

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

SECRETARIAT OF STATE FOR ENVIRONMENT AND NATURAL RESOURCES  
THE DOMINICAN REPUBLIC

**THE MASTER PLAN STUDY  
ON  
WATERSHED MANAGEMENT  
IN  
THE UPPER AREA OF  
THE SABANA YEGUA DAM  
IN  
THE DOMINICAN REPUBLIC**

**FINAL REPORT**

**JULY 2002**

**JAPAN FOREST TECHNOLOGY ASSOCIATION (JAFTA)**

**TAIYO CONSULTANTS CO., LTD.**

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## PREFACE

In response to the request from the Government of the Dominican Republic, the Government of Japan decided to conduct the Master Plan Study on Watershed Management in the Upper Area of Sabana Yegua Dam in the Dominican Republic and entrusted the study to Japan International Cooperation Agency (JICA).

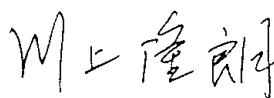
JICA sent to Dominican Republic a study team headed by Mr. Susumu Sakamoto of Japan Forest Technology Association, four (4) times between November 2000 to May 2002.

The team held discussions with the officials concerned of the Government of the Dominican Republic, and conducted field surveys in the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between the two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Dominican Republic for their close cooperation extended to the team.

July 2002



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Takao Kawakami  
President  
Japan International Cooperation Agency

## LETTER OF TRANSMITTAL

July 2002

Mr. Takao Kawakami  
President  
Japan International Cooperation Agency

Dear Sir,

I am pleased to submit the Final Report for the Master Plan Study on Watershed Management in the Upper Area of the Sabana Yegua Dam in the Dominican Republic. The Report compiles the findings of the Study conducted between November, 2000 and July, 2002, those of subsequent analyses and plans formulated by the Study Team.

In the course of the Study, the Master Plan for Watershed Management in the Upper Area of the Sabana Yegua Dam has been formulated for the purpose of achieving the restoration of the headwater conservation function and soil conservation by means of forest management, agroforestry, community development, forest fire prevention and control measures and others. In addition, a demonstration project consisting of a forest fire control project and a community project was conducted to ensure the excellent applicability of the Master Plan and the intended results and understanding of the need for watershed management on the part of local residents were achieved. Furthermore, a technology transfer in third countries was organized for the Dominican counterparts together with OJT during the field survey periods and positive technology transfer results were achieved.

It is my strongest hope that the Master Plan will be precisely implemented through the efforts of the Government of the Dominican Republic and other related bodies and personnel to contribute to the restoration of forests in the said watershed where forest degradation is in progress and also to the improved livelihood of local residents.

I would like to express my gratitude to officials of the JICA, the Ministry of Foreign Affairs and the Ministry of Agriculture, Forestry and Fisheries for their understanding of and assistance for the Study. I would also like to commend the advice and assistance provided to the Study Team by members of the JICA's Dominican Office, the Embassy of Japan in the Dominican Republic, the Dominican Secretariat of State for Environment and Natural Resources and other related organizations.

I sincerely hope that this Report will be actively used by the JICA to materialise and promote the Master Plan concerned.

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Susumu Sakamoto

Team Leader

Study Team for the Master Plan Study on  
Watershed Management in the Upper Area of  
the Sabana Yegua Dam in the Dominican  
Republic

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## LIST OF ABBREVIATIONS

Abbreviation	Español	English
AECI	Agencia Espanola de Cooperacion Internacional	The Spanish Agency for International Cooperation
ADESJO	Asociacion para el Desarrollo de San Jose de Ocoa, Inc.	San Jose de Ocoa Development Association
ASADA	Asociacion Agricola de Los Dajaos	Dajaos Agricultural Association
BID	Banco Interamericano de Desarrollo	Interamerican Development Bank
AT (SW)	Alcance de Trabajo	Scope of Work
CAD	Consortio Ambiental Dominicano	Environmental Consortium of Dominica (D)
CATIE	Centro Agronomico Tropical de Investigacion y Ensenanza	Tropical Agricultural Research and Education Centre of Costa Rica
CDA	Consejo de Desarrollo Agroforestal	Agroforestry Development Council (D)
CECARENA	Centro de Capacitacion en Recursos Naturales	Natural Resources Research Centre (D)
CEPROS	Centro de Estudios y Promocion Social	Social Development Research Centre (D)
CONATEF	Comision Nacional Tecnica Forestal	National Technical Commission for Forests
DED	Servicio Aleman de Cooperacion Tecnica y Social	German Technical and Social Cooperation Service
DGF	Direccion General Forestal	(Former) Directorate General of Forestry (D)
DIRENA	Departamento de Inventario de Recursos Naturales	Department of Natural Resources Inventory (D)
DRP (PRA)	Diagnostico Rural Participativo	Participatory Rural Appraisal
DRR (RRA)	Diagnostico Rural Rapido	Rapid Rural Appraisal
Enda Caribe	Desarrollo Medio Ambiente en el Caribe	Environmental Development of the Caribbean
ESNAFOR	Escuela Nacional Forestal	National Forest School (D)
FAO	FA Organizacion de las Naciones Unidas para la Agricultura y la Alimentacion	Food and Agricultural Organization of the United Nations
FIDA	Fondo Internacional para el Desarrollo Agropecuario	International Fund for Agropastoral Development
FUDECO	Fundacion para el Desarrollo Comunitario	Community Development Foundation (D)
Fundacion Progressio	Fundacion para el Mejoramiento Humano	Foundation for Human Life Improvement (D)
GPS	Sistema de Posicionamiento Global	Global Positioning System
GTZ	Agencia Alueman de Cooperacion Tecnica	German Technical Cooperation Agency
INAREF	Instituto Nacional de los Recursos Forestales	National Institute of Forest Resources (D)
INDRHI	Instituto Nacional de los Recursos Hidraulicos	National Institute of Water Resources (D)
ISA	Instituto Superior de Agricultura	Higher Institute of Agriculture (D)
JICA	Agencia de Cooperacion Internacional de Japon	Japan International Cooperation Agency
KFW	Banco Alueman para la Reconstruccion	German Bank for Reconstruction
MARENA	Manejo de Recursos Naturales	Natural Resources Management
PM (MP)	Plan Maestro	Master Plan
OJT	On-the-Job Training	On-the-Job Training
ONG (NGO)	Organizaciones No Gubernamentales	Non-Governmental Organization
Oxfam	Oxfam	Oxfam

Abbreviation	Español	English
PROCARYN	Proyecto de Manejo y Conservacion de la Cuenca Alta del Rio Yaque del Norte	Yaque del Norte Watershed Management and Conservation Project
PRODAS	Programa de Desarrollo Agricola de San Juan de la Maguana	San Juan de la Maguana Agricultural Development Programme
PRODAZ	Proyecto de Desarrollo Agroforestal de Zambrana	Zambrana Agroforestry Development Project
PROMASIR	Programa de Administracion de Recursos de Riego	Irrigation Resources Management Programme
PRONATURA		
PUCMM	Pontificia Universidad Catolica Madre y Maestra	Madre y Maestra Catholic Pontifical University
SEA	Secretaria de Estado de Agricultura	Secretariat of State for Agriculture (D)
SIG (GIS)	Sistema de Informacion Agricultura	Geographical Information System
T&V	Visita a Proyectos Implementados con Cierto Exito	Study Visits by Local Residents to Successful Sites
UAFAM	Universidad Agroforestal Fernando Arturo de Merino	Fernando Arturo de Merino Agricultural University (D)
UASD	Universidad Autonoma de Santo Domingo	Santo Domingo Autonomous University (D)
UCEDP	Universidad Central de Estudios Profesionales	Central University for Professional Studies (D)
UNPHU	Universidad Nacional Pedro Henriquez Hurena	Pedro Henriquez Hurena National University (D)
UNESCO	Organizacion Educativa, Cientifica y Cultural de las Naciones Unidas	United Nations Educational, Scientific and Cultural Organization
USAID	Agencia Internacional de logs E.U. (USA)	US Agency for International Development
USDA	Departamento Agricultura de E.U.	United States Department of Agriculture

- (D) Indicates a Dominican organization.
- A foreign exchange rate of RD\$16.7 to one US dollar (June, 2001) is used in this Report.



