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**The Forestry
Sector
Development
Project in
Ecuador:**

FINAL REPORT

DESFIL

Development Strategies for Fragile Lands

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Development Alternatives, Inc. • Tropical Research and Development, Inc.
in association with: Earth Satellite Corporation • Social Consultants International

The Forestry Sector Development Project in Ecuador: Final Report

by

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ACRONYMS

| | | |
|------------------|----------|---|
| ANRO | : | Agriculture and Natural Resources Office |
| ARCO | : | Atlantic Richfield Petroleum Co. |
| COFYAL | : | Cooperativa Forestal Yanesha |
| CONUEP | : | Consejo Nacional de Universidades y Escuelas Politécnicas |
| CORMADERA | : | Corporación para el Desarrollo de la Industria de la Madera |
| DAI | : | Development Alternatives, Inc. |
| DESFIL | : | Development Strategies for Fragile Lands in Latin America and the Caribbean |
| DINAF | : | Dirección Nacional Forestal |
| ENDEFOR | : | Empresa Nacional de Forestación |
| ENDESA | : | Empresa Nacional de Desarrollo, Sociedad Anónima |
| FOIN | : | Federación de Organizaciones Indígenas del Napo |
| FSDP | : | Forestry Sector Development Project (also known as Forestry Support Program) |
| GOE | : | Government of Ecuador |
| INIAP | : | Instituto Nacional de Investigaciones Agropecuarias |
| IPM | : | Integrated Pest Management |
| LETIMAREN | : | Legitimación de Tierras Marginales del Napo |
| NRM | : | Natural Resources Management |
| MAG | : | Ministerio de Agricultura y Ganadería |
| MBG | : | Missouri Botanical Garden |

| | | |
|-----------|---|---|
| PACD | : | Project Assistance Completion Date |
| PIO/T | : | Project Implementation Order/Technical Services |
| PLANTABAL | : | Plantaciones de Balsa S.A. |
| PREDESUR | : | Programa de Desarrollo para el Sur del País |
| PROMUSTA | : | Programa de Manejo para Uso Sostenible de Tierras Altas |
| PUMAREN | : | Programa de Uso y Manejo de Recursos Naturales |
| REPAAN | : | Red Interamericana de Pastos Andinos |
| RM | : | Resource Management |
| S&T/RD | : | Science & Technology (Bureau)/Research & Development (Division) |
| SUBIR | : | Sustainable Uses for Biological Resources Project |
| SUFOREN | : | Subsecretaría Forestal y de Recursos Naturales Renovables |
| UCLA | : | University of California at Los Angeles |
| UNOCAL | : | Union Oil of California |
| USAID | : | United States Agency for International Development |
| USIS | : | United States Information Service (Overseas) |

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PART ONE

A BRIEF HISTORY OF THE FORESTRY SECTOR DEVELOPMENT PROJECT (FSDP)

The FSDP was approved in August, 1982 and the first payment from USAID to the project was made in August, 1983. The Project Assistance Completion Date (PACD), originally December 1987, was changed to 1990. Project financing consisted of US \$6.5 million in loans to the Government of Ecuador (GOE) and US \$1.6 million in grant funds as of May 1986. The project financed activities grouped into three major components:

- a) Institutional Development of the National Forestry Directorate (originally DINAF, now SUFOREN). This component has included training, the development of a forest protection network, and the contracting of a management consulting firm.
- b) Productive Forestry Applied Research and Field Demonstration Activities. This component has included support for agroforestry activities in Ecuador's three principal geographical regions: the Pacific coast, the Sierra, and the Amazon or Oriente.
- c) Protective Forest and Watershed Management. This component has included support for the delimitation of national parks and reserves and the "Patrimonio Forestal" and protection of the Pichincha protective forest. Watershed management was eliminated from the project at an early stage because of serious institutional and technical constraints to implementing this important activity.

The revised PACD was 3/31/88. On Dec. 9, 1987, amendment No.4 extended the PACD to 3/31/90. On April 25, 1990 Amendment No.5 was signed extending the PACD to 9/30/91. Both amendments 4 and 5 reduced the scope of the project to more closely conform to SUFOREN's implementation capabilities.

Progress toward achieving project objectives had been slow, partly because certain elements of the project purpose such as the emphasis on reforestation/afforestation, watershed management, and delimitation of natural areas were inappropriate, and partly because of institutional resistance to planning, coordination, and collaboration and to becoming involved in non-traditional forestry activities such as forest management.

Nevertheless, because important and promising field activities such as agroforestry in the Amazon basin and the Sierra, the forest protection network, botanical research, and natural resource management training for indigenous groups had shown significant progress during the preceding year, USAID advised the Ministry of Agriculture, in June 1989, that it would be willing to consider a request for an extension of the project. Following several months of discussions, SUFOREN submitted a request for extension on October 25. USAID found the proposal to be generally acceptable except for the request that all loan funds be converted to grant funds and inadequate proposals for coastal agroforestry, mangrove management, and

delimitation and management of natural parks and reserves. USAID also decided not to approve a two year extension, as requested, but to end the project on 9/30/91.

The budget proposed by SUFOREN was modified to provide funding for 18 rather than 24 months. A cable requesting authority for the Mission Director to approve an additional project extension was sent to Washington, authority was granted, and a PIO/T for a buy-in to the DESFIL Project to provide technical assistance and other implementation services was drafted and sent to S&T/RD for comment. All documents necessary to extend the project were ready by March 31, but the leadership vacuum at SUFOREN and within the MAG delayed GOE approval of the project amendment until April 25 and of the PIO/T for the buy-in to DESFIL until May 31.

Amendment No.5 extended the Project, with a further reduction in the number of activities, to include the following:

1. Amazon Agroforestry
2. Sierra Agroforestry (including CARE activities)
3. Forest Protection (Pathology and Entomology)
4. Management of Natural Areas
5. Work with ethnic Indian Federations and communities (Cultural Survival)
6. Flora of Ecuador (Missouri Botanical Garden)
7. Research

These activities involved the provision of expatriate technical assistance and managerial services. As noted previously, a buy-in to the DESFIL Project was used for this purpose as is established in Amendment No.5 of the Project Loan Agreement between the Government of Ecuador and the Government of the United States of America for Forestry Sector Development.

Development Alternatives, Inc (DAI), through the DESFIL Project submitted a proposal to assist USAID/Quito in its extension of the Ecuador FSDP, recommended an effective starting date of August 21, 1990 and a completion date of September 30, 1991.

The proposal contained a detailed project budget, detailed level of effort projections, and a management plan. It also included statements of justification to contract two Ecuadorians as Chief of Party and Administrative Assistant in the project office that was established in the MAG in Quito, Ecuador.

PART TWO

PROJECT COMPONENTS: PURPOSE, OBJECTIVES AND SPECIFIC ACTIONS.

AMAZON AGROFORESTRY¹

In the early 1970's, consequent upon the oil boom, increasingly larger numbers of non-indigenous Ecuadorians colonized the eastern Amazonian lowlands between 200 and 700 meters elevation. Typical land use ~~was characterized by slash and burn agriculture~~, accompanied by the use of traditional agricultural technology to cultivate coffee, mixed agricultural crops for subsistence, and beef cattle. Market saturation, coffee diseases, and land use well beyond its inherent capability led to resource depletion and soil exhaustion, declining farm incomes, and continuing pressure to bring new eastern forest areas into agricultural use. Development programs in forestry, agricultural production, marketing, and credit were largely absent in the area.

Purpose and Objectives

To stabilize land use, ease deforestation pressure, enhance colonist income, and arrest resource degradation, a demonstration outreach project was designed. Its objectives were:

- a) To increase the absolute levels and even the intertemporal distribution of the production and income of colonist producers of wood, beef cattle, and coffee in the region's second-growth forest areas; and
- b) To make production systems sustainable by controlling soil erosion and depletion, improving soil structure, and maintaining resource productivity through time (and by doing so, to reduce pressure on remaining natural forests).

Specific Actions

Beginning in 1984, MAG/SUFOREN (then DINAF), with USAID assistance, set up a series of agroforestry demonstration trials. Approximately 250 farms in the vicinity of Francisco de Orellana (Coca), Sucumbios Province, eventually participated.

Traditional colonist agriculture was subjected to a series of improved agroforestry practices. These included the pruning and other management of robusta coffee; the selective management of naturally regenerating tree species; the planting of selected additional valuable hardwood tree species, especially ~~Swartzia~~ (laurel); and the introduction of leguminous ground cover crops, especially ~~Centrosema~~. These development interventions built on earlier research conducted by the Ministry's research arm, INIAP. In fact, they emulated some

practices already exhibited by colonist-farmers such as selectively encouraging the natural regeneration of valuable hardwood tree species in secondary forest regrowth. A cadre of extension agents was established and trained. These were supported by technical assistance and donor-provided equipment and materials (office space, motorcycles, jeeps, nurseries, office machines, paper and supplies, per diem funds, training courses, etc.). Each participating farmer kept a folder of data forms to be used to record periodically information indicating performance on project sponsored practices. Periodic studies and evaluations took place. Surveys were funded. Reports were written.

SIERRA AGROFORESTRY

The majority of the inter-Andean basin of Ecuador is under intensive agricultural management by peasant farmers. Agricultural production is limited by problems of soil erosion as well as by wind and frost damage to crops. At the same time, there are serious scarcities of fuelwood, on-farm construction materials, and animal fodder. Sustainable steepland agriculture in this region requires both soil conservation and tree management practices.

