therefore biological diversity. Management and preservation of stream corridors of natural vegetation will have a large impact on the preservation of biological diversity and the reduction of negative environmental effects in down stream ecosystems.

The combination of stream corridors, in concert with other protected areas which have serious limitations for agricultural development, provides a valuable opportunity for maintaining biological diversity while maintaining the environmental soundness of farms and wood lots. Moreover, insular theory (Wilcox, 1980; Foster, 1980) suggests that small "islands of biological diversity" delineated and protected by the land use potential maps will play an important role in maintaining important habitat for migratory and resident birds, insects, small animals and economically important game species. An additional benefit is the reduction of pressure on the two reserves and the wildlife refuge for hunting, fishing and logging for fuel wood and saw timber.

4.2.3 Protection of Biological Diversity

Biological diversity is represented by the variety of resources seen and used daily and the genetic resources they represent. The successful exploitation of agriculture, marine resources and forestry all depend on biological diversity. Thus, a critical issue for the NRM Project is how to maintain the genetic resources represented by biological diversity, which is vital to human welfare, including the improvement of present agricultural varieties. Preservation of biological diversity also preserves choices for agricultural, medical, marine, forestry and industrial opportunities.

4.3 Environmental Consequences of Loss of Forest and Biological Diversity

The loss of tropical forest represents the loss of resources and opportunities which are, in most cases, irreversible. This loss might include complete ecosystems with their associated biodiversity and genetic resources as well as their valuable services including the production of timber, protection of soils and the maintenance of hydrological cycles, water quality, fisheries, navigation, and wildlife habitat.

The loss of biological diversity is not an inevitable consequence of economic development, rather, its loss undermines the foundations upon which sustainable economic development is constructed and the very basis of human life itself. A nation which has preserved its biological diversity is better prepared to provide for the welfare of its people than

one whose biological diversity has been impoverished by short-sighted exploitation and the destruction of its heritage of renewable natural resources.

Nicaragua contains the largest tract of tropical forest north of the Amazon. It also has one of the few remnants of seasonally dry tropical forests in Central America, as well as vast tracts of mangrove and coastal forests on its Atlantic coast. These represent areas of high biological diversity which will be of increasing importance to future generations of all nationalities on a crowded planet. The well-being and livelihood of the majority of Nicaraguans depends directly on the exploitation of the diversity of its renewable natural resources. Thus, in seeking to achieve sound economic development via the sustainable use of marine and forest resources, while expanding its agricultural frontiers, the country's utilization of resources with high capabilities must go hand in hand with the maintenance of areas with high biological diversity.

4.3.1 Deforestation

Deforestation is a project issue because from 1960 to 1980, Nicaragua experienced the highest rate of deforestation in Central America, with 1000 km² converted to scrub and pasture annually. In the past decade, in large measure due to the economic and social disruption caused by armed conflict, the deforestation rate diminished greatly. However, since the cessation of fighting, pent-up demand for land has expanded the agricultural frontier, resulting in a deforestation estimate by INRA for the 1990-91 dry season of 200,000 ha. This suggests an urgent need to strengthen and expand natural resource conservation and management efforts.

In addition, as noted previously, a 50,000 ha of forest set aside for settlement in the Bocay valley could be completely destroyed. At the same time, a significant opportunity--as well as environmental responsibility -- exists in the Bosawás subproject because the GON settlement program has not yet begun. Additional opportunities exist in the buffer zones of the other two subprojects for the protection of riparian zones, mangrove forests, and other sites with low land use potential that are too valuable to be cleared for non-sustainable agriculture.

Another area for concern is the cutting of fuel wood in the Chacocente region which is an important cause of deforestation. On the Miskito Coast and its buffer zones trees, other than mangroves, appear to be restricted to high spots -- forming islands in a vast plain of seasonally inundated nutrient poor soils. These subprojects need a fuel wood and saw timber production component just as the Bocay valley subproject needs a tree management component.

The need for fuelwood and lumber for construction and domestic use is obvious in a country where virtually all rural fuel and construction material comes from locally available wood. The loss of forest cover and harvestable wild life means that local people would have to buy or poach both their wood and game needs. Such poaching would come in the PAs and contribute to an attitude which would be in conflict with both IRENA and A.I.D. goals.