## **SUMMARY**

## SUMMARY

The findings of the present Study for the Master Plan, which was conducted from mid-November, 2000 to July, 2002, have now been compiled in the Final Report. The contents of this Report are summarised here.

### 1. Outline of the Study

#### (1) Background and Objectives of the Study

The forest ratio in the national land of the Dominican Republic showed a sharp decline from some 70% around 1940 to 28% in 1998, causing grave concern in regard to adverse impacts by flooding, etc. on the conservation of the national land.

The Study Area, i.e. the upper reaches of the Sabana Yegua Dam, has varied topography ranging from lowland to highland with an elevation of 2,000 m or higher. The southern part in particular is considered to be an area of poverty where extensive shifting cultivation is the livelihood of many of the inhabitants.

Although the Sabana Yegua Dam has been playing the important role of supplying water to the lower reaches, there is serious concern for its remaining life due to increased sediment inflow in recent years, in turn caused by land degradation in the upper reaches due to agriculture and damage by hurricanes, etc.

Under these circumstances, the Government of the Dominican Republic made a request to the Government of Japan to conduct a development study of which the main objectives were the formulation of the Master Plan for Watershed Management for the area in question and the transfer of technology to Dominican personnel working in related fields in the area. In response, the Government of Japan dispatched the Preliminary Study Team to the Dominican Republic in July, 2000 to discuss the scope of work (S/W) and the S/W was signed by both sides on 26<sup>th</sup> July.

#### (2) Study Area

Yaque del Sur River, which runs through the Study Area, originates near the summit of Mt. Duarte (El. 3,057 m) in the Central Mountains and empties into the Caribbean Sea. It is one of the country's most important rivers with a total length of 141 km and a total watershed area of 480,000 ha. Both Grande del Medio River and Las Cuevas River join

Yaque del Sur River in the mid-stream from the east before the latter reaches the Sabana Yegua Dam.

The Study Area covers some 166,000 ha which is largely divided into the northern part around the city of Constanza and the southern part around the city of Padre Las Casas.

### (3) Scope of the Study

In the first year of the Study, the Inception Report was prepared as work in Japan, followed by the preparation of the Progress Report based on the First Field Survey focusing on the general conditions of the Study Area.

In the second year, a community project and forest fire control work, etc. were conducted together with a natural conditions survey as part of the Second Field Survey (Part 1). Based on the results of this work, a field report and the Interim Report were prepared.

During the First Work period in Japan, a meeting of the Advisory Committee was held.

Several workshops were held and the community project was continued and evaluated during the Second Field Survey (Part 2). Meanwhile, the Second Work in Japan mainly focused on the preparation of the Draft Final Report.

During the Third Field Survey in the third year, explanation of and discussions on the Draft Final Report and various draft manuals were conducted along with a technology transfer seminar. The Third Work in Japan was devoted to the preparation of the Final Report and various manuals.

## **2. Master Plan Formulation Approach**

The adopted approach for the formulation of the Master Plan was firstly to examine the possibility of zoning for the formulation of such a plan which is suitable for the characteristics of the Study Area, the introduction of appropriate technologies and the participation of local residents. It was also decided to implement a demonstration project consisting of forest fire control work and a community project to ensure the rational formulation of the Master Plan. The finalised Master Plan reflects the results of (i) the examination of methods to strengthen the organization to implement the Master Plan so that the formulated Master Plan could be smoothly as well as effectively implemented and (ii) the evaluation of the effectiveness of the Master Plan, including the aspect of environmental care. GIS technology was used for zoning, for preparation of various thematic maps and the Master Plan maps. The transfer of

technology to the counterparts was also conducted as part of this approach to enable them to master the technologies and techniques required to formulate similar plans by themselves.

