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Contract Number
525-0191-C-00-1019-00

Project No. 525-0191

Project Title: Technical Assistance to RENARE

FINAL SUMMARY REPORT
WATERSHED MANAGEMENT PROJECT - PANAMA

Prepared for
RENARE/USAID 525-T-049

Prepared By
Experience, Incorporated Project Administrator

November 1983

EXPERIENCE, INCORPORATED
MINNEAPOLIS, MINNESOTA 55402

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FINAL SUMMARY REPORT OUTLINE

Watershed Managment Project - Panama

I. Introduction

In accordance with Article VII, Para C and upon completion of contract No. 525-0191-C-00-1019, dated 7-27-81 Experience, Incorporated submits this final report describing accomplishments of the contract and makes recommendations to RENARE/USAID regarding future improvements toward achieving overall renewable natural resource objectives in Panama.

Experience, Incorporated has appreciated the opportunity to contribute its efforts toward the achievement of such specific objectives as:

1. Strengthing the technical capacity, direction and administrative capability of RENARE.
2. Deepening the understanding of the importance of the proper administration and conservation of the renewable natural resources of Panama.
3. And the establishment of programs for the proper employment and preservation of the hydrographical watersheds of the Panama Canal, Rio La Villa and the Rio Caldera by involving the population of each area with the integral development of the area.

While the achievement of these objectives requires long term efforts and, in fact, is a continuing process, significant achievements have been attained as evidenced by content and substance of this final report.

II. Scope of work

A. Services Performed

Technical assistance was provided by Experience, Incorporated in the several disciplines and in a manner required to best meet administrative and program planning and implementation needs of RENARE during the contract period. The original contract of July 27, 1981 provided for the following mutually agreed upon level of effort by technical specialists in various disciplines:

	Prime Contract	Level of Effort
1.	Agro-Forestry	24 Person-Months
2.	Watershed Management	24 Person-Months
3.	Tropical Forestry	24 Person-Months
4.	Soil and Water Conservation	12 Person-Months
5.	Home Office Support (not to exceed)	3 Person-Months
	Sub-Contractor	
6.	Humid Tropical Ecology	12 Person-Months
	TOTAL	99 Person-Months

This planned schedule for technical assistance was modified in the contract under amendment No. 3, dated February 18, 1983 as follows:

	Prime Contract	Level of Effort
1.	Agro-Forestry	12 person-months
2.	Watershed Management	24 person-months
3.	Tropical Forestry	24 person-months
4.	Soil and Water Conservation	4 person-months
5.	Home Office Support (not to exceed)	3 person-months

Sub-Contractor

6.	Humid Tropical Ecology Short Term Consultants - E.I.	12 person-months
7.	Genetic Improvement and Plantation Management of Coffee and Cacao and Possibly Cashew and Peach Palm	2 person-months
8.	Social Programs and Technical Assistance for Rural Areas	1 person-month
9.	Analysis and Programming of Data on Natural Resources by Computer	2 person-month
10.	Hydrology	2 person-month
11.	Forestry Control - Legislation Enforcement	2 person-month
12.	Conservation and Multiplication of Germplasm	1 person-month
13.	Cultivation and Industrialization of Natural Rubber	2 person-month
	TOTAL	91 person-month

As of the end of the contract period (September 26, 1983), Experience, Incorporated had provided 82.9 person months of services by the following specialists:

Long-term

Agro-Forestry - Dr. C. Buford Briscoe (team leader)	12 months
Tropical Forestry - Dr. Waldemar Albertin (subsequent team leader)	24 months
Watershed Management - Dr. Edward J. Finegan	24 months

Short-term

Soil Conservation - Mr. William M. Johnson	8 weeks
Hydrology - Dr. Curtis L. Larson	8 weeks
Extension - Mr. Richard E. Griffin	16 weeks
Germ Plasm - Mr. Pablo Sanchez Vindas	3 weeks
Germ Plasm - Mr. Luis Poveda	3 weeks
Natural Rubber - Mr. David Robertson	4 weeks
Sub-total -	10.5 months

Sub-contract - Tropical Science Center, San José, Costa Rica

Dr. Joseph Tosi O.
Dr. César Pérez
Mr. Ralph Bolanos
Mr. Leon Gonzales
Mr. Vincent Watson C.

Sub-total - 10.4 months)

Project Management - Home Office, Experience, Inc. 2 months

TOTAL 82.9 months

B. Reports submitted

All technical specialists submitted final reports in Spanish and English upon completion of their tours of duty. Three long term technicians prepared 8 quarterly reports during the contract period. The following list of reports was prepared and submitted in accordance with contract requirements:

1. Work Plan
2. Quarterly Reports
   - 1981 - 2 reports
   - 1982 - 4 reports
   - 1983 - 2 reports

3. End of Tour Reports
   a. Agro-Forestry - Dr. C. Buford Briscoe
   b. Tropical Forestry - Dr. Waldemar Albertin
   c. Watershed Management - Dr. Edward J. Finegan
   d. Soil and Water Conservation Program - William M. Johnson
   e. Water Resource Management - Dr. Curtis L. Larson
   f. Rubber Cultivation and Industrialization - David Robertson
   g. Needs for an Extension Service - Richard E. Griffin
   h. Tropical Forest Ecology of three Watersheds in the Republic of Panama - Tropical Science Center
   i. Useful Plants Little Known in Panama: Phenology - L. Poveda
   j. Useful Plant Little Known in Panama: Ornamentals - P. Sanchez
4. Final Summary Report - Experience, Incorporated Project Administrator