4.3.2 Loss of Riparian Zones and Forest Cover

The down stream effects of poor natural resources management practices are well-documented. When forests are eliminated and crops or pastures are established, especially in unsuitable areas, there is a substantial reduction in the regulating effect of vegetation on the

hydrological cycle. The increase in sediment loads and the change in the natural hydroperiod in the rivers, lagoons and swampy areas of the region, reduces water quality, fisheries, and navigation and increases the risk of floods -- which affects infrastructure as well as crops and livestock. The community of organisms connected with the aquatic environment is modified in response to the new pattern of matter and energy flows. Food chains, where the final link is usually the human population, are broken.

The empirical information available indicates that when changes in land use begin, the effects on soil and aquatic ecosystems are of relatively little importance. As a greater proportion of the watershed is affected, the effects become more noticeable. In large watersheds, the critical point appears to be about 50 percent of the area under tree cover. If tree cover is greater than 50 percent, the effects on the quality of the water and the aquatic system in general are not noticeably improved. However, once lower this limit is passed, changes occur quickly, and both the aquatic system and the terrestrial environment deteriorate rapidly. The effects are accelerated if the forest cover is removed from areas with steep slopes and heavy rainfall.

4.4 Environmental Consequences of Each Alternative

Although the NRM Project is a conservation and sustainable use project, the current PP does not contain a method for determining land use capability or sufficient information on the management of certain marine resources.

There is the very real possibility the farm parcels in the Bocay valley settlement program will be delineated by the GON by simply drawing straight lines on a map. Such a system would result in parcels of uneven potential being assigned to settlers without regard for production potential or riparian zones and to the allocation of sites too poor to develop into a sustainable production system. This would lead to the needless destruction of tropical forests and riparian zones, with little or no benefit to the program participants who will eventually abandon their farms after depleting nutrients and destroying the resources present.

The largest remnant of seasonally dry forest in Nicaragua is the Chacocente Wildlife refuge and its buffer zone. It is in danger of destruction primarily by fuel wood cutters.

The pine savannas of the Miskito Cays subproject are on seasonally inundated hydrosols consisting of nutrient deficient humic clays and sands which have little potential to produce more than small stands of timber for local construction and cabinet making. However, these sites offer habitat for an enormous variety of wildlife from caimans and white tail deer to migratory and resident birds.

Riparian zones are not considered in the PP, and this is one of the critical issues which the project must take into account. The PP programs for soil conservation will have little effect on the conservation of the quality of water and the aquatic environment in general, if there is no integrated management of water courses of all sizes. In order to achieve this, rivers, streams and brooks must be viewed as corridors which include not only the channels along which the water flows but also the riparian vegetation. This vegetation has a tremendous influence on the magnitude and periodicity of the flow of water, nutrients, sediments, and organic matter entering the stream.

The need to utilize the marine resources is obvious on both coasts. The short-term, unmanaged over-exploitation of these valuable resources toward extinction can only lead to the long-term impoverishment of the Nicaraguan people. It is obvious that many people must utilize marine resources simply to survive. The stated objective of the MIKUPIA NGO in the Miskito Cays subproject is to return the control of the natural resources to the inhabitants of this region. One activity of the Chacocente subproject is to manage sea turtle egg harvest. Both of these subprojects will attempt to satisfy very real short-term needs with long-term management programs to provide a sustained yield of these renewable natural resource. The best way to prevent the over-exploitation and possible extinction of this resource is to implement Alternative II of the NRM/EA and require both subprojects to submit detailed written plans which specify their management and protection program for these animals and allow both USAID/N and A.I.D./Washington opportunities to assess and monitor these subproject components.

If the project is implemented as presented in the PP, it could lead to unsustainable use of land and other renewable natural resources, as well as the irreversible loss of soil to erosion with the concomitant loss of habitat and biodiversity. The destruction of riparian zones and the cutting of forests on the poorer sites will lead to soil erosion and the pointless loss of valuable ecosystems to attempt agriculture on sites lacking sustainable production capacity.

If the second alternative is implemented with its additions, it is more likely to lead to sustainable land use, the conservation of tropical forests and the preservation of biological diversity, and thus enhance the socio-economic well being of the people of Nicaragua.

If the "no action" option is taken, the adverse effects pointed out previously will continue.

4.5 Mitigating Measures

It will only be possible to develop a commitment to conservation and understanding of the values of forest cover in cases where the farmers and others have a sustainable source of construction material and fuel wood as well as habitat for game animals. Specifically, many biologically rich remnants can be saved in the Bosawás buffer zone for long-term benefit. Also, Chacocente and the Miskito Cays can conserve considerable wildlife habitat and biodiversity by managing wood lots for fuel and saw timber.