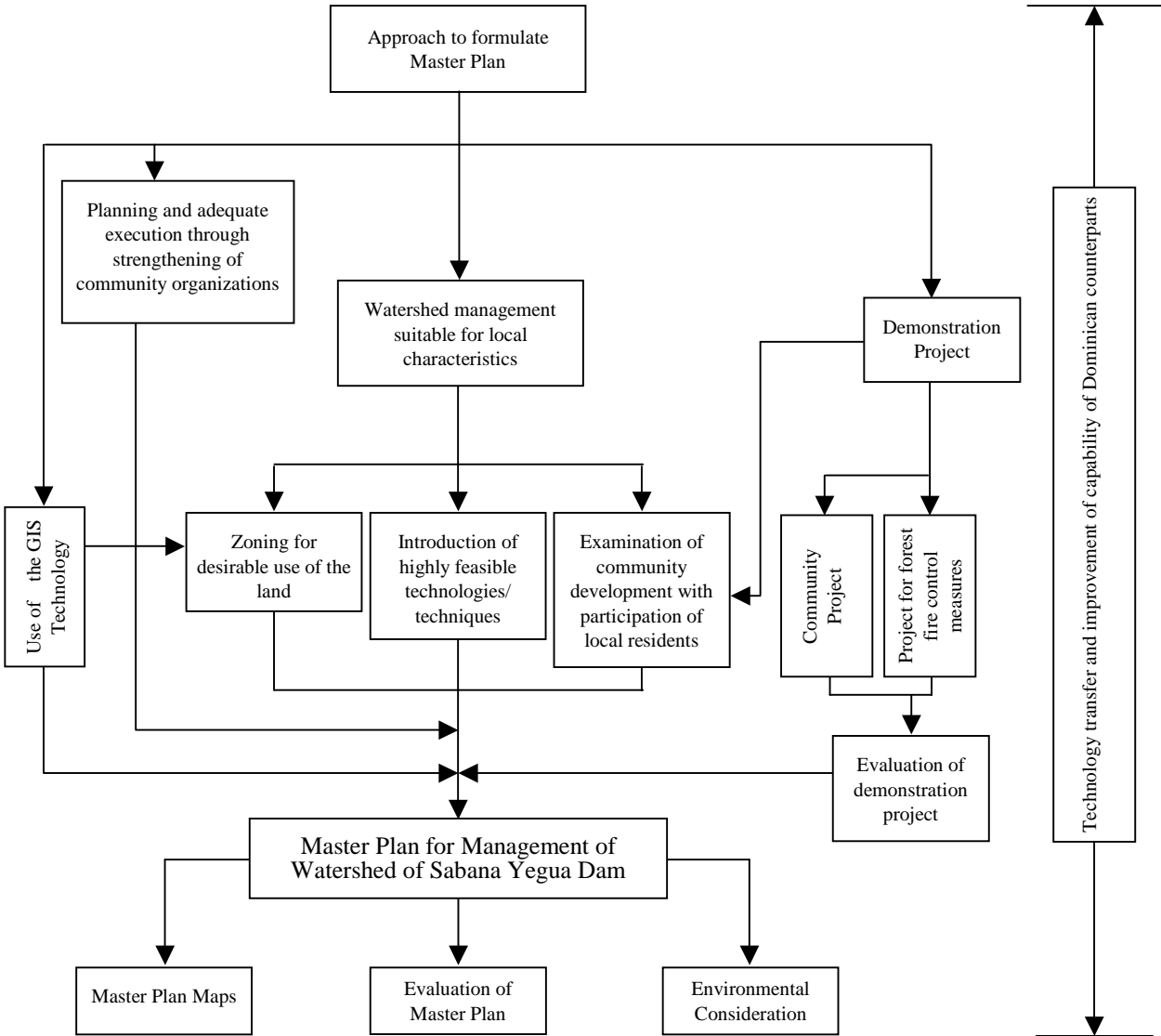


Fig.1 Master Plan Formulation Approach

**3. Current Conditions of Forests and Forestry**

(1) Forest Resources and Forestry Policies

The latest data on forest resources can be found in the “Inventory Study on Land Use and Vegetation in the Dominican Republic (1999)”. According to this study, the country has a total forest area of 13,266 km<sup>2</sup>, accounting for 27% of the national land area.

Forests cover some 964 km<sup>2</sup> of the Study Area and the forest ratio of 57% is more than double the national average, partly because of the presence of two national parks in the area.

The Law Concerning Conservation of Forests and Fruit Trees (Law No. 5856) of 1962 provides the foundations for forestry administration in the Dominican Republic. In August, 2000, the Law Concerning Environment and Natural Resources (Law No. 64-00) was enacted, creating the backbone for current forestry policies.

## (2) Reforestation

There appears to have been no concrete reforestation plan with specific targets prior to the Green Quisqueya Plan formulated by the previous government. The Green Quisqueya Plan was originally a 20 year plan but was modified to the current National Reforestation Plan following the change of the government.

While the original plan was funded by the Presidential special budget, the current plan is funded within the general account of the government, suggesting increased financial stability of the plan. In February, 2001, the President stated in a speech on government policies that 300 million Dominican pesos would be appropriated for reforestation.

## (3) Forest Products Industry

Almost 100% of the wood used in the Dominican Republic is imported as the domestic wood market is practically non-existent, making improvement of the self-sufficiency rate an important task for the future. While the demand for fuelwood once rapidly declined for a short period of time, a trend of increasing fuelwood consumption is believed to exist in the Study Area where the majority of local residents are poor.

## (4) Human Resources Development for and Institutional Set-Up of Forestry Sector

The Superior Institute of Agriculture (Spanish abbreviation of ISA) is the only higher educational institute in the Dominican Republic to train forestry engineers through its forestry course. Meanwhile, the National School of Forestry provides courses to train forestry technicians and forest guards respectively. As the number of students enrolling on and completing these courses significantly fluctuates from one year to another, the reality is far from a sustained human resources development regime in the forestry sector.

The internal training system is currently unsatisfactory. Although some engineers have rich experience and advanced knowledge as well as skills, the problem is that the number of such high-class engineers is quite limited.

The current administrative system for forestry was developed pursuant to Law No. 64-00 of 2000. Following the enforcement of this law, the former National Institute of Forest Resources was reorganized as the Under-Secretariat of State for Forest Resources of the Secretariat of State for Environment and Natural Resources. Following this reorganization, many staff members working in the environment sections have been transferred to the forest administration sections and the reorganization process is still in progress.

#### (5) Existing Projects

A survey was conducted on seven projects of six types which were believed to be highly relevant to the present Study because of many similarities or to positively contribute to the implementation of projects based on the Master Plan from the viewpoints of the self-help efforts and grouping of local residents, change of the farming practice of shifting cultivation and long-term as well as flexible project implementation, etc.

- Government-led project with a loan by an international aid organization : PRODAS
- Project based on bilateral cooperation : PROCARYN
- Project of a government-affiliated body : Plan Sierra  
: Plan Cordillera
- Project of an international NGO : PRODAZ
- Project of a domestic NGO : ADESJO
- Local community development project : ASADA

### **4. Current Conditions of Study Area**

#### (1) Current Conditions of Sabana Yegua Dam

The Sabana Yegua Dam was completed in 1978 and began to store water the following year. Compared to the situation prior to its construction, it has significantly contributed to mitigating flooding in the lower reaches. However, the speed of sedimentation of its reservoir has been much faster than the original estimate. Based on the current forecast by the National Institute of Water Resources (Spanish abbreviation INDRHI) and other data, it appears certain that the present water storage capacity is less than 75% of the original capacity.

## (2) Natural Conditions

The Study Area is dominated by a maritime tropical climate although there are considerable variations from one area to another because of the specific climatic features associated with an island, the area's highly undulating topography with an elevation range of 400 m to 3,000 m and the strong influence of trade winds.

Forests in the Study Area are principally classified into three categories: needle-leaved forests, broad-leaved forests and dry forests. Most needle-leaved forests are pure pine forests which are classified as closed forests, open forests and sparse forests based on the crown density. Meanwhile, broad-leaved forests are classified as mist forests, humid forests and semi-humid forests based on the elevation and other factors.

In regard to the local geology, the soil survey found that the formation processes are fairly complicated, that soil development is insufficient due to the loss of top soil caused by the steep topography and inappropriate access by the public into forests and that the soil groups are classified into various soil units and sub-units based on their specific properties. In addition, the distribution of soil groups was studied.

In regard to flora and fauna, there are extremely few ground mammals and serpents and most species, including plant species, are indigenous. The principal characteristics of fauna are the relative abundance of shrubs and epiphytic plants and the little presence of trees other than pine because of the wide distribution of pure pine forests.

The watershed survey items included rivers, the river system and hydrology. In regard to the current situation of land degradation, the watershed was divided into sub-watersheds and micro-watersheds to establish the scale and distribution of landslides and erosion.

## (3) Socioeconomic Conditions

The survey items on the local social conditions were social culture, schools, clinics, communal organizations, village administration, land ownership and existence of landless farmers. The survey items on the local economic conditions were the various economic activities and economy of farming households in both the southern part around Padre Las Casas and the northern part around Constanza. The survey was also conducted on the activities of simple processing factories of coffee beans and rice mills which constitute local industries, the types of employment of farmers in each part and the situation of unstable household economy due to the price fluctuation of various farming products.