C. Contractor's Tasks

According to contract terms, Experience, Incorporated personnel were required to perform the following tasks of assistance to RENARE:

1. Watershed Management
   a. Participate in the preparation and revision of Watershed Management plans and programs of the La Villa and Caldera watershed projects in coordination with the Executive Director, General Coordinator, technical personnel and other consultants of these watershed projects
   b. Provide technical assistance support to project personnel in the preparation of specific plans and programs related to Watershed Management and Conservation.

c. Participate in the preparation of the training plan for local technical personnel in accordance with the requirements of the project and the country.
d. Participate in the analysis and integration of the necessary basic studies
e. Participate in the preparation of the operating plans for the Watershed Management projects of La Villa and Caldera Rivers.
f. Provide recommendations in relation to the convenient organization and implementation of watershed management and conservation districts.
g. Participate in the conceptualization, preparation and implementation of an administrative system for watershed management applicable to typical sub-watersheds, which would generate information related to water production, quality, sedimentation, erosion, etc., with the purposes of identifying specific problems and the planning of adequate management control of erosion, sedimentation, etc.

2. Tropical Forestry
   a. Update and evaluate the forest inventories of the Panama Canal, the La Villa River and the Caldera River Watersheds.
   b. Identify critical areas that should be planted in protective forests.
   c. Develop and participate in the implementation of plans and management programs for proposed forestry development projects.
   d. Develop and participate in the implementation of reforestation plans and programs employing the use of permanent crops.

e. Develop technical information manuals on forestry planning, management and use.

f. Participate in the updating of forestry legislation for the Republic of Panama.

g. Advise on the selection of forest species suitable for use in the watershed management reforestration program.

3. Ecology of the Humid Tropics

a. Prepare work plans, outline and adjust the ecologic zones of the Canal, La Villa River and Caldera River Watersheds.

b. Prepare training programs on Tropical Ecology for upgrading the skills of professonal Panamanian personnel.

c. Identify typical eco-systems of each of the watersheds of the projects.

d. Cooperate in the selection of forestry species to be utilized in the Canal, La Villa and Caldera Watershed areas.

e. Recommend and provide specific directives for maintaining the eco-systems in their natural and unchanged state and the recovery of already alterated eco-systems.

f. Develop standards and regulations to be applied to all agricultural, urbanistic, and sport activities, etc., in the various watersheds of the project, including the land areas, as well as the lakes and rivers.

4. Soil and Water Conservation

a. Recommend appropriate practices and methods for soil conservation in the Canal, La Villa and Caldera Watersheds.

b. Prepare technical manuals for the design, construction, operation and maintenance of soil conservation facilities.

c. Recommend alternatives, procedures and methods that must be utilized for the control, recovery and maintenance of areas affected by the land erosion.
d. Recommend designs and appropriate structures for the control and corrections that must be made for the stabilization of the affected areas.
e. Develop plans and work programs to effect an appropriate classification of the Canal, La Villa and Caldera Watersheds

5. Agro-Forestry
   a. Recommend the use of appropriate methods and agronomic practices for permanent agricultural crops in the Canal, La Villa and Caldera Watershed areas, introducing and promoting preferably the Taungya System.[1/]
   b. Prepare work plans and programs involving agro-forestry cultivation systems, in order to minimize the costs of forestry plantations primarily in the Canal Watershed.
   c. Develop plans and programs designed to reorient current agricultural practices in the project areas in an effort to increase land productivity, through the use of practical methods, inputs and required fertilizers.
   d. Recommend the organization of specific programs with rural population, to provide work for the population of the area in the development of the project activities with the purpose of avoiding migration to the cities.

The list of submitted reports mentioned previously represents the source information to demonstrate how, where, when, and by whom within the Contractor Team, the various tasks listed above were performed. More specific examples of accomplishments are summarized in later sections of this report.

[1/] Simultaneous planting of trees in plantings of annual crops and/or short term perennials.

III. Summary of the Problem

The irrational use of Panama's natural resources has been a phenomenon of long standing beginning from early Spanish settlement. Land clearing was done by slash and burn techniques for producing agricultural crops and later cattle raising. Over the years over-intensive utilization of sloping land by a growing farm population has led to deforestation, soil erosion and destruction, water loss, flooding and drought problems in many parts of the country as well as a host of related social economic and political ills.

Only recently has the Government of Panama realized the seriousness of the wanton destruction of many of its forest, soil, water and wild life resources. It's creation of RENARE within the Ministry of Agricultural Development represents a part of Panama's strategy for addressing problems related to renewable natural resources. Aside from the many technical problems related to rational use of forests, soils and water resources, there remain many other problems in a fledgling organization of a small developing country such as Panama related to resources conservation/use policies, natural resource legislation, budget priorities, administrative organization and manpower capabilities.