Traditional reforestation programs have emphasized large industrial plantations under multi-party contracts, unavailable to peasant farmers. Thousands of hectares of pine have been planted, mostly on high-elevation community lands, displacing traditional grazing uses. Recently it has been recognized that proper management of these pine plantations can often improve grass and animal production within them. The current plantation resource requires thinning and pruning to maintain tree vigor and wood productivity. The same management activities could establish silvopastoral demonstrations and furnish much needed fuelwood and other small diameter products to the rural population.

Purpose and Objectives

Since 1984, several USAID-financed projects have promoted the incorporation of tree management with agriculture and grazing activities in an attempt to reduce soil erosion, ameliorate on-farm microclimates, and increase wood and fodder production in rural areas. The objectives of these efforts have been to:

- a) Reorient reforestation policies from an industrial plantation focus toward an agroforestry approach with peasant farmers; and
- b) Confront the need for management of pine plantations to improve timber as well as associated grass and livestock production.

Specific Actions

Between 1984 and 1986, CARE, together with MAG-Soils, initiated a rural extension project—PROMUSTA—promoting soil conservation and agroforestry. Between 1988 and 1990, under the SUFOREN/AID FSDP, an agroforestry project was funded in Chimborazo Province. Also under the FSDP between 1987 and 1990, pine management information was published and disseminated throughout the Sierra. Finally in 1989 an agreement was established between the FSDP and PROMUSTA to move funds through CARE to strengthen both agroforestry in PROMUSTA as well as the ability of state forestry districts to execute pine management. This agreement formed the basis for the Sierra Agroforestry component in the FSDP-DESFIL project extension. Under a DESFIL-CARE subcontract, agroforestry activities were to be strengthened in PROMUSTA in the provinces of Cotopaxi, Tungurahua, Chimborazo, Cañar, and Loja. At the same time, resources were to be funneled via CARE to the district forestry offices to supply them with tools and other inputs for plantation management and nursery production.

FOREST PROTECTION

Purpose and Objectives

The purpose of the FSDP forest protection component was to establish a forest protection unit within MAG. While Ecuador had and still has serious current and potential forest protection problems, the main challenge to establishment of a forest protection unit was the lack of trained forest protection specialists: forest entomologists, forest pathologists, and fire management experts. Accordingly, the objectives of the Subproject were as follows:

- a) Technical assistance in forest pathology and entomology to SUFOREN and collaborating institutions;
- b) Technical assistance in forest pathology and entomology to other FSDP subprojects, for example, Amazon Agroforestry, Sierra Agroforestry and Plantation Management;
- c) Organization and presentation of short courses on forest protection topics;
- d) Continuation of forest disease diagnostic services;
- e) Advice to Ecuadorian universities on relevant curricula;
- f) Preparation of a field guide on prevention and control of nursery diseases;
- g) Preparation of a laboratory guide on isolation and culturing techniques of forest diseases; and

- h) Assistance to SUFOREN and collaborating institutions in the development of surveys and control methods for diseases and insect pests.

Specific Actions

Technical assistance visits were made to a large number of plantations and nurseries belonging to SUFOREN, ENDEFOR, ENDESA, CORMADERA, PLANTABAL, AND PREDESUR. During these visits phytosanitary evaluations were made and control measures were recommended where possible. Suggestions were also made on possible simple studies that could be made to answer site specific problems.

Pathological and entomological evaluations were made of the highland and lowland agroforestry subprojects. A visit to the coast was made to observe the actual situation of mangroves and prosopic plantations.

Two courses were presented to about 76 students and professionals. For this purpose, formal papers were prepared which contained the material on forest pathology, entomology and fire control presented during the course.

Field guides were prepared for nursery diseases and several of the most important diseases affecting forest plantation tree species in Ecuador.

MANAGEMENT OF NATURAL AREAS

Traditionally, the world's protected areas have been managed as the exclusive responsibility of the state, and in general as ecological islands isolated from their regional and socio-economic context. Ecuador is not an exception to this situation. Nevertheless, increasingly it is being recognized that environmental conservation, of which protected areas are an important element, is the responsibility of everyone and that it is essential to involve protected area management with the human reality of the country. On the other hand, the level of importance that protected areas have in achieving optimum natural resource management, both within and outside their boundaries, has tremendous implications for the training of the personnel who work in them, and who normally have been limited to working in the protection of their respective areas.

Purpose and Objectives

The purpose of this component was to assist the Natural Areas Division of SUFOREN in carrying out actions which would implement new protected area policies. The specific objectives to be achieved were:

- a) Advise and strengthen the Protected Area Personnel Training Program organized by Fundación Natura with debt swap funding; and

- b) Advise SUFOREN concerning various aspects of the management of the Cuyabeno Faunal Production Reserve, especially: the extension of its boundaries; and the formation of a planning team and consequent preparation of a management plan for the new area as well as updating of the plan for the original reserve.

Specific Actions

With regard to the Training Program, which began in 1989, the Project consultant participated as instructor in two training courses, both directed at Conservation Officials: Administration and Protection of Protected Areas.

This Program, the only one in Latin America which provides structured, organized training for protected area personnel based upon a detailed evaluation of the needs of the different technical levels, has been carried out according to a plan which this same consultant helped to prepare. During the Project, the consultant worked closely with the Program's organizers in the planning of the courses to be carried out, and also in the preparation of a preliminary strategy for follow-up actions to be taken after the first phase of the Program finishes in 1993.

With regard to Cuyabeno, the consultant collaborated with the Reserve's personnel in improving its management, specifically: tourism organization, and preliminary planning of the Interpretive Center located at the Lagunas de Cuyabeno. A principal activity was to assist the central administration of the Natural Areas Division with several problems and projects related to the future management of the Reserve, which is in reality a microcosm of the problems of the Ecuadorian Amazon: colonization, indigenous populations and their territorial claims, and petroleum exploration and drilling. This collaboration involved the private sector and the implementation of new ideas for future area management.

WORK WITH ETHNIC INDIAN FEDERATIONS (Cultural Survival)

Purpose and Objectives

The area around Sumaco volcano in Napo Province is home to nearly 9,000 of the estimated 50,000 lowland Quichua Indians living in Napo and Sucumbios Provinces in the Ecuadorian Amazon.

As soon as the Hollin-Loreto road was completed in 1988, timber companies began to buy standing timber, principally a single species of copal (*Dacryodes copularis*), from Quichua Indian communities along the road and paid them ridiculously low prices. Most of the communities within the zone of influence of the new road belonged to a regional Indian federation known as FOIN (Federation of Indigenous Organizations of the Napo River). Federation officials were alarmed by the uncontrolled logging and began to look for alternatives for their member communities.

Since 1982 Cultural Survival has been providing core support to FOIN. In 1988, with support from USAID, Cultural Survival assisted FOIN in initiating a regional resource management program within the federation. The program, now called PUMAREN (Programa de Uso y Manejo de Recursos Naturales, formerly LETIMAREN) responded to the Federation's desire to halt the indiscriminate logging along the road, and to provide economic alternatives for forest use to member communities in the area.

The second phase of the PUMAREN program focussed on training for the indigenous resource management team to introduce them to a range of economic alternatives that could protect the forest and provide income for member communities. During this phase the PUMAREN technical team was exposed to indigenous conservation efforts, ecotourism, agroforestry, and natural forest management. The program focussed quickly on natural forest management as a viable alternative for local residents. DESFIL's support provided critical technical assistance at this phase in the project, and helped the team move toward implementing a pilot forestry project with three Quichua communities.

Due to the generous "bridge" support provided this program by DESFIL through USAID/-Ecuador, program continuity has been maintained at a critical period. Current plans anticipate at least three years of continued technical, marketing, and administrative support. The extent of this future work will depend on availability of funds.

The main purpose of Cultural Survival's subcontract with DESFIL was to provide short-term technical assistance to support on-going natural resource management training for indigenous communities in Ecuador's upper Napo region. To enable implementation of technical skills, DESFIL funds also provided for training in institution building and administration for the PUMAREN team members and community organizing committees. Direct support for the PUMAREN team was provided with funds from private foundations.

The specific objectives of the technical assistance were to:

- a) Provide expanded training in techniques of natural forest management and the operation of forest industries;
- b) Initiate pilot forestry projects in communities; and
- c) Develop the required administrative and organizational skills necessary for such work.

FOIN and PUMAREN members also indicated a desire to develop a regional NRM plan.

The program also includes a more complex and long-term goal. All current and future project activities are designed to strengthen the institutional and technical capacity of the area's Indian population and their organizations to design and undertake broad programs of resource

management. This includes both the regional Indian federation FOIN as well as its member communities.

Specific Actions

Cultural Survival staff assisted PUMAREN in drafting a preliminary NRM plan for discussion and input by FOIN member communities and directors.

Technical training was directed at two audiences. Initially intensive training in natural forest management and the administration of a forest industry was directed at members of the PUMAREN technical team. Later training in developing a forest management plan was provided for the technical team and for community members who will implement the project. Similarly, organizational and administrative assistance was provided to PUMAREN, the communities, and their joint organizing committee.

Much of the team training was accomplished through Indian-to-Indian training, a methodology which was established during Phase 2 of the program by Kuna and Yanesha resource management specialists from Panama and Peru, respectively. Communities appropriate for natural forest management were identified and the training of community members was integrated with the on-going training of PUMAREN staff.

FLORA OF ECUADOR

Ecuador's position astride the equator in the center of the region of highest biological diversity in the world - northwestern South America - places it among the most species-rich nations in the world, despite Ecuador's small size. The estimated 25,000 species of vascular plants that occur in Ecuador constitute about 10 percent of the total of the Earth's flora, in an area the size of the state of Colorado.