#### (4) Agriculture and Forestry

The general conditions of local forestry are already described in 3 above. Local agriculture can be classified into three types, i.e. (i) irrigation agriculture at permanent sites mainly observed in the northern part, (ii) extensive traditional agriculture and (iii) irrigation agriculture at sloping land where water is guided from the upstream via vinyl pipes which is an intermediate type between the two preceding types. Local agriculture faces many problems, including the aging of the people engaged in farming because of the outflow of young people to urban areas, difficulty of securing water supply and limited scope to secure bank loans.

#### (5) Forest Fires in Study Area

The survey on the reality of forest fires identified, among others, the causes, frequency and peak period, etc. of forest fires, necessity to organize volunteer fire corps and pending tasks relating to the command system as well as monitoring system.

#### (6) Current Conditions of Protected Areas

Slightly less than half of the Study Area is occupied by two national parks where wildlife and trees are protected. Even though farming inside a national park is prohibited, there are cases of farmers dwelling inside national parks. There are more cases of local people actually farming inside national parks even though they do not live there. To combat this situation, the Under-Secretariat for Protected Areas and Biodiversity has announced a policy of introducing buffer zones to relocate farmers currently living inside national parks to these zones with a view to restricting agricultural activities to these zones in the future.

### **5. Causes of Watershed Degradation**

From the viewpoint of forest management, the inappropriate use of forests is one cause of watershed degradation. Indiscriminate cutting since the 1930's and the subsequent switch to an extreme protection policy has made local residents lose interest in forests, preventing the implementation of rational forest management by the forestry administration.

From the viewpoint of the natural conditions, land in the Study Area is essentially very vulnerable because of the presence of many steep slopes. Degradation of the land has been accelerated by damage caused by a series of hurricanes.



The socioeconomic causes include shifting cultivation, grazing and forest fires which are often triggered by either shifting cultivation or grazing. Although shifting cultivation is hardly a sustainable method of agriculture under the natural conditions described earlier, local farmers have no intention of stopping shifting cultivation because of the ease of this method unless a much more efficient farming method is introduced. Much of the grazing land used to be forest land which was cut and transformed to the present state over a long period of time. Accordingly, priority is given to ensuring the efficiency of grazing and hardly any firebreaks have been established. There are many cases of a fire spreading from a burning site to a forest area, resulting in degradation of the watershed.

## **6. Demonstration Project**

### **(1) Forest Fire Control Measures**

Persons responsible for the prevention or extinguishing of forest fires are deployed at local offices of the Under-Secretariat for Forest Resources and forest fire companies are formed at the local offices. Nevertheless, local residents are the first to arrive at the scene of a fire to conduct initial fire-fighting.

However, the reality is that local people do not have effective fire equipment or tools and their fire-fighting activities are restricted to forest fires in the neighbouring area as long as their safety is ensured.

To rectify the situation, a volunteer fire corps has been formed in Constanza and San Juan. In addition, a workshop was held to enhance the awareness of local residents of the need to deal with forest fires and to provide guidance for initial fire-fighting, including the proper handling of equipment and tools, mainly for forest fire-fighters.

Furthermore, the prospect of creating an integrated fire prevention system was examined as the collaboration of the military, the Secretariat of State for Agriculture and the INDHRI, etc. will be required in the case of the occurrence of a major forest fire.

### **(2) Community Project**

#### **1) Village Workshops**

The purposes of these workshops were to make local residents collectively aware of the problems and also to raise their awareness of the direct effects of forest fires on their livelihood. Given these purposes, the Participatory Rural Appraisal (PRA) technique was employed. Six villages were finally selected as the target villages for

the community project, a survey on local needs was conducted and residents' groups were formed.

Table 1 Selected Villages

Watershed	Village	Remarks
Las Cuevas River Watershed	El Recodo	Located in the uppermost accessible part of Cuevas River; severely damaged by Hurricane George
	Las Lagunas	Core village in the area; good demonstration effects can be expected
Grande del Medio River Watershed	El Convento	Village near the Valle Nuevo National Park
	Los Corralitos	High level of poverty; awareness of the beneficial effects of reforestation
Yaque del Sur River Watershed	La Guama	High level of poverty
	Los Frios	Village near the Jose Carmen Lamires National Park

## 2) Implementation of Community Project

The community project was designed to reflect the results on the Master Plan so that the said plan would be highly effective. For this purpose, the project had wide-ranging components, including reforestation, agroforestry, nursery creation, school forest creation, planting of trees by volunteers from secondary schools, erosion control, assistance for the strengthening of community organizations, meetings of leaders and visits to other project sites. Through the implementation of these components, the existing problems of each village, the awareness of such problems among villagers and the effectiveness as well as problematic points of each component were clarified and the key points which would prove useful for the Master Plan were sorted out.

## 3) Evaluation of Demonstration Project

As it is difficult to clearly identify the results of any project if the project period is short, the suitability, impacts and prospects for self-reliant development, etc. were examined based on the implementation results of the community project in each of the selected villages. In the case of forest fire control measures, these were evaluated from the viewpoints of suitability, effectiveness and efficiency while the community project was evaluated for each village together with assessment of its unexpected positive as well as negative impacts.

## **7. Watershed Management Plan (Master Plan)**

### **(1) Basic Concept**

Approximately half of the land in the Study Area is covered by forests and the remaining land is used for farming, grazing and as grassland, etc. In regard to farmland where shifting cultivation, which is one cause of watershed degradation, is conducted, it is impossible to eradicate this method of agriculture unless other viable methods are introduced. Bearing this in mind, land classification was conducted to realise the desirable land use.

In regard to forest management, the target forest management were determined for natural forests while reforestation was planned to create artificial forests in line with the government policies. Possible measures to facilitate the voluntary participation of local residents were examined together with measures to strengthen the collaboration between the government and local communities.

For the control of forest fires, efforts were made to create a joint fire prevention and extinguishing system by the government and local communities and a plan to deploy initial fire-fighting equipment and tools was formulated.

In the case of agroforestry and farming, various measures were examined with a view to ensuring the extension of good practice in order to improve the level of awareness on the part of local residents.

Soil conservation measures focused on small-scale landslides and gullies as these can be dealt with by local residents.

In the case of participation and village development, the proposed measures are those which can contribute to improving the awareness and income of local residents.

In regard to extension and training, the central pillar is “extension by farmers to farmers”. Given the extremely low literacy rate, useful measures, including the use of AV equipment, are proposed.

For the implementation of the Master Plan, a suitable implementation plan should firstly be formulated through in close collaboration with the relevant departments within the Under-Secretariat for Forest Resources. Because of the insufficient manpower and equipment of this government body, measures to obtain the cooperation of NGOs and

private bodies, etc. should be examined in order to obtain the cooperation and assistance of local residents for the implementation of the Master Plan.

## (2) Land Use Plan

The land use plan aims at ensuring the effective utilisation of resources and environmental conservation and must be formulated based on the comprehensive consideration of not only the potential productivity of the land but also the environmental conservation function, socioeconomic implications and extension effects of projects to be implemented.

Given the situation in the Study Area, classification of the land based on the land use potential was firstly conducted and then sites which proved difficult for specific land use were identified to prepare the desirable land use plan.