Because of the complicated socio-economic and cultural factors involved in land use changes occuring in many tropical forest areas, a multi disciplinary approach was considered the best strategy for addressing resource management problems in priority watersheds. Since RENARE's strongest capabilities have been in forestry, most field activities in the past have been oriented to reforestation and forest protection. Recently, work in national parks and forest reserves has advanced significantly. However, much more emphasis is needed by RENARE and cooperating government entities in community development, soil-water conservation, pasture improvement, agroforestry and related industries.

IV. Objectives of the Contract

Recognizing the complexity and magnitude of the many problems relating to RENARE's area of responsibility, it was highly appropriate that RENARE opted for technical assistance that was limited in scope. Technical assistance under this contract provided for institutional strengthening of RENARE and assistance in planning and the conduct of pilot activities in 3 priority watersheds only. While these were the primary thrusts of contractor performance unforseen events compelled that some assistance be provided (in accordance with terms of the contract) to special needs and directives of RENARE. Therefore, minor levels of assistance were provided as requested by RENARE in some geographic areas other than the three specific watersheds previously mentioned. (These included among others, Darien, San Blas, Bocas del Toro and mangrove tidelands.)

V. Accomplishments Toward Achieving Objectives

A. Institutional Strengthening

RENARE as an institution within another institution (MIDA) has been plagued by a host of administrative, management, budgetary, policy and procedural problems that have hindered planning, coordination and conduct of programs to assure effective use and conservation of renewable natural resources in Panama. Mention has been made in various reports of many weaknesses within RENARE such as lack of timely and appropriate procurement, cumbersome proceedures, insufficient office space, inadequate budget, minimum transportation, rapid personnel turnover, limited technical capability of some personnel and the like. Such characteristics are ofter typical in new organizations of developing countries and time is needed for their improvement. Observations have also been made by contract specialists that RENARE has made considerable strides in the last two years as an institution, particularly in improving its planning capability and in upgrading capabilities of its personnel. The presence of contract personnel working side by side with counterparts and co-workers has, no doubt been a major factor in improving RENARE's institutional capabilities. Some specific accomplishments achieved under the contract relating to institutional strengthening include the following:

1. Policy/Planning
    a. Technical assistance was provided to RENARE in the development and review of detailed work plans for 1982-83 covering the technical fields of Tropical Forestry, Agroforestry and Watershed Management programs. Specific geographic priorities were given to the Canal Watershed along with the Rio La Villa Watershed in the Azuero Peninsula and the Rio Caldera Watershed in Chiriqui Province.

b. As part of the contract, ecological studies and related work was conducted in the three watersheds. These provided a new methodology for determining base line ecological data on maximum capability for lands within the watersheds which, when compared with current and actual land use, provided guidance to policy makers and program planners within RENARE on (1) the magnitude of inappropriate natural resource utilization and (2) a determination of technically sound program priorities.

c. Recommendations were provided to RENARE staff on a day-to-day basis and through means of consultant reports by 14 contract specialists regarding various phases of natural resource conservation and use policy and program planning in watershed management.

2. Training

a. Dr. Albertin assisted RENARE in coordinating the training of RENARE staff which participated in long term and short term academic and in-service training in various natural resource related disciplines. Training was provided to 15 staff members in the U.S., 3 in Costa Rica, 2 in Venezuela and 1 in Mexico. Additional training of 12 participants occured through English preparation courses and by means of seminars and workshops benefitting the entire RENARE staff.

b. In-service training (Courses, Seminars, Workshops) Contract specialists assisted or participated in the following:

- Watershed Managemet Course
- Seminar by W. Johnson - Soil and Water Conservation
- Seminar by C. Larson - Water Resource Management
- Seminar by Dr. Briscoe - Agroindustrial Development in Tropical Rainforest Environments (at Smithsonian Tropical Research Institute)

- Seminar by Dr. Briscoe - Agroforestry in Brazil/Panama
- Seminar by Dr. Tosi - Lifezones and Land Capability/Use

3. Development/Transfer of Information

Contract specialists participated in the preparation of leaflets, technical papers, species lists, special reports and manuscripts pertinent to RENARE's need for information on natural resources.

Dr. Briscoe prepared drafts of a first grade workbook on conservation and agroforestry. He prepared leaflet drafts of 8 valuable agroforestry species, lists of agroforestry species to be included in various life zones, a manual [2/] on agroforestry which includes the use of 190 species of plants, a management work plan for cashew plantations and a phenology of 38 species of agroforestry importance found in Summit Gardens.

Dr. Albertin prepared a list of forest and fruit trees for experimental testing, a review of existing natural resource laws, 13 technical manuscripts on forest species, a comprehensive report for a Congressional Committee of the House of Representatives on the status of forestry activities in Panama, and a list of available maps for use by RENARE.

Dr. Finegan conducted a literature review and reviewed base line data on soils, maps, air photos, hydrology and climate, prepared recommendations representing a long term management plan for the Rio La Villa Watershed, prepared appropriate designs for soil erosion structures and measures to be incorporated in target watersheds, developed

[2/] "Agroforesteria Panameña"

a schedule for organizing needed information for management plans and for making necessary analyses, designs and/or recommendations and prepared a comprehensive diagnostic analysis of the Canal and La Villa Watersheds involving compilation and analysis of socio-economic, ecological and natural resource data.