Purpose and Objectives

Until very recently the flora of Ecuador, particularly in the eastern, Amazonian part of the country, has been very poorly known. The USAID-Funded Flora of Ecuador subproject, carried out since 1985 as part of USAID's Forestry Sector Development project, has contributed substantially to an increased knowledge of the plants of eastern Ecuador. This information has helped in planning for conservation and sustainable development of natural resources in the region. In addition, training has been provided for Ecuadorian biologists, enabling them to conduct research on the floristic resources of the country, and Ecuador's biological research institution have been strengthened through activities carried out by the Flora of Ecuador subproject.

During 1985-1986, the Flora subproject was conducted jointly by New York and Missouri Botanical Gardens, and during 1987-1991 by Missouri Botanical Garden. (The New York Botanical Garden conducted a separate project on economic plants during 1988-1990, funded by AID/Washington).

Specific Actions

1. Botanical Inventories

Botanical field work, which during 1985-1990 was concentrated in Amazonian Ecuador was extended in 1991 to the species-rich, very wet forests of northwestern Ecuador (the southern extension of the Colombian Chocó region) and the forest fragments in the northern Ecuadorian Andes. Intensive collecting programs were conducted in the following areas:

- 1.1 The Awá Ethnic Reserve near the Colombian border, and surrounding areas in Carchi and Esmeraldas provinces. This area was the principal focus of research during this period. It includes large tracts of primary forest from near sea level up to timberline at 3,000 meters. Within the Awá Reserve, field work is done in collaboration with the Awá Indian Federation.
- 1.2 The Maquipucuna Reserve, a 3,000-hectare mid-elevation site in northwest Pichincha province. Collecting was conducted in collaboration with the Maquipucuna Foundation, which owns the reserve.
- 1.3 Field work in lowland Amazonian Ecuador. This work, which will continue, focuses primarily on botanical collecting at the oil well and road construction sites, including the proposed 150-km road to be built by Conoco in Yasuni National Park and the Waorani Ethnic Reserve. Oil well sites to the south, in Pastaza and Morona-Santiago provinces, will also be sampled. Collecting will also be done along the new Morona-Mendes road in southeastern Ecuador.

2. Collaboration with Indigenous Groups

In 1988-1989, the Flora of Ecuador subproject collaborated with FOIN, the federation of indigenous Quichua-speaking people in Napo Province. Two FOIN representatives worked with the project as botanical and zoological research trainees. The botanical trainee subsequently joined the PUMARIN project, a natural resource management team made up of native Quichuas, sponsored by FOIN and Cultural Survival with AID funding.

3. Training Courses in 1990-91

3.1 Two dendrology courses were taught by project personnel at the Jatun Sacha Biological Station in Amazonian region.

3.2 MBG in St. Louis, MO carried out a training program and work sessions in herbarium and library research in which four Ecuadorians participated.

4. Herbarium Development

The project undertook the establishment of the National Herbarium of Ecuador, which will unify the Forestry Herbarium of the MAG and the herbarium of the Natural Sciences Museum. The unified National Herbarium will begin with approximately 40,000 mounted specimens, and will grow by 20,000 specimens annually over the next several years. Herbarium personnel will be hired both through PROMOBOT and Flora of Ecuador funds.

RESEARCH

Historically, SUFOREN and its antecedents have not had a systematic program of research. There also had not been consistent collaboration and sharing of information between SUFOREN and the various Ecuadorian universities engaged in forestry research.

Purpose and Objectives

The purpose of the research component was to provide technical assistance to SUFOREN to strengthen its research network and to emphasize research by universities and other institutions outside of SUFOREN. Assistance was also provided to design and carry out research on the establishment and management of forest plantations and experiment stations.

The specific objectives of the research component were to:

- a) Identify universities, private sector organizations, and other groups with forestry research capabilities in Ecuador;
- b) Assist SUFOREN in establishing links with those organizations with identified forest research capabilities;
- c) Work with SUFOREN to evaluate the research being conducted on the La Chiquita Experiment Station;
- d) Initiate research on pastures and forage in conjunction with the agroforestry components; and

- e) Complete Forest Zonification Study begun in 1988 and prepare report.

Specific Actions

- a) A review was conducted of present activities in forestry in both the public and private sector.
- b) Conferrals were held with several public and private sector institutions and universities concerning future training and research cooperation with SUFOREN.
- c) Two meetings were organized for research personnel, librarians and computer specialists to discuss sources of funding for forestry research in Ecuador and how to write research pre-proposals and proposals.
- d) The silvicultural trials at La Chiquita Experiment Station were evaluated and an Immediate Action Plan presented.
- e) Field visits were made to four provinces for the zonification assignment, literature reviewed, meteorological and soil data collected, and a final report prepared.
- f) Two pasture research trials were established, and two papers on pasture identification and nutritional value were prepared.

USAID-MAG/SUFOREN INTERFACE

Purpose and Objectives

The Extension of the FSDP called for a complex, multistranded set of activities to be completed during a brief span of 12 months. In order to accomplish what was required in an efficient and timely fashion, DESFIL staffed an office in Ecuador and provided continuous administrative and technical support from its Washington DC office.

DESFIL established a local project office in the Ministry of Agriculture (MAG) building in Quito, MAG/SUFOREN provided space and some office furniture. The office accommodated resident administrative staff, as well as visiting TDY consultants.

The DESFIL/Quito office was staffed for the duration of the project by an Ecuadorian Chief of Party (COP) and an Ecuadorian Administrative Assistant (AA). The COP's duties included the following tasks:

- * Liaison among DESFIL, MAG/SUFOREN and USAID/Quito;

- * Responsibility for general oversight of activities conducted by subcontractors to insure timely implementation and completion of tasks and submission of necessary reports;
- * Coordination of site visits for all technical specialists;
- * Arrangement of visits to field activities by SUFOREN and USAID personnel and visitors;
- * Communication and regular consultation with the DESFIL/Washington DC office;
- * Scheduling of periodic meetings with SUFOREN coordinators, USAID Project Officer and the DESFIL team members; and
- * Submission of quarterly reports and other documents as appropriate.

The COP was assisted by the AA. The AA was responsible for maintaining current accounting records of DESFIL funds, submitting vouchers to DESFIL/Washington in a timely fashion, and performing secretarial (and occasional translation) tasks for visiting DESFIL Technical Specialists.

Specific Actions

During the last semester of the first phase of the project it became obvious that SUFOREN's headquarters staff had limited knowledge of the project's objectives and accomplishments. Because USAID had dealt chiefly with the Director of the Forest Service, a political appointee, frequent changes in directors meant that new directors learned about the project from an uninformed staff. To remedy this, the following actions were taken:

- * The DESFIL Chief of Party met on a regular basis with the USAID Project Officer, the Forestry Director, the Subsecretary for Reforestation and Natural Resources and with the SUFOREN project activity coordinators.
- Counterparts were named for each project activity and district level personnel were involved in the field activities carried out by the technical advisors.
- * Different field trips were arranged to visit sites of project activities, with the participation of the SUFOREN Director, USAID Project Officer, SUFOREN counterparts, and CARE personnel.
- * Periodic meetings were held with the expatriate consultants, the USAID Project Officer and SUFOREN Director to evaluate activities, implement corrective

actions and to ensure that the GOE complied with its obligations under the project agreement.

PART THREE

RESULTS AND FINDINGS

AMAZON AGROFORESTRY

After five years, 193 farms were surveyed² to assess the adoption of the improved agroforestry practices advocated by the project. More than 99% of surveyed farms were managing valuable hardwood trees. Of these, 70% had adopted the practice without project stimulus (spontaneous diffusion). More than 92% of surveyed farms were pruning and otherwise managing coffee. Of these, 81% had adopted the coffee management practices without project stimulus. Only 5% of surveyed farms had adopted leguminous ground covers.

Practices advocated were technically feasible in the sense that they increase the physical production of timber and coffee per hectare per year using the same or lowered levels of production inputs. They were economically feasible in that they led to higher farmer incomes at little increase in costs and greatly increased returns to land and labor.

Together, these practices (and the technical assistance, monitoring, and applied research that extended, demonstrated, and evaluated them) had a dramatic effect on the welfare of traditional colonists. Coffee harvests persisted through ten instead of six years. Total coffee output over the 20 year coffee-tree rotation more than doubled. Among other effects, the pruning of coffee bushes concentrated more productive branches per bush and lowered bush height, facilitating harvest. A smaller number of total trees but a larger number of valuable hardwood trees per hectare - 100 vs. 30 - increased average tree chest-height diameter by 25% over the 16 -20 year rotation and tripled the volume of wood harvested. At the same time, the amount of shade was reduced (by leaving only 100 total trees per hectare, instead of 200), leading to greater insolation at ground level, greater yields of both coffee and hardwood, and a reduced use of costly fungicides. The use of the *Desmodium* ground cover lowered herbicide requirements. More vigorous coffee bushes required less insecticides. Best of all from the colonists' point of view, per hectare income increased and persisted through twelve instead of six years; annual per hectare labor requirements were reduced but more remunerative use of colonist labor persisted through twelve instead of six years; and the need for cash inputs decreased. Chief economic effects were a greatly increased return to land and applied labor, and increases in per hectare net income of 200% to 600%. As economic returns to both labor and land dramatically increased and persisted over a longer time, pressure on new forest areas from these same colonists abated.

Colonists resisted the leguminous ground cover *Desmodium ovalifolium*. Its use as a ground cover was a new technology. Farmers did not adequately cut or otherwise manage it. As a

result it tended to overwhelm other crops. Several farmers sought to eradicate the Desmodium after introducing it.