Table 2 Changes of Land Use Before and After Planning

(ha)

Classification	Before the Plan	After the Plan							
		Forest-1	Forest-2	Forest-3	Grazing-1	Grazing-2	Farmland-1	Farmland-2	Total
Forest	87,531	2,252	34,556	50,723					87,531
Shrub Land	6,301	323	2,951	3,027					6,301
Intensive Grazing Land	2,580		104	28	95	2,353			2,580
Grassland (without trees)	51,724		4,399	21,404			119	25,802	51,724
Farmland	10,355		198	1,649			1,551	6,957	10,355
Total	158,491	2,575	42,208	76,831	95	2,353	1,670	32,759	158,491

## (3) Forest Management Plan

### 1) Direction of Forest Management Plan

Forests in the Study Area cover a total area of 87,531 ha with a forest ratio of 52.5%. In principle, these forests both inside and outside national parks will be preserved. Land which is unsuitable for farming and which is currently used for shifting cultivation and grazing will, in principle, be converted to forests. Forest management should correspond to the site conditions and sufficient consideration should be given to the environment.

## 2) Forest Management Categories

Forest management categories are introduced based on the forest maintenance and management criteria used for the land use plan and management standards for each category are prepared, taking the actual forest types and other factors into consideration.

## 3) Management Types

Five forest management types are introduced, i.e. artificial forest management with clear cutting, natural forest management with selective cutting (I), natural forest management with selective cutting (II), natural forest management with prohibited cutting (I) and natural forest management with prohibited cutting (II). For each type, the cutting, regeneration and tending methods and others are indicated.

## 4) Supply of Seedlings

Seeds are controlled and supplied by the Seed Bank of the Under-Secretariat for Forest Resources. In the case of seedlings, the use of village nurseries should be promoted from the viewpoint of encouraging the participation of local residents in addition to their supply by public nurseries.

## 5) Participation of Local Residents

There can be many ways for local residents to participate. In the case of the management of natural forests in the vicinity of a village, local residents may be able to remove dead trees and conduct other types of work along with forest patrols. When farmers intend to conduct small-scale planting, seedlings may be supplied and convenience provided in regard to their obtaining a reforestation certificate and other matters.

## (4) Agroforestry and Farming Plan

### 1) Subject Farmers

Although the subject farmers are grouped for the purpose of agroforestry, it is essential to pay proper attention to differences between farmers even in the same group in terms of the cultivated crops, level of interest, funding capacity, size of farmland and labour capacity, etc.

## 2) Types of Agroforestry

To ensure efficient cultivation, such individual components as the development of agroforestry with line planting and the introduction of fruit trees, etc. should be conducted in connection with other components. For efficient grazing, techniques to produce fodder trees and to raise stock indoor for half of the time should be extended together with the introduction of silvo-pastoral techniques and others.

## 3) Implementation Process

Any farmer with involvement in a new farming plan is not expected to be enthusiastic right at the beginning because of the need for new labour input in addition to conventional farming work. The proper introduction of agroforestry requires the prior establishment of a firm relationship of trust between extension workers and farmers. Careful attention must be paid to the contents of and manner of providing incentives.

## (5) Soil Conservation Plan

### 1) Soil Conservation Target

Although soil erosion and landslides of various scales are taking place in the Study Area, the target of this plan is to control small-scale gullies and landslides which can be dealt with by local residents using materials which can be easily obtained in the Study Area.

### 2) Control Measures

Control work is classified as gully erosion control, landslide control and torrent erosion control and feasible control measures with the participation of mainly local residents are proposed.

### 3) Participation of Local Residents

The participation of local residents is essential to enhance the positive effects of water and soil conservation measures. As it is difficult for small landowners to individually achieve the desirable effects, it is necessary for them to form water and soil conservation groups to conduct the necessary activities. In the case of large landowners, the degree of interest in soil conservation measures may vary from one owner to another. If they are capable of implementing these measures, they should be encouraged to do so. If not, measures to make them involved in group activities should be considered.

(6) Forest Fire Prevention and Extinguishing Plan

Forest fire control measures consist of fire prevention measures and fire extinguishing measures. Up to the present day, monitoring, communication and other systems have been developed as fire extinguishing measures even though the systems in place are not totally adequate. Meanwhile, hardly any prevention measures have been introduced, making improvement of the fire prevention awareness of local residents, guidance on fire prevention through school education and intensification of public activities necessary.

(7) Community Development Plan

Given the facts that the Study Area is the poorest area in the country and that local poverty is an indirect cause of watershed degradation, the Master Plan must be capable of contributing to community development. Accordingly, a livelihood improvement plan and a social infrastructure development plan will be the main pillars of community development.

For the implementation of livelihood improvement, three groups are initially considered: the first group incorporates items for which a need by local residents exists and which are highly feasible in the planned work, the second group incorporates items which have some risks but for which a positive return can also be expected while the third group incorporates items of which the implementation is significantly determined by the external conditions. Based on this classification, the conditions, timing and points to note are clarified for the first group of which the feasibility is the highest.

The introduction of a social infrastructure development plan should be examined, taking into consideration not only the strong need by local residents but also the progress of the livelihood improvement plan and degree of change of people's awareness.

(8) Plan to Strengthen Residents' Organizations

At present, residents' organizations are generally weak even though there are some exceptions. The efficient development of various activities under the Master Plan cannot be hoped for unless there are residents' organizations in each village of which the capacity is above a certain level. The same can be said from the viewpoint of community development. The strengthening of an organization is a long process and it is necessary to guide local residents by selecting appropriate work and projects in order to achieve a gradual enhancement of the organizational strength.

## (9) Extension and Training Plan

For farmers in the Study Area to abandon their traditional extensive agriculture in favour of a resources conservation-type farming method, it is necessary for them to accumulate the relevant experience and knowledge. The number of extension workers is currently limited and the frequency of their visits is necessarily low in the case of remote villages.

In the Study Area which is characterised by a low level of awareness of the need for reform and an extremely low literacy rate, the central pillar of the extension strategy is the fostering of capable farmers as core farmers in order to realise “extension by farmers to farmers”.

For this strategy to be realistic, a combination of appropriate means of extension is selected with due consideration being paid to the socioeconomic gap between different areas.

## (10) Operation and Management

### 1) Project Implementation System

As the participation of local residents is a precondition for the implementation of projects under the Master Plan, how to induce the voluntary commitment of farmers to developing their awareness as the driving force of projects is an important theme.

Meanwhile a cooperative or collaborative system between the administrative bodies and local public bodies involved in watershed management is essential and, therefore, the establishment of a council to adjust the implementation policies and contents of projects formulated by various organizations is necessary together with a secretariat which specialises in the implementation of concrete projects under the Master Plan. The utilisation of NGOs and private consultants with close links to the local area is also desirable for the efficient implementation of project-related work in the area.

### 2) Implementation Schedule

In view of the time required for fruit trees to grow and the cutting period of planted trees, the project implementation period should be set at 15 years to formulate a “long-term watershed management plan”. In addition, a five year watershed management plan covering a period of the first five years should be formulated for priority areas for project implementation. Moreover, an annual plan should be



formulated based on the five year plan. The long-term watershed management plan consists of three phases.

#### (11) Project Planning

The project items are classified and the planned quantity of work for each item is estimated. At the same time, the project cost is roughly estimated based on the minimum cost of equipment, etc. which is required for project implementation.