Personal files, books, maps, and working papers of contract technicians were turned over to RENARE upon completion of their tours of duty. All of the activities indicated above represent examples of day-to-day accomplishments that contributed to the achievement of two specific objectives of the contract: strengthening the technical capacity, direction and administrative capability of RENARE and deepening the understanding of the importance of the proper administration and conservation of the renewable natural resources of Panama.

B. Planning and conducting watershed management activities

Several accomplishments were achieved under the contract that relate to a third objective, i.e. the establishment of programs for the proper employment and preservation of the hydrographical watersheds of the Panama Canal, Rio La Villa and the Rio Caldera by involving the population of each area with the integral development of the area.

Contract personnel participated with RENARE counterparts and staff in the achievements of a series of specific accomplishments in forestry, agroforestry and watershed management. Dr. Albertin developed work plans for forestry that were incorporated into RENARE's overall plan. He assisted RENARE in obtaining large quantities of high quality forest and fruit tree seed from CATIE in Costa Rica and with co-workers collected seed in Panama. In addition to the 2500 hectares of

fruit and forest trees planted in the Canal Watershed area prior to June 1983 an additional 1000 hectares (more than 1,000,000 trees) were planted nationwide in June of 1983, in response to the "Month of Reforestation in Panama".

Dr. Albertin was assigned by the Director of RENARE to nationwide responsibilities in initiating forestry research activities. As a consequence, considerable time was spent by Dr. Albertin on field trips to all regions of Panama. Some research planning was achieved in collaboration with Panamanian co-workers. On a daily basis, routine advice, suggestions and recommendations were made to co-workers in many aspects of forestry activities.

By December 1981, Dr. Briscoe had developed detailed work plans for agroforestry activities. He assisted in review of overall plans of operation for 1982-83. Other accomplishments included a market analysis and species evaluation for agroforestry activities, development of a family sized solar food drier for fruits and vegetables, testing in food preservation, procurement of technical pamphlets and fruit tree seed from Costa Rica, revision of the Experience, Incorporated contract, visitation to numerous regions of Panama to select areas for demonstration plots in agroforestry and the preparation of a plan for establishing 28 demonstrations of one half hectare each.

Dr. Finegan with co-workers developed a two year work plan (1982-83) for watershed management activities. He participated in a review of this operational plan, he traveled extensively with co-workers for a variety of purposes related to on-going RENARE operations and future program planning. He assisted in orienting the Ecology Group in their study, specifically in defining areas of work to be covered and identifying data

needed for incorporation into management plans for the second phase of the Watershed Project. Dr. Finegan spent considerable effort in special studies within watershed areas gathering data on census, land ownership and use, health and medical care and other information of a socio-economic nature that was needed to serve as a foundation for watershed management. In the absence of a rural sociologist or extension specialist within the contract team, Dr. Finegan assisted in guidance of social promotion personnel and staff of RENARE in this subject matter.

Among the most significant accomplishments of the contract were the ecological studies conducted in the Canal Watershed and also the La Villa and Caldera Watersheds under a sub contract with the Tropical Science Center in San José, Costa Rica. This work and results are described in detail in the report[3/] "Tropical Forest Ecology of Three Watersheds in Panama". Summary of the activities include the following:

1) Identification and delineation of life zones according to the Holdridge classification, and the presentation of the different life zones at a map scale of 1:100,000 for the Canal Watershed and 1:50,000 for the La Villa and Caldera Watersheds;
2) Descriptions in each life zone of the most representative associations based on soil and vegetative studies conducted in certain areas covered with natural vegetation in the Canal Watershed;
3) Elaboration of land use capacity maps for the 3 watersheds based on the Tosi system at 1:100,000 scale for the Canal Watershed and 1:50,000 for the La Villa and Caldera Watersheds.

3/ Conducted under supervision of Dr. Joseph Tosi, Tropical Science Center

The system employed permits in quantitative form the classification of maximum use capacity of rural land according to the bioclimatic conditions, physiographic and edaphic factors, and the system of agro-technology employed.

The bioclimatic conditions utilized in the study are precipitation and biotemperature as incorporated in Holdridge's life zone ecology classification system. Four different life zones were defined for the Canal watershed: wet tropical forest, very wet tropical forest, very wet premontane forest, and premontane rainforest. The study also defined 6 life zones in the Rio La Villa Watershed, and 5 life zones in the Rio Caldera Watershed. The study provided ample descriptions of all the above life zones as they occur in the different watersheds.