On most demonstration farms, project extensionists and supervisors did not regularly update or protect the data forms introduced to monitor and indicate project performance. The whereabouts and condition of whatever data may have been preserved is unknown. As a result, additional surveys were funded and carried out. Research reports have relied on a few well documented individual case studies, rather than continuously recorded observations from most of the 250 Coca demonstration farms.

SIERRA AGROFORESTRY

The following is a list of accomplishments realized within the Sierra Agroforestry component from late 1990 through September, 1991.

- a) **Accomplishments in the field:**
 - * Establishment of approximately 600 agroforestry plans with peasant farmers (with the probability of another 400 by June, 1992);
 - * Management of approximately 150 hectares of pine plantation (with the intention of managing another 450 hectares by September, 1992);
 - * Production of 425,000 tree seedlings in nurseries; and
 - * Realization of 120 short courses on agroforestry or plantation management in rural communities.

- b) **Technical training for extensionists:**
 - * 7 agroforestry short courses or workshops for extensionists involving a total of 135 participants;
 - * 2 regional seminars on vegetative propagation involving 100 professionals and technicians;
 - * 1 nursery course with 21 participants from PROMUSTA and SUFOREN; and
 - * 1 course for PROMUSTA extensionists on forest protection.

- c) **Didactic material developed:**
 - * A 14-page flipchart for agroforestry promotion;
 - * A 13-page flipchart for training in plantation management;
 - * A slide-cassette show for agroforestry promotion;
 - * A poster promoting the Ecuadorian "arbor day;" and
 - * A poster recommending species for use in reforestation.

- d) **Tree nurseries:**
 - * Container sizes for A-F seedling production were doubled in PROMUSTA to improve seedling quality (size and root formation);

- * Vegetative propagation trials of high Andean tree genera were installed in the principal nurseries in each province; and
 - * For the first time in PROMUSTA, plants were successfully propagated of the desirable *Polylepis* genus.
- e) Plantation management:
- * The 5 forestry districts and PROMUSTA-Saraguro were equipped with hand tools for plantation management; and
 - * In the forestry districts of Cotopaxi, Chimborazo, and Loja coordinators were designated to oversee management activities.
- f) Institution building and materials input:
- * Two project-wide meetings were held between SUFOREN and PROMUSTA, one initial planning meeting and a final evaluation; and
 - * Over US \$40,000 was invested in tools and inputs to the forestry districts, representing a three-fold increase over that supplied during the previous two years of the FSDP.

FOREST PROTECTION

For six years, Forest Protection Unit has worked with MAG district foresters and private foresters in addressing forest nursery and plantation problems. Some examples are as follows:

- a) Nurseries belonging to the private sector as well as those of SUFOREN have serious disease problems associated with poor management practices. This has caused wide spread seedling mortality due to damping off fungi and poor seedling development and growth due to *Dothistroma septospora* infections, lack of proper micorrhizal management and so forth. On various occasions the Unit has visited the nurseries and discussed with the managers the norms of good nursery management; courses in forest pathology and entomology have highlighted solutions to these kinds of problems.

Dothistroma septospora is the most important disease affecting forest plantations in Ecuador. The disease is not serious in plantations above 3,600 meters, but at decreasing elevations damage becomes progressively worse and in plantations below 3,000 meters in areas of high rainfall and humidity, the fungus can cause severe defoliation and growth loss.

Two resistant species that show promise are *P. pseudostrobus* and *P. muricata*. There are also some individual trees of *P. radiata* in Ecuadorian plantations which appear to be resistant to the disease. These trees should be selected and propagated to develop resistant progeny for planting in high risk areas. However, there appears to be little expertise or interest in doing this on the part of the Ecuadorian Forestry sector. Until

a tree improvement program is carried out, *P. radiata* will never attain its full potential in the Sierra of Ecuador.

- b) Another serious problem in plantations of *P. radiata* is dieback. Poor site selection, poor nutrition, poor or no management, drought, or a combination of some or all of these factors, often put the trees under considerable stress and they thus become more susceptible to secondary fungi such as *Phomopsis occult* or *Sphaeropsis sapinea*. Similar stress problems occur in *E. globulus*, with top and branch dieback, and formation of gum veins and gum exudation from the trunk as the major symptoms. Proper management will solve most of these problems.
- c) A canker disease of undetermined origin is causing severe damage in pachaco (*Schizolobium parahybum*). Pachaco is a very promising species for planting in the coastal plain. Determining the cause and control of the canker disease should be given high priority. Another canker disease for which the pathogen has not been determined is causing severe damage to balsa (*Ochroma lagopus*), an important export product of Ecuador. Research on the cause and control of this disease should also be given high priority.
- d) Field guides were prepared for nursery disease and several of the most important diseases affecting forest and plantation tree species in Ecuador. Information contained in these guides included the name or names of the pathogen(s), host(s) affected, symptoms and signs of the disease, damage caused, biology of the pathogen, control and references. These guides are to be published as individual leaflets.
- e) The Forest Protection Unit has been involved with management of forest pests through ecological research that provides silvicultural management of the problems. The pine defoliator, *Leucolopsis parvistrigata*, is a case in point. The large and dense radiata pine stands have changed the availability of the insect's favored food plant. In time the defoliator adapted to feeding on pine needles. This adaptation was further enhanced by the weakened condition of the pines during the severe *Dothistroma* blight problem associated with the El Niño effect and magnified by lack of silvicultural prescriptions. An integrated pest management system for the defoliator was formulated by the Forest Protection Unit and discussed with various other members of the Ecuadorian forestry sector. The IPM system involves: a management component, including thinning regimes, site analysis, parasite identification and use, and *Dothistroma* blight hazard analysis; a remedial component, timely use of a biological insecticide, *Bacillus thuringiensis*, and; a pest monitoring system. This IPM proposal has also been included in a forest protection course given in August 1991.

MANAGEMENT OF NATURAL AREAS

Eighteen Conservation Officials were trained in protected area Protection and Administration. The Consultant also evaluated the courses and identified their strengths and weaknesses. A report was prepared which evaluated the Program's progress and made recommendations for the follow-up to the Program's first phase, which had concentrated on basic training for the areas' three personnel levels: Superintendents, Conservation Officials, and Rangers. Select groups have also received training in specialized fields such as environmental interpretation, protected area protection techniques, and design of recreational infrastructure.

One course in which the consultant was to participate was suspended because of coordination problems between the Fundación Natura and SUFOREN, a situation which seems to occur frequently with the debt swap project, although it is improving slowly.

During 1990-91, two important steps were taken with regard to Cuyabeno: the extension of its boundaries towards the east, increasing its area from 254,000 to 655,000 hectares; and the formation of a planning team which will prepare a management plan for this new area.

The boundary extension was motivated by several factors: oil pollution problems in the original Reserve; the pressure exerted by 10,000 colonists located within this same area; the recommendations of the strategies for the development of the National System of Wildlands Areas which determined that the area included within the boundary extension should be declared a protected area; and the interest of Metropolitan Touring in the implementation of an ecotourism project in this same area, which could constitute a model project of this type for the Amazon region. After lengthy negotiations between SUFOREN and Metropolitan Touring, during which DESFIL FSDP played a key mediation/promotion and technical advisor role, the following 3-component strategy was developed:

- 1) Extension of the Reserve's boundaries to include the sector where Metropolitan wished to implement its project, and that also includes the area recommended to be a new protected area;
- 2) The preparation of an agreement between Metropolitan and SUFOREN which would permit Metropolitan to implement its tourism project and define its economic support for the Reserve; and
- 3) The preparation of a management plan for the entire Cuyabeno Reserve, to be financed by Metropolitan, and which will incorporate several new ideas for the management of protected areas which SUFOREN wishes to implement. These ideas include: working with the private sector and NGOs in the management of the area; working closely with the private sector to insure that funding for area management originates primarily from

that source, and that mutual objectives are achieved; and achieving sustainable use of the area's resources through activities such as ecotourism and applied research.

By September of 1991, the Reserve's boundaries had been extended, a draft of the contract agreement between Metropolitan and SUFOREN had been prepared, and the management planning team had been formed. None of these steps were easy, and as could be predicted, the grand experiment in collaboration between the public and private sector has had its ups and downs, due primarily to misunderstandings and preconceived ideas, at times justified, concerning the intentions and abilities of the other side. Nevertheless, a great deal has been accomplished, and the Management Plan should be finished by February, 1992.

The agreement between Metropolitan and SUFOREN has not been finalized because of the unstable situation created by PetroEcuador's imminent oil drilling activity. This has caused Metropolitan to postpone its project implementation. Oil exploration and the drilling which would follow would have serious repercussions for all aspects of the Reserve's management. Together with the preparation of the Management Plan, Metropolitan, other tourism operators, NGOs and SUFOREN plan to initiate a national and international campaign to increase public awareness of the problems which oil exploitation causes in the Amazon region, as well as demonstrate that ecotourism and other sustainable activities will provide greater economic benefit in the long term than will oil.

WORK WITH ETHNIC INDIAN FEDERATIONS (Cultural Survival)

Indian-to-Indian Training

Indian-to Indian training for the PUMAREM technical team has proved effective in introducing new concepts such as conservation and land use planning (Kuna) and broad aspects of natural forest management (Yanesha). However, cultural differences among groups can make the experience difficult at times, both for the indigenous teachers and for their students. These difficulties were more pronounced when PUMAREM worked with the Yanesha Forestry Coop. Part of the difficulty in this case probably relates to the differences in educational level, maturity, and degree of integration into local communities of the respective technicians.