### **8. Project Evaluation**

#### (1) Basic Principles

The identification of the positive effects of the Master Plan and the suitability of projects under various sub-plans are examined based on the following principles.

- ① Both the internal economic effects and external economic effects are taken into consideration.
- ② The effects to be examined are those generated by the change of land use.
- ③ The main focus is on the importance of functions to benefit the public rather than economic investment effects.
- ④ The financial sustainability of farming households is examined from the viewpoint of the coexistence of productive activities and conservation activities.

#### (2) Classification of Effects

The implementation effects of the Master Plan are classified into production effects and effects which benefit the public in general.

The former mean agricultural products and forest products and these results directly belong to the persons involved. The latter mean the conservation or restoration of the public benefit functions of forests and the recipients are local residents as well as the general public. The effects of the Master Plan are also classified in terms of the locations where such effects take place.

#### (3) Estimation of Effects

The soil erosion mitigation effect is examined as an effect which benefits the public by means of comparing the volume of sediment discharge before and after the implementation of the Master Plan. In regard to production effects, the production values

before the implementation of the Master Plan are estimated. Reference is also made to effects which cannot be quantified.

## **9. Environmental Consideration**

In view of the environmental characteristics of the Study Area, scoping was conducted to clarify the likely scope and scale of the environmental impacts in advance by collating the environmental factors with components of the Master Plan. General evaluation of the environmental consideration under the Master Plan was then conducted based on the scoping results. While some beneficial impacts can be expected to take place in the case of some items, no items were found to suffer from any serious negative impacts.

## **10. Utilization of Geographical Information System (GIS)**

### **(1) GIS Specifications**

Two PCs, one colour scanner and one colour plotter were installed as hardware to support the GIS. Their smooth functioning and specifications are described.

### **(2) Preparation of Various Thematic Maps**

Such thematic maps as a land use and forest type maps, soil maps, watershed maps and land use potential maps were prepared by means of scanner input.

### **(3) Preparation of Master Plan Maps**

Master plan maps were prepared using the GIS and the watershed management support database.

### **(4) Use of GIS**

The newly created database makes it possible to prepare map outputs which are suitable for various purposes, the display of the totalisation and analysis results and the preparation of new thematic maps, etc. using the GIS function.

## 11. Technology Transfer and Organizational Strengthening

### (1) Technology Transfer

#### 1) Contents and Method of Technology Transfer

Details of the contents and method of technology transfer are described in the document entitled “Plan for Technology Transfer”. The main subjects dealt with in this document are (i) OJT on matters relating to the formulation of the Master Plan, (ii) training in third countries and the technology transfer seminar, (iii) survey methods relating to the socioeconomic, agricultural and forestry conditions in the Study Area and (iv) methods to prepare various manuals.

#### 2) Evaluation of Achievement Level of Technology Transfer

Although it is difficult to quantify the degree of achievement of technology transfer, possession of the basic knowledge and capability to conduct a field survey on the part of the counterparts (C/Ps) was evaluated at the beginning and end of the Study to check any improvement. The evaluation was based on eight items, including possession of the basic knowledge and capability to plan surveys for each technology transfer component, taking the self-evaluation results of the C/Ps into consideration.

The improvement of the technical expertise of the C/Ps to reach the target level considerably varies from one technical field to another, mainly because of the difficulty to achieve the planned improvement in the short study period in certain fields. Nevertheless, it is generally believed that the level of technical expertise of the C/Ps is now sufficient to implement the various projects envisaged by the Master Plan.

### (2) Organizational Strengthening

#### 1) Purpose of and Direction for Organizational Strengthening

While efforts are being made to institutionalise the forest and forestry administration to ensure the rational as well as sustainable use of forests, the internal organizational structure of the Under-Secretariat for Forest Resources is not necessarily compatible with its activities. In the coming years, the said Under-Secretariat must actively commit itself to projects designed to promote the conservation and utilisation of forests with the participation of local residents and its relevant departments/sections must play an important role.

## 2) Establishment of Collaborative System

The establishment of the Executive Office for Master Plan Projects is planned to ensure a project implementation system which is in line with the Master Plan. A government notification to make such an office a reality must come from the highest level possible. Moreover, the guidelines for project implementation must describe the desirable manner of collaboration involving various organizations and the contents of each project in a concrete manner together with the basic concept.

## 3) Human Resources Development

It is desirable for the future recruitment of forestry engineers by the Under-Secretariat for Forest Resources to be conducted in a fair manner through selection testing and other means with clearly defined recruitment rules being introduced at the same time. It is also necessary to improve the method and contents of the training system.

# **CHAPTER 1    OUTLINE OF THE STUDY**

# CHAPTER 1 OUTLINE OF THE STUDY

## 1.1 Background of the Study

While 70% of the national land of the Dominican Republic was covered by forests around 1940, this forest ratio sharply declined to 28% in 1998 due to commercial cutting, the negative reaction to rigorous forest protection policies, disorderly shifting cultivation and forest fires, etc.

The Study Area, i.e. the upper reaches of the Sabana Yegua Dam, has diverse natural conditions ranging from dry lowland to wet highland and is considered to be an area of poverty except for the flat land of the Constanza area and around the dam site where many people are engaged in shifting cultivation on slopes.

The Sabana Yegua Dam plays the important role of supplying water for hydropower generation, irrigation agriculture and domestic consumption. Meanwhile, there is an urgent need for the restoration of forests and the introduction of soil conservation measures in the face of a growing risk of flooding in the lower reaches due to the decline of the water and soil conservation function of the watershed. This decline is primarily associated with the progress of sedimentation in the dam reservoir, in turn caused by forest degradation and soil erosion resulting from shifting cultivation on land unsuitable for agriculture in the upper reaches, frequent forest fires and damage by large hurricanes, including recent Hurricane George.

Under these circumstances, the Government of the Dominican Republic made a request to the Government of Japan in September, 1999 to conduct a development study for the Formulation of the Master Plan. In response, the Government of Japan dispatched the Preliminary Study Team to the Dominican Republic in July, 2000 to discuss the scope of work (S/W) and the S/W was signed by both sides on 26<sup>th</sup> July.

## 1.2 Objectives of the Study

The Study has the following objectives.

- ① Formulation of a master plan for watershed management in the upper reaches of the Sabana Yegua Dam in the Dominican Republic to restore the headwater conservation function and soil conservation function by means of forest management, agroforestry, community (village) development and forest fire control measures, etc.

- ② Transfer of various survey techniques, forest management plan formulation techniques, various technologies and skills required for project implementation and techniques associated with participatory surveys to the counterparts through the study for the formulation of the Master Plan in question and a demonstration project

### **1.3 Study Area**

Yaque del Sur River, which runs through the Study Area, originates near the summit of Mt. Duarte (El. 3,057 m) in the Central Mountains and empties into the Caribbean Sea. It is one of the country's most important rivers with a total length of 141 km and a total watershed area of 480,000 ha. Both Grande del Medio River (watershed area 68,913ha) and Las Cuevas River (watershed area 58,574ha) join Yaque del Sur River (watershed area 39,398ha) in the mid-stream from the east before the latter reaches the Sabana Yegua Dam. The watershed of the Sabana Yegua Dam, i.e. the Study Area, covers an area of approximately 166,000 ha.