4.5.1 Bosawás

Fifty thousand hectares of tropical forest in the Bosawás has been allocated by the GON for settlement. This program will require the clearing of 20,000 to 30,000 ha of lowland forest; at the same time, it provides an opportunity to save 20,000 to 30,000 ha of the most valuable forest, i.e., riparian forests and those on rocky outcrops and poor soils. Much of this forest will have to be cleared for agricultural purposes. However, a rare opportunity, and concomitant responsibility, exists for the Bosawás subproject to save pieces of the most valuable and biologically rich forest on farms and in the buffer zones. By designating 10 to 20 m of riparian zone along the drainages and tributaries of the Bocay river, the subproject can demonstrate the value of these areas for fisheries and wildlife habitat to the settlers and local inhabitants and thus create an atmosphere of conservation in a settlement program.

The assignment of land with real agricultural potential and the targeting of land for different production capabilities is crucial for the success of this settlement program. A land use potential, or capability, assessment should be performed prior to producing any crop: agricultural, animal or tree. It should certainly be performed prior to dividing a large tract of land into individual parcels for a settlement program. This assessment should then become the departure point for a complete agricultural development program. By conducting a superficial soil survey to produce land use potential maps which designate riparian zones and sites of poor production potential more than 20,000 ha of tropical forests with its biodiversity can be saved and utilized on a sustainable basis for food and fiber production. This activity would save a great deal of wildlife habitat, maintain watershed integrity, and preserve biodiversity while reducing the chances of failure by settlers in this program.

4.5.2 Miskito Cays

Due to the lack of enforcement powers of MIKUPIA and Caribbean Conservation Corporation, it is recommended that the Miskito Cays subproject devote special attention to the management of sea turtles and restrict access to the marine resource maps it plans to develop as part of its subproject activities. This would reduce the chances of unscrupulous persons using these resource maps to concentrate their efforts more effectively on exploiting resources and driving important species to extinction.

4.5.3 Chacocente

By taking advantage of the known expertise of the CCC and requesting their assistance in the sea turtle management component of the Chacocente subproject, IRENA can incorporate part of the training for its reserve guards and sea turtle managers into the CCC/MIKUPIA sea turtle and management program. This would include field/training trips to Costa Rica. IRENA should also take advantage of the excellent work on the development of the Santa Rosa National Park less than 100 km to the south in Costa Rica. Santa Rosa is an excellent model for Chacocente in that it is a well developed and protected National Park and Wildlife Refuge in the same life zone with the same plants and animals, including sea turtles, and should be visited by all members of the staff at Chacocente. By contacting Santa Rosa to develop a program for the training of park guards, wildlife managers and administrative personnel, IRENA can rapidly improve the operations and management of its Chacocente Wildlife Refuge at minimal costs.

4.5.4 Socio-Economic Development

The development of wood lots for fuel and saw timber, will maintain a high level of biodiversity which will also improve the socio-economic well being of the project participants. Wood lots for fuel wood and saw timber will reduce environmental degradation and provide fuel wood and construction materials, as well game animals and recreation possibilities.

The inclusion of children in 4-H activities will involve the next generation of decision makers in the project and enhance socio-economic development. By contacting the 4-H program in the U.S. to investigate the possibility of developing a 4-H program in Nicaragua, which would actively involve children in household projects ranging from food preservation to

gardening, IRENA and the NGOs submitting proposals for the two subprojects could effectively include more beneficiaries in their subprojects at less cost.

4.6 Cost Estimate for Implementing the Mitigating Measures

The costs for implementing the mitigating measures in alternative two will come mainly from conducting the soil survey and the preparation of the land use potential maps. The cost of this activity can be absorbed in the budgets of the PACA consortium, IRENA, and by INRA as part of the GON's settlement program. The logging cooperative should be self sufficient after its initial start-up investment which can be incorporated into the PACA and IRENA budgets. The implementation of the Riparian Zones and Preserved Areas along with the Wildlife Management and wood lots programs can be covered in the education, extension and training budgets for the NGOs and IRENA.

4.7 A Final Note of Concern

Aggressive interdiction actions involving park and reserve guards, military or police forces in violent confrontation with resource pirates, the local residents, colonists, loggers and/or hunters in NRM Project areas are incompatible with the goals and purpose of the project. Proposed and existing project staff and interventions must have the clear legal mandate as well as the support of local people, in order to work effectively in the areas of reserve protection and resources management. Confrontations in the enforcement of park and reserve boundaries and/or conservation strategies will reduce the ability of the project to carry out its goals and purpose.

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