PUMAREM members were selected for their educational level (all had graduated from high school, and some had attended university). Because they are now working professionally with FOIN they engage to a lesser degree in day-to-day community activities such as subsistence or commercial farming. Yanesha technicians, on the other hand, are in general older and more established in their communities, and have usually not attended high school. In general, we felt that the Yanesha interacted more effectively with Quichua community members than with the PUMAREM team.

Despite these differences, the opportunity to learn in the context of an on-going forestry project (COFYAL) was an effective method. PUMAREN members learned general concepts of natural forest management, and also day-to-day operational activities. They were critical in their learning, and analyzed the problems they noted in the Peruvian experience and the need to adapt lessons learned from the Yanasha to a different Ecuador reality.

We have also noted that training, both for PUMAREN and for community members is carried out most effectively in the context of concrete activities, and less effectively in workshops or courses that try to provide them with the tools for carrying out future (and thus more abstract) activities. This is one of the reasons that PUMAREN decided to move ahead with the implementation of a pilot forestry project before they felt they had mastered the technical aspects of natural forest management. Plans for future training are now focussed on integrating training with on-going-work.

Additional Training

At various times during the course of the program, technical assistance or the need to consult with natural forest management specialists in Ecuador seemed highly desirable. However, such specialists are virtually non-existent and there are no national programs in natural forest management. Without such support in-country the ability to continue and expand community-based natural forest management will be severely hampered.

Implementing a Forestry Project

As mentioned earlier, the program has long-and short-term goals. From a technical and managerial standpoint, it would be easier to focus on a single community or even a cluster of individuals. This, however, would circumvent the regional organization, and thus minimize the potential multiplier effect necessary for broad regional planning and programming. The difficulty, and more important, the long-term value, of maintaining a long-term focus is illustrated by the preparation of the regional resource management plan, and the establishment of community-based, forest management plots.

Preparation of the regional NRM plan is the role of the communities and FOIN. Over the past two years a draft document has been circulated to the communities, the staff of Project PUMAREN has held two special assemblies to permit further discussion and input from the communities, and it was expected to come up for further discussion during the August 1991 General Congress. However, other items dominated the agenda of the congress.

This discussion leading to consensus cannot be rushed either by the technical team or by any external agency. To obtain any legitimacy and long-term utility the regional resource management plan must be prepared in a culturally appropriate manner and at a culturally appropriate pace.

In a similar manner, while work on the community application of the forestry projects has progressed well, experimental strip-harvest plots have not been established during this grant period. This illustrates a social, rather than a technical, aspect of the project.

Initially PUMAREN members assumed the responsibility for the extension work needed to establish the project in the communities. Though team members were Indians and were associated with a regional organization which represented the communities, their role caused considerable confusion, and sometimes suspicion, at the community level. These impressions required a rethinking of project methodology before actually setting up forestry projects at the community level. Through coordination provided by James Levy, and evaluation and technical assistance provided by Charles Walkinshaw, a management committee was established in early 1991. This included a representative from each of the communities that had expressed interest in the project, a representative from PUMAREN, and a representative from FOIN.

The management team now participates in all project decisions. This has enabled the project to work closely with the communities in clarifying the overall goals of the project, and subsequently working with them to identify the areas that will be set aside for the forest management projects. It has also led to the decision that the day-to-day functioning of the project will rest with the communities. The PUMAREN team will coordinate and provide much of the training to community-based technical teams. Though apparently cumbersome, this structure facilitates communication and enables a flow of technical assistance.

These issues illustrate why, at various times throughout the course of this program, social conditions have required rethinking and restructuring. Though this may slow progress in the short run, we feel that adapting the program to local conditions and responding to local concerns will strengthen the long-term foundation of the program.

FLORA OF ECUADOR (Missouri Botanical Garden)

Botanical Inventories

From August 1990 through September 1991, project personnel carried out botanical inventories in three major regions of the country: lowland Amazonia, the east Andean slopes, and the northwest Andean slopes. Approximately 7,000 collection numbers were obtained. An estimated total of 42,000 specimens were collected by project personnel during the year.

Lowland Amazonia: Oil Well Sites

During the year, most of the project's botanical fieldwork in lowland Amazonian Ecuador has been carried out at oil well sites in Pastaza province, the "central Oriente." The well sites sampled in Pastaza province (and the oil companies that cleared the site and supported the botanical inventories) are the following:

| | |
|--------------------------|-------------------|
| Corrientes site (Unocal) | Aug-Sep 1990 |
| Danta 2 site (Unocal) | Oct 1990 |
| Moretecocha site (ARCO) | Nov 1990-Feb 1991 |
| Namoyacu site (Unocal) | Nov 1990 |

At the Moretecocha site, ARCO petroleum company agreed to support experimental revegetation of the cleared site by replacing topsoil and planting trees—and this work was carried out.

Lowland Amazonia: Quantitative Inventories at Jatun Sacha

The Jatun Sacha Biological Station on the upper Río Napo near the eastern base of the Andes has been a focal point of the project's botanical research since 1985. An intensive floristic inventory at Jatun Sacha's small 4 km² forest reserve has documented and identified more than 1,500 plant species; the total flora is estimated at about 2,000 species.

Jatun Sacha is also the site of quantitative studies of the structure and composition of Amazonian forests.

Eastern Andean Slopes

During September-October, 1990, Palacios carried out extensive botanical collections from the northern part of the east Andean slopes, in the upper Río Coca valley between Baeza and Lumbaqui. This work was part of an environmental impact study for a proposed INECEL hydroelectric project in the area. This area is adjacent to the Cayambe-Coca Ecological Reserve, one of the target areas for the upcoming USAID-funded SUBIR project. These floristic and forest inventories also complement the project's earlier work in the nearby Sumaco region during 1988-89, which contributed to the DESFIL Sumaco management plan.

In December 1990, Palacios and Neill participated in the first botanical expedition to the Cordillera del Cóndor and the Río Nangaritza valley, near the disputed Peru-Ecuador border in Zamora-Chinchipe province.

In the Cóndor-Nangaritza region the quinine tree, *Cinchona*, was found to be abundant and taxonomically diverse, with as many as six different species collected during the expedition, in a variety of forest habitat types. These *Cinchona* populations may in the future prove to be important germplasm resources for the genetic improvement of natural quinine. A biogeographical anomaly discovered on the trip was *Gyranthera* (Bombacaceae family), a huge canopy emergent tree known only from eastern Panama and northern Venezuela. Better material needs to be collected from the Nangaritza *Gyranthera*; it may turn out to be a new genus altogether.

Western Andean Slopes

The project's fieldwork in western Ecuador during the past year was focused on the Awá Indigenous Reserve in Carchi and Esmeraldas provinces. Biogeographically, this area is the southern end of the Colombian Chocó region.

Fieldwork on the western Andean slopes also included the beginning of an intensive botanical inventory of the 3,000 hectare Maquipucuna Reserve, near Nanegal northwest of Quito. This work is done in collaboration with the Fundación Maquipucuna, which owns and manages the reserve.

Dry Forests of Western Ecuador

The lowland, seasonally dry forests of western Ecuador are among the most severely threatened habitats in the country, and very few remnants of this vegetation type remain. Since Ecuadorian dry forests are completely isolated from other areas of similar habitat in the American tropics, plant species endemism is relatively high (estimated at 19% by Dodson & Gentry).

In August 1991, the botanical project initiated botanical inventories at the Cerro Blanco Reserve. These will be continued at bimonthly intervals during the coming year.

Development of the National Herbarium of Ecuador

A major goal of the project during the past year was to develop the physical facilities of the National Herbarium and to organize the plant collections according to internationally acceptable standards so that they are available to researchers. The mounting and filing of the large backlog of plant specimens has continued throughout the year at a rate of over 2,000 specimens monthly. During the year, with USAID/DESFIL support, the herbarium collections doubled in number from 25,000 to 50,000 specimens.

The data for the plant collections made by project personnel is entered into the herbarium's microcomputer. This information is sent to St. Louis on diskette and transferred to the TROPICOS botanical database system on MBG's mainframe computer. The plant specimen labels were printed in St. Louis from this database and mailed to Quito.

Professional Training

Beginning in 1986, several Ecuadorian staff members of the USAID-supported botanical projects have travelled to the Missouri Botanical Garden in St. Louis for period of one to several months to receive training in herbarium and library research methods. During the current DESFIL-supported project, five Ecuadorian botanists attended a one-month training program at MBG.

In late January 1991, Dr. Robbin Moran, a specialist in fern taxonomy at MBG, taught a 3-day course in identification of ferns.

In March and July 1991, Neill taught two one-week field courses in Amazonian dendrology (classification and identification of native tree species) at the Jatun Sacha Biological Station. The March course was directed to the lowland Quichua members of the PUMAREN natural resource management team.

Publications

The following publications resulting from project activities are in press in September 1991:

- * Neill, D. A., *Ecuador: Centro Mundial de la Diversidad Biológica;*
- * Neill, D. A., & W. A. Palacios, *Composition and Structure of One Hectare of Tropical Wet Forest on the Río Napo, Amazonian Ecuador,* and
- * Sandoval, S., D. Neill, & A. Suárez, *Historia Natural del Alto Río Napo: Un Manual para Guías de Ecoturismo.*

RESEARCH

Training

SUFOREN has many excellent field sites, demonstration plots, species elimination trials, etc., which are not being utilized to their fullest potential. The university at Loja has an agreement with SUFOREN for cooperation in forestry investigation and is eager to cooperate with them in field research, particularly research which would satisfy student thesis requirements. In addition, the Durini Foundation has expressed an interest in cooperating with SUFOREN research personnel.