# DOMINICAN REPUBLIC

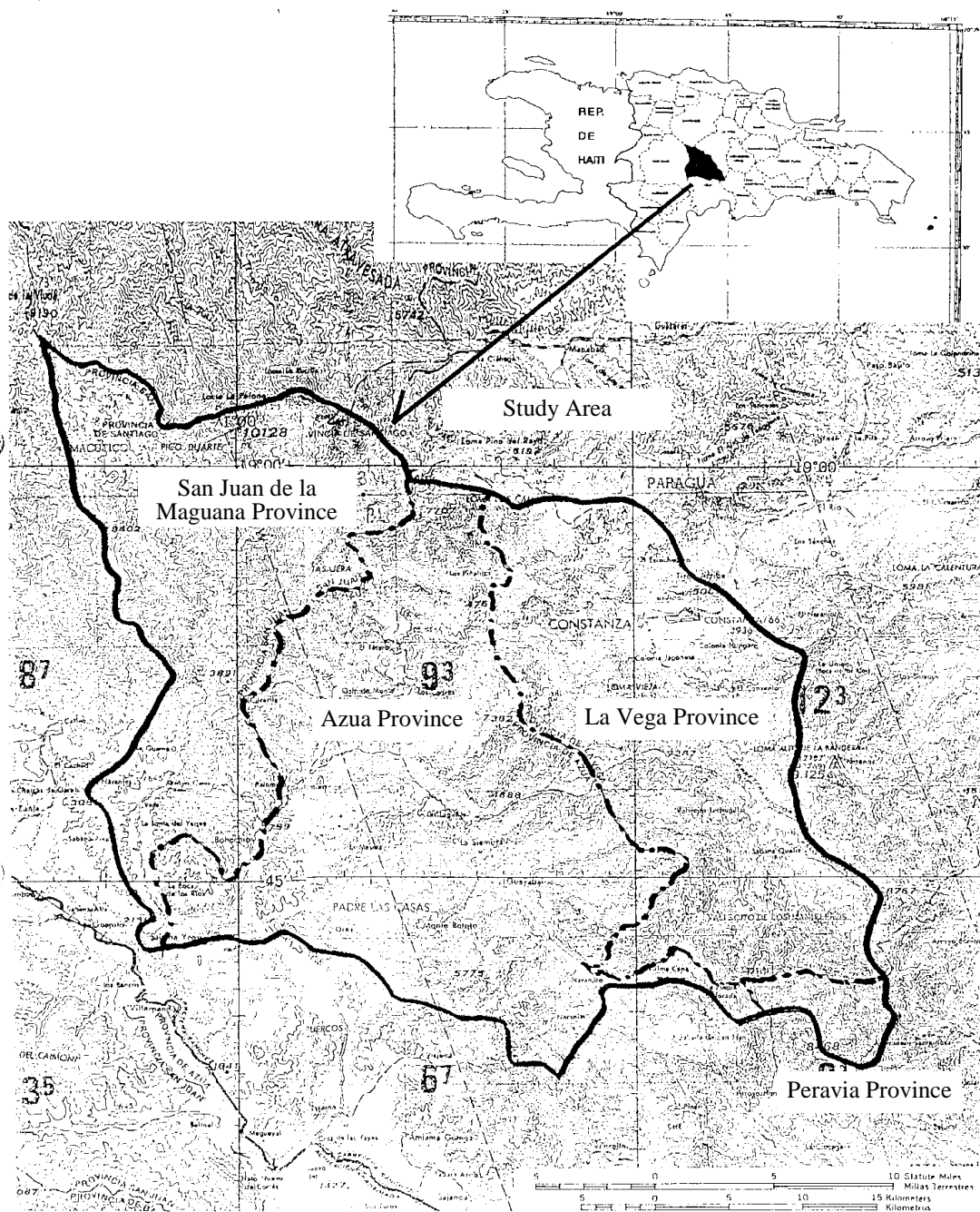


Fig. 1-1 Location Map of the Study Area



## **1.4 Scope of the Study**

The components of the Study in each study year are described below.

### **1.4.1 First Year of the Study**

(1) Preparatory Work in Japan

Preparation of the Inception Report; Technology Transfer Plan (Draft); Advisory Committee meeting (1)

(2) First Field Survey

Discussions on the Inception Report; survey on the general socioeconomic conditions; community (village) workshop; forest fire control measures (Part 1); survey on the general agricultural and forestry conditions; survey on human resources development; GIS application; preparation and explanation of the Progress Report

### **1.4.2 Second Year of the Study**

(1) Second Field Survey (Part 1)

Survey on the natural conditions and forest resources; start of the community project; forest fire control measures (Part 2); survey on cases of technology transfer in third countries; GIS input and analysis; decision on the formulation principles for the Master Plan; preparation and explanation of the Field Report; survey on project evaluation; preparation of the draft Master Plan; preparation of the Interim Report

(2) First Work in Japan

Advisory Committee meeting (2)

(3) Second Field Survey (Part 2)

Explanation of and discussions on the Interim Report; workshop on the formulation of the Master Plan and GIS; continuation and evaluation of the community project

(4) Second Work in Japan

Preparation of the Draft Final Report; preparation of various manuals (draft); Advisory Committee meeting

### **1.4.3 Third Year of the Study**

(1) Third Field Survey

Explanation of and discussions on the Draft Final Report and various manuals (draft);  
technology transfer seminar

(2) Third Work in Japan

Preparation of the Final Report; finalisation of various manuals

## **CHAPTER 2    MASTER PLAN FORMULATION APPROACH**

## **CHAPTER 2 MASTER PLAN FORMULATION APPROACH**

The adopted approach for the formulation of the Master Plan was firstly to examine the possibility of zoning for the formulation of such a plan which is suitable for the characteristics of the Study Area, the introduction of appropriate technologies and the participation of local residents. It was also decided to implement a demonstration project consisting of forest fire control work and a community project to ensure the rational formulation of the Master Plan. The finalised Master Plan reflects the results of (i) the examination of methods to strengthen the organization to implement the Master Plan so that the formulated Master Plan could be smoothly as well as effectively implemented and (ii) the evaluation of the effectiveness of the Master Plan, including the aspect of environmental care. GIS technology was used for zoning, for preparation of various thematic maps and the Master Plan maps. The transfer of technology to the counterparts was conducted as part of this approach to enable them to master the technologies and techniques required to formulate similar plans by themselves. The master plan formulation approach described above is shown in the schematic diagramme in Fig. 2-1.