The land use capacity mapping was based on established limits of 10 physiographic and edaphic factors according to prepared keys for each life zone. The 10 factors were:

- % of slope (5 classes)
- microrelief (4 classes)
- effective soil depth (5 classes)
- soil texture (4 classes)
- rockiness (5 classes)
- internal drainage (5 classes)
- fertility (5 classes)
- degree of erosion present (5 classes)
- salinity
- flood danger (5 classes)

Risk of erosion was one of the basic criteria in the definition of land capacity. The system incorporated the universal equation for determining soil losses (as defined by Wischmeier and Smith) under different climatic and soil conditions. That equation is as follows:

A - R.K.L.S.C.P. where

A - soil loss in tons/hectare/year
R - rain factor
K - soil's susceptibility to erosion
L - length of the slope in meters
S - % of slope
C - vegetative cover protection index
P - protection index of soil conservation methods used

The primary sources of information for land form and soil data were studies conducted during the 1960's by the Castastro Rural de Tierras y Aguas de Panama (CATAPAN). Incorporating this with climatic data provided a means of determining appropriate land uses or vegetative cover under the different slope conditions, considering the soil conservation and agricultural techniques used.

Employing maps and results described in the report of the Ecological studies, Dr. Finegan and co-workers of RENARE performed further work to organize data related to maximum land capacity to support different uses, actual land use conflicts that exist between the land's capacity and its actual use, and other socio-economic factors which affect the dynamics of land use change. Employing the 1:100,000 scale map of the Canal Watershed, total areas of the different land capacity classes were measured. A summary of the data follows:

TABLE I

Land Capacity	Map Symbol	Area in Hectares	% of land in Watershed
Protection	X	2,932	1.1
Protection - production foresty	XB	145,924	52.4
Production forestry	B	56,242	20.2
Production forestry - permanent tree crops	BCF	51,617	18.5
Production forestry permanent crops	BC	3,892	1.4
Permanent crops - pasture	CP-PC	10,228	3.7
Pasture - permanent crops- annual crops	PCA	1,075	0.4
Permanent crops - annual crops	CA	2,980	1.1
Annual crops	A	3,420	1.2
Total land area		278,310	100.0%
Water covered		47,750	
Total watershed area		326,060	

Further land measurement work was performed to measure the extent and to show the types of conflicts existing between capacity and actual land use. Results are presented in Table II.

The table combines the 4 major land use classes that presently dominate in the Canal Watershed (primary forest, shifting cultivation/forest fallow, pastures in fallow or weed covered, pastures with scattered agriculture) with the land capacity classification categories defined in the study. Although the actual land use categories are not the same as those of the capacity classification, there is enough information to show in general terms the types of conflicts existing between use and capacity for the watershed's lands.

Primary Forest - This study's results show that these forest areas cover 45.1% of the watershed's land area for a total of 125,500 hectares. Of this 125,500 hectares, 82% are located on lands classified for having a capacity mainly for protection activities (X and XB); 17% are on areas classified for production forestry and tree crop production (B and BCF); and the remaining areas (less than 2%) are classified primarily for pasture and permanent crop production. Therefore, almost all areas presently covered with forest should remain under some type of forest cover to provide needed protection and to remain within the land's maximum use capacity.

Forest Fallow/Shifting Cultivation - Based on available data, 30.2% of the watershed was used for activities related to shifting cultivation when including areas of forest fallow secondary forest growth. Of the 84,000 hectares within this category, 38% are located on lands with capacity classifications for primarily protection activities (X and XB); 50% are in areas classified for production forestry and

TABLE II

Comparison of Actual Land Use with the Tosi Land Capacity Classification in the Panama Canal Watershed

Land Capacity Classification

	Annual Crops	Permanent Crops - Annual Crops	Pasture-Permanent Crops - Annual Crops	Permanent Crops - Pasture	Production Forestry-Permanent Crops	Production Forestry-Permanent Tree Crops	Production - Forestry	Protection Production - Forestry	Protection areas	Totals - According To Actual Land Use
1. Primary Forest				CP						
Map Symbol	1A	1CA	1PCA	1 PC	1BC	1BCF	1B	1XB	1X	
Area in hectares (x's 000)	-	.554	.212	1.18	-	5.03	15.8	101	1.68	125.5
% of land in watershed	-	.199	.076	.424	-	1.81	5.68	36.3	.604	45.1%
2. Forest Fallow/Shifting Cultivation				CP						
Map Symbol	2A	2CA	2PCA	2 PC	2BC	2BCF	2B	2XB	2X	
Area in hectares (x's 000)	1.19	1.82	.375	5.21	2.13	17.0	23.1	31.6	.635	84.06
% of land in watershed	.423	.654	.135	1.87	.765	6.11	8.30	11.2	.228	30.2%
3. Pastures - fallow or weed covered				CP						
Map Symbol	3A	3CA	3PCA	3 PC	3BC	3BCF	3B	3XB	3X	
Area in hectares (x's 000)	-	.081	-	.114	-	2.07	2.75	5.15	-	10.16
% of land in watershed	-	.029	-	.040	-	.744	.988	1.85	-	3.6%
4. Pastures with Scattered Agriculture				CP						
Map Symbol	4A	4CA	4PCA	4PC	4BC	4BCF	4B	4XB	4X	
Area in hectares (x's 000)	2.23	.521	.489	3.73	1.76	27.5	14.6	7.69	.586	59.11
% of land in watershed	.801	.187	.176	1.34	.632	9.88	5.25	2.76	.211	21.2%
Total according hec.	3.42	2.98	1.08	10.2	3.89	51.6	56.2	146	2.90	278.3
to land capacity %	1.22	1.07	.387	3.67	1.40	18.5	20.2	52.5	1.04	100%

production forestry incorporated with various permanent crops (B, BCF and BC); 7% are in areas suitable for pasture and permanent crop combinations (CP, PC and PCA); and 4% are on areas suitable for annual cropping and/or permanent crop combinations (A and CA). If the areas classified for production forestry (without crops) are included with the protection areas, then the shifting cultivation and associated forest fallow areas can be considered to be exceeding the lands support capacity on 65% of the 84,000 hectares where this use predominates. The actual degree of danger to these sites would be dependent on the length of the forest fallow, cropping techniques, degree of multi-layered cropping present (tree/crop combinations), length of cropping period, plus the various site limitations. There are no circumstances where this use can be considered suitable in X and XB sites.