In order to improve the research capabilities of SUFOREN, a meeting of research personnel, librarians and computer specialists was held to discuss sources of funding for forestry research in Ecuador and how write research pre-proposals and proposals. During this meeting:

- * The small grants programs of six nations with representatives in Quito were presented;
- * The progress of the library network and data retrieval system was reviewed; and
- * A representative from the Consejo Nacional de Universidades y Escuelas Politécnicas (CONUEP) described their access to BITNET and ECUNET through

Berry University in Florida and the use of electronic mail with several other universities in the US, including UCLA. The USIS Library expects to network with CONUEP.

La Chiquita Experiment Station

At the La Chiquita Experiment Station near San Lorenzo in Esmeraldas province, the silvicultural investigations were found to be almost entirely abandoned. They had not received the necessary maintenance. Further, there is no complete written history of tabulations and observations from the silvicultural plots. It appears that, for the most part, none were carried out.

Some of the surviving trees have macro-morphological characteristics which indicate their adaptability to the site i.e.; good form and growth in the exotic species *Pino caribaea* var. *hondurensis*, *Terminalia* spp., *Araucaria cunninghamii*, *Schizolobium parahybum* and in the native species *Cordia alliodora*, *Hyeronima chochoensis*.

Uncontrolled hunting and tree-felling activities occur on the Station. There has been no control over invasion of the Station's lands by colonists. SUFOREN presently does not have legal title to the Station's lands. Finally, the Station has no administrator, nor are there sufficient economic resources designated for administration.

A meeting was held to discuss the problems of renovating the Forestry research reserve at La Chiquita. The following recommendations resulted:

- * Evaluate the species trials that exist at La Chiquita and recommend species for planting and introduction into this zone;
- * Evaluate the condition of the native forests in the region and recommend a management plan for native species; and
- * Develop and/or revise technical information on the production and management of native and plantation forests in the region.

Forest Zonification Study

Measurements of the rate of growth of specimens of the most common species of trees in the lowland dry zones (four provinces) were taken, along with measurements of each specimen's age, and data about climate and soil conditions. This information was compared with the rates of growth predicted in the literature about these species. Since temperature and rainfall data were not always available for the exact locations of the forests studied, it is recommended that more precise measurements be obtained in the future. Additionally, absence of a management

plan in these forest zones has prevented the optimum growth of these species. The final report of this project contains preliminary results that suggest that some species are adapting to the prevailing environmental conditions. These results, however, must be confirmed through better evaluation of the prevailing environmental conditions.

Pasture and Forage Research

Three sets of soil samples from the two small plots that were established have been analyzed. Statistical analyses have been conducted and no differences in forage quantity or availability have been detected for any of the sampling dates. There were significant differences in botanical composition in each treatment: there was an increase of *Calamagrostis* spp. in the intensive thinning treatment (500 trees/ha.), and an increase of an invader species of wet and poorly drained sites, *Azorella peduncularis*, in the no thinning treatment (850 trees/ha.). These findings, although very preliminary, would suggest that the more closed canopies foster the conditions needed for grass growth in this high altitude environment.

A list of the most frequent forage species was compiled, and the technicians sampling the experiments became quite proficient in their identification. A guide was prepared for distribution to all technicians working in the sierra.

A worldwide literature review has been conducted to compile the available information about woody species which have potential animal fodder, including *Alnus jorullensis*, *Acacia dealbata*, *A. mearcii*, *Bacharis* spp. and *Spartium junceum*. Information such as their resistance to pruning and repeated foraging, their best cutting height, their nutritive value, or their potential toxicity effects should be made available to forestry technicians.

USAID-MAG/SUFOREN, INTERFACE

The FSDP under DESFIL management began in Ecuador on August 26, 1990 with the establishment of offices in the MAG building. In order to inform administrative and technical personnel of SUFOREN of activities planned under the new agreement, a team building workshop was held at the Forestry Training Center at Conocoto on September 25 and 26, 1990. This meeting was attended by 12 administrators and technicians from SUFOREN, several district foresters, 3 DESFIL core staff from Washington, DC, the DESFIL FSDP Chief of Party, several DESFIL consultants and subcontractors representatives, and representatives from USAID/Quito and AID/S&T/RD in Washington, DC.

In general terms, this workshop opened the door for DESFIL to establish a good working relationship with SUFOREN, served as a forum for discussion of the preliminary work plan, provided an opportunity for all of the technical specialists to express their views, and resulted in some revision of the preliminary work plan. The overall result was that DESFIL received the interest and collaboration of SUFOREN directors and technicians.

After the workshop some of the DESFIL technicians and core staff remained in Ecuador to begin their own scheduled activities and help establish a time schedule of future visits.

Drs. Philip Young and Michael Hanrahan, together with José Orellana, Chief of Party in Ecuador, held a series of working meetings relating to project implementation with Dr. Howard Clark and Mr. David Alverson of ANRO/USAID/Quito, with Mr. Ron Savage of CARE, and with Mr. Marco Vinuesa, the SUFOREN subsecretary. In addition, an interview was held with Eng. Alfredo Saltos G., Minister of Agriculture, to appraise him of planned project activities and project component programs to be carried out.

Young and Hanrahan visited the provinces of Cotopaxi and Tungurahua in order to view the agroforestry activities that had been implemented during the first phase of the FSDP which were scheduled to continue.

During the course of the project, about 20 meetings were held involving expatriate consultants, the Chief of Party, and the National Forestry director. In some cases the Forestry Subsecretary and the USAID Project Officer were also present.

Meetings were also held with representatives of Cultural Survival, CARE, and the Missouri Botanical Garden and representatives of SUFOREN.

The DESFIL FSDP Chief of Party participated each Monday in the ANRO staff meeting of USAID/Quito and in occasional meetings with the Minister of Agriculture. He also had at least one meeting per week with the SUFOREN director and the heads of the agroforestry and national parks divisions of SUFOREN.

The Chief of Party participated in the DAI annual meeting of field chiefs of party held in Bethesda, MD in January, 1991. He also met and talked with the DESFIL S&T Project Officer and other AID/Washington officials and DAI personnel.

PART FOUR

CONCLUSIONS AND RECOMMENDED FUTURE ACTIONS

AMAZON AGROFORESTRY

Summary

The improved agroforestry practices of the Coca demonstrations are technically and economically viable and socially appealing. They require very small incremental investments, improve total cash income and its distribution through time, increase returns to labor, and distribute available colonist labor more evenly throughout the year.

The adoption of the advocated practices, in whole or in part, but especially as a package, does contribute to achieving the goals and objectives stated for the project. Specifically, these practices lead to increased crop yields, increased colonist income, sustained resource productivity, and reduced pressure on existing natural forest areas.

The tree and coffee management practices were understandable and uncomplicated modifications of existing land use and cropping patterns, from the colonists' point of view. Coffee was already the most common income-producing crop in the area (once the wood had been mined). Pruning and the other coffee management practices made colonist labor more productive, led to reduced cash expenditures for production inputs, and generated readily observable increases in coffee produced. Valuable hardwood trees were already allowed to naturally regenerate in secondary forest regrowth. Further deliberate selection of valuable hardwood trees, limited planting of valuable hardwood tree seedlings, and reduced total tree numbers per hectare were simple modifications of existing practices and led to readily observable increases in productivity. The ground covers, the only real innovations, showed the most resistance to adoption.

In eastern lowland forest areas between 200 and 700 meters elevation, ~~natural forest re-generation~~
~~is a viable forestation strategy.~~

The observed results have great significance for macroeconomic land use and colonization policies. The Ecuadorian Government must design and enact land policies that explicitly recognize natural forests and improved agroforestry farming systems, including the managed natural regeneration of secondary forests on areas once logged, as appropriate and productive land uses in Amazonian Ecuador. Colonists must not be automatically rewarded for destroying forests, nor penalized for allowing forest to regenerate nor for incorporating trees into farming systems.

Given technically feasible and economically viable land use innovations, the use of social resources (such as donor and public funds and trained manpower) for demonstration and outreach in support of the innovations is cost effective. The Coca results show that the resources expended to promote adoption and diffusion of the advocated agroforestry practices more than returned the cost expended on them.

The failure to actively monitor, record, and preserve data from demonstration participants is a tragic project failure. Widespread adoption of practices such as these has revolutionary significance for farmer welfare, national land use policy, biodiversity, and tropical forest preservation. But adoption will be impelled only by the weight of careful scientific evidence. In the Coca demonstration trials that evidence has been largely lost. National and donor agencies must track and measure the achievements induced by their work elsewhere, and avoid the repetition of costly mistakes.

Recommended Future Actions

There is a continuing need for the establishment of buffer zones, parks, and reserves throughout Ecuador.

Extension practices are needed that closely integrate donor-provided resources with ongoing programs/field actions of MAG-SUFOREN.

Systematic monitoring and quantification of performance are needed to track and evaluate results.

Macro policy reform is a current prevalent approach to development. It is the lead point in Ambassador Michel's regional objectives for Development Assistance. In the resources area, USAID/Ecuador should intensify pressure on the GOE to consolidate and reform existing land use and colonization regulations. Free access to trees and enforced forest destruction as a condition for recognition of land claims must end. And the GOE must advocate and support both data gathering, analysis, and outreach programs associated with adoption of required technical innovations in agriculture, livestock, and forestry.

SIERRA AGROFORESTRY

Summary

An effective rural extension program is a prerequisite for promoting agroforestry among the peasant farmers in the Andes. Agroforestry must be part of an integrated approach that promotes soil conservation and improved agricultural techniques. Given that SUFOREN does not have the capacity to maintain an extension program, it must work with NGOs to promote agroforestry.

As PROMUSTA has the largest number of extensionists in the field, and works under an integrated philosophy prioritizing farmer training, it is the most capable project for promoting and investigating agroforestry in the highlands. Of all the NGOs working with natural resources in the Sierra, CARE is the most amenable to working with State agencies.

The technical and financial support from DESFIL-FSDP during the past year helped advance notably the agroforestry activities in PROMUSTA. Through accelerated training of extensionists and confronting problems of seedling production in nurseries, the project was able to aggressively expand its agroforestry promotion. Various technical and organizational problems limiting advances of agroforestry were uncovered in PROMUSTA, most of which have been at least partially resolved. Among these are:

- * The need to improve quality of seedlings produced in nurseries;
- * The need for continuous training and auto-evaluation of extensionists in the establishment and management of trees;
- * The need to develop seedling production goals based on actual field requirements defined by the extensionists; and
- * The need to develop appropriate agroforestry models to promote in each area, recognizing different natural resource and social conditions.

Resources were effectively funneled through CARE to the district forestry offices equipping them with tools for management, inputs for nursery production, and vehicle repair. This support helped increase the momentum for plantation management that has been building over the past years. Nevertheless, with the exception of Tungurahua, the other districts did not progress noticeably in improving the quality or diversity of seedling production in nurseries.

Clearly, in the future the role of SUFOREN in promoting agroforestry will not be through project execution. Rather via its forestry districts, it should coordinate the geographic distribution of agroforestry projects in each province, and define general work policies (such as equalizing seedling prices charged among projects, etc.) in an effort to minimize inter-project conflicts. From Quito SUFOREN can best play this role via the existing Ecuadorian Agroforestry Network.

The forestry districts should use their nursery and transportation infrastructures to support agroforestry projects. NGOs active in agroforestry promotion will be able to support the financial needs of districts if they show a willingness to support the projects. It should be emphasized, however, that for districts to play such a role they must improve the quality and diversity of seedling production. Finally, the SUFOREN through the districts should prioritize the promotion of plantation management. To do this, the districts need only lend their tools and

technical assistance to communities, while helping to identify markets for the products of thinning and alleviating obstacles to management often originating in reforestation contracts.

Recommended Future Actions

If USAID decides to continue actively supporting agroforestry activities throughout the Sierra, the most appropriate route would be through continued financial and technical support to PROMUSTA. The project currently works in 6 provinces with the intention of expanding into 3 or 4 more. It employs many of the best young national technicians working in the field. PROMUSTA is the best vehicle through which to expand applied research in the production, establishment, and management techniques needed to expand small farm agroforestry in the highlands.

Future support for agroforestry in PROMUSTA should be via a contract with CARE, thus allowing for the administrative flexibility to invest project funds opportunely, and to respond to evolving initiatives during project operation. CARE through PROMUSTA can best define what formal relations to establish with SUFOREN at the provincial level.

The best opportunities for continuing formal projects between PROMUSTA and SUFOREN at this time are:

- In Tungurahua, where the district's nursery in Pillaro has progressed more than other state nurseries in diversifying species production. While seedling quality needs improvement, this centrally located nursery could help supply seedling needs of agroforestry projects throughout the Central Sierra. There is also an opportunity to extend a project with the district to support commercialization of products from plantation management occurring in communities west of Ambato.

- * In Loja, where the district and PROMUSTA are coordinating in the management of the 800 hectare Carboncillo plantation. This area includes the headwaters of three stream systems, and covers a large part of the northern rim of the Saraguro basin. Combining the application of an appropriate management plan for Carboncillo along with the plantation and natural forest management efforts being promoted by PROMUSTA on the south and east sides of the basin has the potential of evolving into a successful implementation of a forest management effort for the entire Saraguro basin.

FOREST PROTECTION

Summary

The FSDP Forest Protection component has trained three forest pathologists, a forest entomologist and an expert in forest fire management. These professionals have a well equipped laboratory and are ready to protect national and international investments in management or conservation of the country's natural resources. However, this potential is not being realized because of the following administrative problems:

- a) The SUFOREN administration is in constant flux with periodic major changes. Every new regime requires a period of reeducation on the importance of supporting a strong forest protection program. If this is not done in time, highly trained personnel and equipment are lost.
- b) The Forest Protection Unit has so far been allowed to function as a professional group only when assisted by an AID/DESFIL advisor.

Forest Pathology recommendations

The following are specific recommendations for the Forest Pathology program:

1. Give better financial and institutional support to the Forest Protection Unit, including funds for laboratory supplies and field travel for the purpose of diagnosing disease problems and establishing research studies;
2. Identify trees of *P. radiata* resistant to Dothistroma needle blight and propagate resistant material through seed, grafting, or tissue culture and establishment of seed orchards;
3. Identify the fungi involved in damping-off and other diseases in nurseries so that better recommendations for control can be made;
4. Establish species and provenance trials of *Eucalyptus* spp. in the Oriente and coastal plain with special attention to resistance to canker caused by *Cryphonectria cubensis*; and
5. Initiate studies to determine the cause, factors affecting disease development, and control of the canker diseases of pachaco and balsa.

Forest Entomology Recommendations

It is difficult to separate serious administrative problems from purely entomological ones. Good leadership, based on a real understanding of the need for a national forest protection program,

would create an atmosphere for excellent entomological work. The following are specific recommendations for the forest entomological program:

1. The Ministry should establish a nation-wide program, throughout the forest districts, requiring district personnel to send pest-action forms when pests are found, together with damage samples to the Forest Protection Unit. The Unit will then provide an important diagnostic service as well as providing pest control recommendations.
2. An Integrated Pest Management system must be established to prevent outbreaks of *L. parvistrigata*. The IPM system would be based on establishment of thinning regimes and site analyses. The system will require knowledge of the regulating force of natural and introduced egg parasites as well as information on when and what applied remedial treatments might be necessary. A population monitoring system would keep the Unit informed on the need to intensify the IPM system. Naturally, design and implementation of the IPM system will require establishment of pertinent study plans.
3. The life cycle of the neotropical walnut borer, *Greschena garai*, must be determined together with its flight and host selection patterns. This information is needed to develop an applied control program for this important pest of walnut plantations. Research plans on this topic have been established and their implementation is of high priority.
4. Host selection patterns of the leaf cutting ants in the lowland tropics must be studied. This information will be used to develop a baiting-control-system which is in operation for Brazil and other tropical countries. Study plans for this already have been developed.
5. Management of the mahogany shoot borer, *Hypsipyla grandella*, should begin by:
 - a) Determining planting sites for *Cedrela odorata* where the trees grow well and successfully prevent severe *H. grandella* attacks;
 - b) Establishing test plantations of *C. angustifoliae* and *C. fissilis* which are species that recover apical dominance after borer attacks and;
 - c) Developing sustained release insecticide treatments which can be used in areas with light borer attacks. This research would link with the current AID/Office of the Science Advisor studies currently being carried out in Ecuador.

General Recommended Future Actions

Finally, it is essential that the Forest Protection Unit conduct intensive field courses for nursery personnel on the safe and correct use of pesticides. More advanced courses stressing principles

of toxicology as well as safe and proper use of pesticides should be given to district foresters, MAG administrators and professionals of consulting firms.

Despite handicaps, the Unit is in operation and forms the basis for a national forest protection service. Accordingly, USAID should continue to support and reinforce the Forest Protection Unit. In the near future, the Unit would protect innovative resource management programs from losses caused by diseases, insects and fire: it is essential that the AID/SUBIR work plans should include forest protection capabilities. Moreover, an important link to the previous AID/Forest Support/DESFIL efforts is the fact that additional support of the forest protection program will be the impetus needed to make its presence known as an essential element to the natural resource management goals of the country. The protection unit almost has attained this recognition, especially in its fire suppression efforts. If the international resource conservation and management programs are to succeed, then the long term stability of the forest protection program, in all its disciplines, will have to become a national priority.

MANAGEMENT OF NATURAL AREAS

Summary

The Natural Areas component of the FSDP has contributed in a decisive manner to SUFOREN's private sector partnership initiative via the establishment and planning of a new protected area. While this initiative has not concluded, it is well underway and will undoubtedly be successful. The Project's consultant will continue to contribute occasionally to this effort through the SUBIR Project.

This type of initiative is essential for achieving the goals for future establishment and management of protected areas as stated by the "Strategy for a Protected Areas System, Phase 2," published in 1989. The GOE will have enormous difficulty assuming the economic and administrative responsibility which this represents. Additionally, this is one way in which the private sector can be involved directly in the conservation of natural resources.

With regard to training, the Project has strengthened the only real "system" for training protected areas personnel in Latin America, helping to train technical level personnel in fields which are important for the future development of protected areas. However, more emphasis needs to be placed on training, both by SUFOREN and the Fundación Natura. The present system is inadequate for training the personnel needed to implement the new policies formulated by SUFOREN for protected areas. The Project has contributed to the preparation of a preliminary strategy which, if implemented, will assure that the second phase of the training program will achieve SUFOREN's objectives.

Recommended Future Actions

Via the SUBIR Project and other mechanisms, USAID should strengthen the Training Program, contributing to the development of a new system with longer courses which would be oriented towards linking protected area management with the social context, and to sustainable development issues. USAID should also support the creation of a training center which would fulfill these criteria and at the same time provide training to the wide range of private and public sector personnel needed to achieve sustainable use of Ecuador's natural resources.