Pastures - Fallow or Weed Covered - These are land areas previously cleared of forest and which are now covered by weeds such as saccharum grass, or which have been used for pasture, but are currently in fallow or overgrown. Slightly more than 10,000 hectares or 3.6% of the watershed land areas are within this classification. Of this 10,000 hectares, 51% are located on land with a capacity classification for primarily protection activities (XB); 47% are located on areas suited for production forestry and permanent tree crop combinations (B and BCF); and less than 2% are on areas suited for pasture or more intensive uses (PC and CA). More than 98% of this land use has been located on land not capable of supporting open, non-forest land use without serious site degradation. This may be a primary reason for these areas' initial management problems when converted to nonforest use and the abandonment of many such lands to weed cover.

Pastures With Scattered Agriculture - These areas have pasture as the primary use, but agriculture plots can be found scattered throughout. Photo and land use map scales and

categories have not permitted an accurate separation of pasture and most agriculture land uses. Slightly more than 59,000 hectares or 21.2% of the watershed's land area are within this land use category. Of these 59,000 hectares, 14% are located in areas with capacity classifications for primarily protection (X and XB); 25% are on production forestry areas (B) and 50% on production forestry/permanent crop lands (BCF and BC); 7% are located on areas classified predominantly for pasture/permanent crop combinations (PC, CP, PCA); and less than 5% are on more intensive use areas for annual crops and permanent crops (CA and A). Eighty-eight percent of this land use category is located on lands in which such use is in excess of the land's support capacity. Environmental deterioration and site degradation can be expected on such areas, the degree of which would depend on specific site conditions and the degree of intensity of the land use practices.

The glaring conclusion derived from this study is that protection must assume the dominant role in Canal Watershed activities. The land capacity/land use data clearly indicates that the great majority of agricultural/cattle land use is already on lands not suited for such intensive utilization. There is no evidence to support the view that the first phase of the project has had a significant effect in altering land use patterns or the dynamics of land use change. With 82% of the remaining primary forest areas being located on sites classified for protection (X and XB capacity), environmental degradation and soil erosion problems can be expected to increase unless effective systems are implemented to protect these critical forest areas from the encroachment of less suitable land uses.

The above study performed by this contract but with free collaboration and participation by technical staff of RENARE represents an example of institutional strengthening that is highly valuable to RENARE as it grows to become a more effective organization.

VI. Observations, Findings, Recommendations

A. Natural Resource Policy/Legislation

This contract has not focused specifically on natural resource policy or legislation at the national level. An FAO expert in this field is currently engaged in an analysis of policy and legislative constraints in the natural resource sector. Observations by our contract specialists are that considerable modifications are needed in policy and laws regarding renewable natural resources. Increased budgets, new laws, enforcement of existing laws, creation of new institutions and organizations and higher policy priorities to protection of existing resources are all very obvious needs. We recommend to RENARE that more emphasis be placed on needed studies and analyses of policies and legislation affecting renewable natural resources. More specifically, we recommend consideration that RENARE be established as an independent public institute with modified authorities and responsibilities. As the principle natural resource agency and with its past experience, RENARE should be the coordinating agency for all matters relating to conservation/use of renewable natural resources. Its collaboration and cooperaton with other government agencies in programs with common and related objectives would be expected. For example, since poor design of roads is one of the major causes of soil erosion at present, collaboration and cooperation between Ministry of Public Works and RENARE is essential for solving such problems. It should be stated policy of the Governement that strong inter-agency collaboration/cooperation is the expected norm.

B. Administration/Organization within RENARE

The contractor task did not include specific technical assistance in administration, therefore, our observations, findings and recommendations are of a general nature intended to advise management of RENARE of areas of administration which are obviously weak.

Whether RENARE assumes complete autonomy, limited autonomy or remains within the MIDA, it must seek additional financing from all sources possible. Additional financing is needed for adequate physical facilities; new departments such as agro-forestry; strengthening of existing but weak sections (such as the Center for Information and Distribution); new programs of research, for example, research on wood products at the Wood Technology Center; additional staff; operating expenses; transportation; training and other costs. Other suggestions are:

- RENARE needs a basic reorganization with more decentralization and more delegation of authority on operational matters.

- Improved internal policies, regulations and proceedures are needed to create a more efficient organization, for example an improved system is needed for providing supplies, funds, etc., to field personnel.

- The central library needs to be strengthened with good administrative and control proceedures.

- RENARE should establish records of plant histories in permanent files for use by all interested parties.