Whenever possible, SUFOREN initiatives which attempt to involve the private sector in the management and administration of protected areas should be supported, as long as primary conservation objectives are maintained. There are several possible activities of this type in the SUBIR Project which might be implemented.

As a general suggestion, USAID should promote and support the creation of a national protected area institution with sufficient administrative and economic independence to permit it to carry out its responsibilities efficiently. The present situation impedes any effort to achieve change and respond to the real needs of the protected areas.

WORK WITH INDIAN ETHNIC FEDERATIONS (Cultural Survival)

Summary

Effective technical training in techniques of natural forest management has proved to be among the easiest tasks in implementing a pilot forestry project in lowland Quichua communities in the Ecuadorian Amazon. Indigenous people with minimal schooling quickly learn how to delimit, map, and inventory forest lands for production. The greater challenge is to achieve an effective coordination of local communities with the FOIN RM program, the integration of local knowledge of forest products and ecological processes in the development of an indigenous forestry project, and the capacity to design and administer an integrated forest plan. Furthermore, linking indigenous communities with appropriate markets for forest products will undoubtedly prove to be a significant challenge.

Recommended Future Actions

The following specific recommendations are made:

1. Provide appropriate forestry training. Develop an educational program for Ecuadorian foresters or forest ecologists to train them in three areas: the concepts of natural forest management; the development of community-based forestry plans in conjunction with local people; methods for integrating local knowledge into forestry plans. Train indigenous forest managers. Foresters or forest ecologists must work jointly with the

indigenous forest managers who will implement forestry activities to provide training to devise forest management plans, not to conceive and write these plans themselves.

2. Provide on-going technical assistance in developing community forest management plans and an integrated forestry plan for the indigenous forest industry.
3. Provide administrative and organizational support for FOIN and PUMAREN, and for community members implementing forestry projects.
4. Initiate research projects to provide baseline studies for silvicultural trials.
5. Develop marketing studies and establish contacts with specialized markets. CS has been working with an international Wood Certification Working Group to develop guidelines for certifying to "green" consumers that the wood they buy is obtained by good forest stewardship practices. We are also working on the advisory board of WARP (Woodworker's Association for Rainforest Protection) to make direct connections between forest producers and wood consumers. These activities are designed to provide the links that will enable indigenous peoples in lowland Ecuador to obtain a premium for the wood that they produce under a management plan, and also to sell a wider range of lesser known species than they can market in the national market. We recommend that these activities be intensified and specific marketing studies and connections with consumers be established.
6. Base future program assistance to the greatest extent possible on the fact that indigenous people will determine the pace and timing of all program activities, regardless of donor desires.

FLORA OF ECUADOR

Summary

The Flora of Ecuador component, as well as the previous USAID-supported projects carried out by the Missouri Botanical Garden, have contributed very significantly to Ecuador's basic scientific infrastructure in regard to the country's natural resources and biological diversity. These contributions have included strengthening of research institutions and information centers, and training of Ecuadorian professionals, as well as basic research and inventory of plant resources.

Recommended Future Actions

The development of this basic scientific infrastructure is a long-term process. While not a quick fix for immediate environmental problems, basic research and institutional support are essential

to all phases in the development of an effective means of managing and protecting natural resources in the country.

Ecuador's biological research institutions, including the National Herbarium, still require outside support in order to enable them to carry out their mission and contribute to resource conservation and management. MBG, under contracts with USAID/Quito and DESFIL, has effectively provided this support to botanical research institutions and personnel in Ecuador since 1985. This program should continue to be included in USAID's natural resource strategy for Ecuador. Botanical research should be included in the SUBIR project and any future DESFIL II activity in Ecuador. At the same time, MBG as an AID contractor should redouble its efforts to disseminate the research results in the form of scientific publications and reports in a timely fashion, so that the information is available to institutions and persons engaged in resource management and conservation in Ecuador.

Ideally, the National Herbarium should serve the entire country as an information center on the plants of Ecuador and should contribute in various ways to the efforts to conserve and manage Ecuador's immense wealth of plant resources. The plant collections and associated library should function effectively as the basic data base on the distribution of plants in Ecuador.

Adequate management of the National Herbarium will require at least one technician with a degree in botany or forest engineering. The position should be a permanent appointment by MAG/SUFOREN. This person should collaborate closely with the PROMOBOT project and be trained in floristic investigation methods and herbarium management. It would be ideal to have two or three trained professionals to run the National Herbarium.

RESEARCH

General Recommendations

The difficulty of improving research and extension in SUFOREN should not be underestimated. However it is clear from past history that piecemeal and/or temporary changes in policy are unlikely to be effective. It is therefore suggested that at least three research personnel be hired by SUFOREN or that SUFOREN designate three of its personnel as researchers and make provision for appropriate training. The members of this research arm should have appointments of approximately 60% research and 40% extension (i.e., an average of 3 days a week research and 2 extension) since most activities will overlap.

Under the present circumstances the most cost effective means for SUFOREN to accomplish research is to reach an agreement with other research organizations such as INIAP, CORMADERA, FUNDACION FORESTAL DURINI, or the various universities like the National University at Loja, at Ibarra, etc. to do the research for them.

There is a great deal of important, scientifically valid, applied research to be done in four important life zones in Ecuador (mangrove forest, semiarid coastal plain, inter-mountain valleys, and the Ecuadorian Amazon) such as progeny trials, plant introduction and species elimination trials, labor-intensive vegetation and disease suppression (e.g., control of weeds, insects, disease), and the thinning and pruning of plantation and native forests.

Recommendations for La Chiquita Experiment Station

1. Define a management category for the Station, i.e. Ecological Reserve, Forest Reserve, Biological Reserve, Silvicultural Experiment Station, Ecotourism Area.
2. Designate technical and administrative personnel and the concomitant resources in order to execute the activities defined by the new management designation.
3. Establish Pilot Plantations with the most promising species as inferred from results and observations of this study.
4. Re-plant in the already established plantations.
5. Install a permanent nursery at the Station especially to provide plants for the silvicultural activities proposed here.
6. Transfer legal title to the Station from IERAC to SUFOREN.
7. Identify and mark the exceptional surviving trees in the silvicultural trials so that they may be used as seed trees.

Pastures Recommendations

The importance and potential of forage species within the production systems of the Sierra has been established through FSDP research. Animal production can increase dramatically in the region by following some simple practices in management of animal and forage species. For indigenous groups in the Sierra, particularly those situated in forest areas (land classes IX, X, and XI), this can mean a considerable increase in revenues, and an important step towards economic and ecologic sustainability of the production systems.

It is especially recommended that SUFOREN follow up DESFIL FSDP activities with the establishment of MOUs and other cooperative mechanisms with INIAP, FEPAAM (the Inter-American Network of Andean Pastures) and other relevant institutions, in order to conduct joint research and extension on silvopastoral systems and soil conservation. This will be the most appropriate route and the most efficient use of the limited human and infrastructure resources of Ecuador.

The recommendations focus on two different forage management schemes: (a) Herbaceous forage species; and (b) woody forage species. Both are within the mandate of SUFOREN due to involvement and primary responsibility for the woodlands of Ecuador and the importance of silvopastoral systems and soil conservation in these areas.

1. Herbaceous Forage Species

It is important to continue with the experiments that have been established in Cacha-Chuyug (Chimborazo) and Cotopaxi. The minimum duration of those trials should be two years. One year is not sufficient to establish available forage quantity and animal carrying capacity, due to the great influence of rainfall and temperature on pasture growth. Two years would help to avoid a biased estimate due to weather.

2. Woody Forage Species

(a) The next step is to conduct a producer field-level survey to determine the extent and use of tree fodder in the region, and what species are preferred, which are known or thought to be toxic, etc.

(b) From the survey results, and with information made available by the Literature Review, a joint applied research plan should be drawn up among SUFOREN, INIAP, CARE and the Inter-Andean Pastures Network (REPAAM) to initiate a concerted effort in woody legumes, which have enormous animal feed potential in the Ecuadorian Sierra.

Zonification Recommendations

The zonification work is a valuable diagnostic and this work should be continued based upon the conclusions to be found in the final report on zonification.

A general recommendation is that all information on forest zonification in Ecuador be collected and published in one place as an aid to studies in this area.

USAID-MAG/SUFOREN INTERFACE

Summary

Having the DESFIL FSDP office in the MAG building has proved very valuable for maintaining daily contact with SUFOREN directors and counterparts. This has permitted prompt resolution of problems as they arose, facilitated changes or modifications in activities that were deemed necessary, and has resulted in the completion of the proposed purposes and objectives of the FSDP.

DESFIL has also been able to assist SUFOREN in carrying out additional activities, for example, the formulation of a training plan, repair and maintenance of vehicles necessary to project activities, assistance for participation in international conferences, etc. which has contributed to institutional strengthening.

Recommended Future Actions

On the basis of this experience, it is recommended that a means be found to continue this USAID-MAG/SUFOREN relationship as a positive means for normal and satisfactory execution of development projects in Ecuador. In this way, certain activities identified as successful in the DESFIL FSDP project in regard to their positive impact on conservation of natural resources, such as Amazonian and Sierran Agroforestry, Natural Areas Management, Forest Protection and Pastures Research could be continued through SUBIR or other appropriate projects.

ENDNOTES

1. The sections on Amazon Agroforestry summarize material from the research and writing of Jorge Uquillas, Alvaro Ramírez, Carlos Sere, Robert Peck, Franco Gutiérrez, and John Bishop. The work of these professionals is recognized here as the source of this material.
2. Some of these 193 farms were among the 250 demonstration farms, and some were not.