- Publication of professional papers should be encouraged.

- RENARE should require that annual reports or terminal reports be requested of all technical personnel or units to describe activities, list accomplishments and provide recommendations to improve project activities.

- RENARE should recruit/assign an officer specifically trained in publicity and communications to foster and promote RENARE's image and programs both nationally and internationally.

C. Program Planning/Implementation

1. Natural Resource Protection

Major observations and findings regarding protection of natural resources follow. Extensive forest areas shown to be unsuitable for non-forest use continue to be cleared within the Canal Watershed and throughout the country. Protecting what is already in place is easier and more economical than reforestation. Considering the importance of these efforts in the management of the Canal and other watersheds, not nearly enough funds have been directed into these activities. In future projects, protection should assume a top priority position and funds increased accordingly. This must include the definition and protection of park/reserve boundaries; the definition of appropriate multiple-use regulations for forest reserves with the needed support programs; the setting aside of unique, scenic and other special use areas and reserves; the expansion of public education related to the appropriate use of these protected lands; and the incorporation of private groups into the agency's protection activities.

A series of important related recommendations are as follows:

- The use of land capability classification needs to be incorporated into the overall planning process of RENARE to optimize natural resource protection objectives.

- Programming of activities within projects need to be realistic with clearly defined priorities and assurances that adequate incentives exist to maximize farmer participation in reforestation and similar activities.

- More emphasis should be placed on silvo-pastural management methods as part of the soil conservation and pasture improvement activities. Research and demonstrations should be included.

- There is need to establish a special Protection Program, including a public awareness campaign; establishment of warning systems, creation and stiff enforcement of laws against firesetting and illegal forest destruction; adequate funding for equipment, training, costs of operations for protection guards, youth corps and local authorities. Protection would be aimed at forests and grasslands as well as coastal, aquatic and maritime resources. Resettlement of colonizers would be necessary in certain critical areas.

- National laws are needed to enunciate a clear, bold, firm and enforceable national conservation policy; to create a resource conservation program and to identify the agency to administer the program; to provide for funding; to authorize conservation incentives and restraints; to

provide for the role of provincial governments in the program; and to authorize the creation of independent soil and water conservation districts composed of cooperating farmers and others. An early initiative in the program might well be the creation of an emergency "youth conservation corps" to apply conservation measures directly on the land in critically eroding areas.

Soil surveys are needed for the entire country to guide the selection and transfer of appropriate agrotechnology. Consideration should be given to consultant contracting under joint IDIAP-RENARE direction to obtain these surveys quickly and efficiently. Bilateral or multilateral assistance projects could provide at least some of the funding.

Supporting research and testing of conservation practices should be carried out by IDIAP with close cooperation of RENARE in planning the studies and applying the results.

Incentives are needed to encourage acceptance by farmers of conservation practices. Incentives may include cost-sharing, labor-sharing, low-interest loans, loans of specialized equipment and free seeds, tree seedlings and fertilizers.

Soil and water conservation districts are tremendously important sources of political support. They also help to achieve full cooperation of local farmers and to disseminate information about the program.

2. Land Use Managment: Foundation work has been completed during the project period related to land use, land capability, conflicts between current use and land

capabilities, and basic strategies to address land use management within the Canal Watershed. To make further progress in this area requires concentrated efforts aimed at selected land use problems in specific sub-watershed areas. Investigation is especially necessary in silvo-pastural systems. This is an obvious area of overlap between RENARE and IDIAP in which inter-agency cooperation is needed to promote solutions to cattle exploitation on lands not totally suited to open pastures. Such "mixed" land uses can help bring many areas within the watershed (that are now over exploited from cattle production) more into line with their true capacity. Other important areas related to land use management in need of emphasis in future watershed activities include: a legislative framework providing enforcement authority to correct critical land use problems; a system of taxes and incentives to encourage land use in accordance with the land's capacity; investigation and on-the-farm application of agri-silviculture in shifting cultivation areas using multi-layered production methods incorporating annuals, perennials and tree crops; a technical assistance effort aimed at promoting silvo-pastoral and agri--silviculture land use at the individual farm level.

3. Tropical forestry/Silviculture/Agroforestry

Our observations are that RENARE has exerted considerable effort in recent years in tree nursery development and reforestation, primarily by monocultural plantations. Although this work in itself can serve certain investigative purposes, a strong

tropical forestry program incorporating investigation and practical application has not yet developed in the context of the watershed project. To help give direction in the coming years, future project funds would be important in the followng areas: investigative work with native and exotic tree species aimed at producing appropriate combinations for use in silvo-pastoral, agri-silviculture and private and communal woodlots within the ecological constraints of the watershed and other designated project areas; proper forest management systems for use within the multiple-use areas of the forest reserves; the development of a satellite nursery program which would transfer seedling production technology directly to individual farmers or groups in those areas where private reforestation efforts are to be encouraged; and a seed collection and seed bank program which fully meets the needs of the agency.

Consideration should be given to the additional following suggestions regarding program planning and implementation of forest related activities:

- A management plan for a reforestation effort should be prepared well in advance of the implementation schedule.

- A plant material collection system should be established to obtain superior germ plasm from all world sources.

- Experimental reforestation plots employing native species need to be established.

- High quality adaptable species should be included in large scale reforestation efforts.

- More fruit trees should be included in reforestion programs.

- Incentives need to be created to encourage the private sector and the wood industry to become more involved in reforestation and to modernize processing and marketing phases of the industry.

- RENARE should train an adequate corp of technicians in remote sensing technology to serve forest inventory needs.

- RENARE's control programs on forest concessions needs complete revision with new laws, regulations, and procedures. Concessions to harvest lumber on government lands should be limited in size for adequate control; concessions fees need to be adjusted upward; and concessions should be issued contingent upon prior reforestation of equivalent sized areas.

- The use of Taungya System needs to be employed on a more widespread basis than as present.

4. Community Relations

According to our observations, there has been little incorporation of rural groups into project activities. Many participating farmers do not feel they are incorporated into reforestation efforts except to serve as laborers for RENARE's programs. There is little information provided to local communities by RENARE. In the few incidences where RENARE has contacted local communities, reactions were favorable.

There is a low level of education among the rural people, especially in relatively under-developed areas of the agriculture-forest frontier. The general poverty of these areas has further contributed to efforts to change existing land use systems or to regulate current practices. The problems of slash and burn agriculture remain unsolved. Alternatives for producing food needs have not yet been developed.

Lack of land titles in the agriculture-forest frontier area reduces the interest of most farmers to participate in a long-term costly investment of trees or agroforestry at their own expense. Lack of plant materials and technical assistance limits small farmer development of agroforestry. Lack of transport and market for fruit products are other constraints in many areas.

Recommendations follow:

A new strategy is needed away from the current patronage approach so that the individual farmers or organized groups assume rights and obligations in reforestation and agroforestry programs. In areas where individual use-rights have been established on the land, there is an overwhelming preference for private control and responsibility. In these areas, a great part of the cost (primarily labor) of establishing agri-silviculture and silvo-pastoral systems should be assumed by the individual participants.

In areas where use-rights are not secure or where the state will maintain those rights (such as in forest reserves), the continuance of a strategy based on a direct payment system would be necessary. This would really only be desirable in areas designated for multiple-use as buffers to parks and protected areas. In these cases a primary objective would be to stabilize the agriculture-forest frontier and to provide the communities and individuals in such areas with an alternative to slash and burn agriculture with certain clear ownership rights to products derived from these state lands. Participating farmers should be required to assume a major role in selecting crop species and designing the agroforestry system.

An inter-agency approach is needed in agroforestry activities with local communities to assure proper technical assistance related to agricultural and tree crops, and to assure clear information related to markets and local agroindustrial potentials for crops to be produced.

There is not enough emphasis placed on working with private farmers or organized groups instead of depending so extensively on salaried workers to advance reforestation and land protection objectives. This requires a redefinition of incentives within the programs in which tax credit and extension would play a major role in encouraging direct participation of private farmers or organized groups.

In accordance with results from land capability studies conducted during the first phase of the project, there needs to be an increased emphasis on permanent crops in many areas of the watershed. This would provide a foundation on which improvements could be introduced that would be more easily transferred to local farmers.

Other recommendations include the following:

- Cultural and socio-economic characteristics within different areas need to be incorporated into basic program design to provide flexibility for implementing programs under existing diverse social conditions.

- Specific information on species and varieties of annual, perennial and permanent tree crops with potential agro-foresty application needs to be organized and distributed to stimulate local interest.

- Pasture improvement demonstration plots should be smaller in size and more numerous to reach a greater number of farmers.

5. Other Activities

A series of miscellaneous but important recommendations are made to further improve program planning and implementation.

a. Plant Production

- RENARE should encourage the private sector to become involved in the production of larger quantities of trees for their own reforestation programs.
- In RENARE nurseries more trees should be propagated and distributed employing bare root techniques and/or smaller sized plastic bags.
- Relatively more fruit trees should be propagated for distribution.
- All nurseries should be kept filled at all times in case of immediate need.

- RENARE should attempt to establish small satellite nurseries under control/operation of local farmers and/or their wives with RENARE providing technical assistance and certain support resources.
- Species selection for further multiplication should be based upon desirability and not availability alone.
- More widespread use of a larger number of improved plant material types need to be promoted on small farms

b. Wood Technology Center of RENARE (CETMA)
Existing documents on wood characteristics of 113 native species should be duplicated and distributed to the private sector wood industry

- Project equipment for CETMA should be installed in existing facilities as soon as possible.

- Graduate training should be provided to 5 CETMA staff personnel for furthering the research work of CETMA.

c. Parks
Some advance in park and forest reserve protection has occured during the contracting period by strengthening the Parks and Wildlife Department and by developing management plans for certain park and reserve areas. The following suggestions should be seriously considered for future implementation.

- RENARE should survey all of Panama to determine unique or unspoiled tropical habitats.

- Complete protection laws should be created for these tropical habitats.

- Financial support from all sources should be sought to maintain the current status of these locations for scientific study and other appropriate purposes.

- All inhabitants in or adjacent to these locations would have to be relocated elsewhere.

- Boundaries should be established to promote protection.