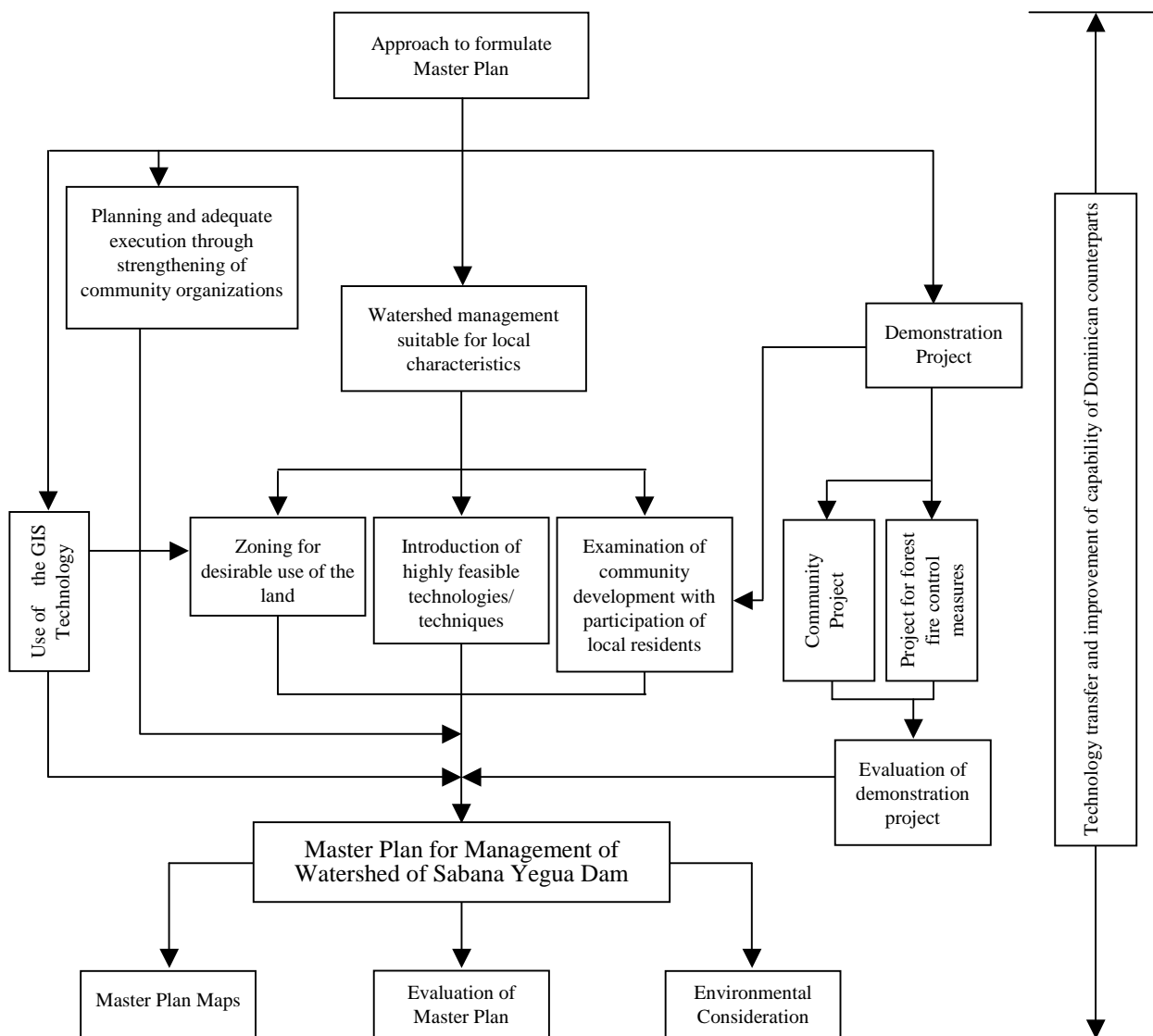


Fig. 2-1 Master Plan Formulation Approach

## 2.1 Formulation of Master Plan Suitable for Local Characteristics

Judging from the current conditions of the Study Area, the biggest factors for the decline of the water and soil conservation function are the disappearance and degradation of forests at sites suitable for forest, originating from disorderly land use in that farmland and grazing land have been created at those sites where land use other than forest should be avoided and that the creation of farmland has been in progress without the introduction of any conservation measures. The Master Plan in question was formulated by (i) introducing zones for the purpose of realising desirable land use as much as possible, (ii) introducing appropriate technologies/techniques based on the natural and socioeconomic conditions of the Study Area

and (iii) creating a highly feasible plan through careful examination of the participation of local residents and community development in the Study Area.

### **2.1.1 Zoning Aimed at Achieving Desirable Land Use**

Land use potential in the Dominican Republic is classified into eight classes from Class I with the highest potential to Class VIII with hardly any potential. Soil erosion and other risks increase from Class I to Class VIII coupled with increased land use restrictions. For the purpose of zoning, zoning criteria to classify the land use potential to suit the land conditions of the entire Study Area were prepared based on the land use potential classification in the Dominican Republic. The resulting land use potential zones were compared to the existing land use to identify unsuitable land use, such as shifting cultivation at sites suitable for forest use. Moreover, improvement targets for degraded forests were established and the desirable land use for watershed management were examined.

### **2.1.2 Introduction of Highly Feasible Technologies/Techniques**

For the realisation of desirable land use, (i) forest management techniques, (ii) agroforestry, (iii) simple erosion control measures and (iv) a forest fire control system, etc. were examined taking the local natural and socioeconomic conditions and the organizational set-up and strength, etc. of the Under-Secretariat for Forest Resources into consideration.

### **2.1.3 Examination of Local Residents Participation and Community Development**

From the technical point of view, the ideas described in 2.1.2 were applied to achieve the desirable land use. However, the participatory implementation of various projects was necessary to ensure the true effectiveness of projects and it was necessary to examine several issues by means of a survey on the rural socioeconomy, community workshops, demonstration projects and relevant cases in other areas. The subject issues were (i) incentives for resident participation, (ii) the desirable direction for community development, (iii) the grouping of local residents and (iv) extension methods and techniques.

## **2.2 Implementation of Demonstration Project for Formulation of Rational Master Plan**

### **2.2.1 Basic Concept of Demonstration Project**

The main objective of the demonstration project was to make the Master Plan reflect the achievements of the said project. In other words, the outcomes of the project components agreed by the Study Team members, C/Ps and local residents were checked to clarify whether or not such outcomes were compatible with the originally planned results. If not, the causes of failure were analysed to make the Master Plan more realistic and feasible.

However, it must be noted that the demonstration project was implemented in a limited period of approximately seven months from June to December, 2001. Given the fact that many watershed management measures require a much longer period for their fruition, it is inevitable that the achievements of the demonstration project were limited in one way or another.

### **2.2.2 Contents of Demonstration Project**

#### **(1) Forest Fire Control Project**

In this forest fire control project, the reality and causes of forest fires in the Study Area were investigated with a view to providing guidance on initial fire-fighting for local forestry personnel, strengthening the monitoring system and organizing voluntary fire corps, etc. Workshops were held for local residents to examine a feasible monitoring and fire extinguishing system with resident participation. Furthermore, guidance was provided on fire prevention for local forestry personnel and local residents and meetings to demonstrate pumping skills were held to confirm the achieving of skill transfer to local forestry personnel.

#### **(2) Community Project**

Based on the results of the socioeconomic survey on villages in the Study Area, community workshops were held to determine the framework for the community project, the subject villages and the project contents. In the selected villages, local consultants were used to decide and implement workshops with various purposes, planting and agroforestry, etc.

### **2.2.3 Evaluation of Demonstration Project**

The demonstration project was prepared and some of its contents were implemented in a period of approximately seven months with the aim of making the Master Plan reflect the project achievements. Accordingly, evaluation of the project features the sustainability and self-manageability of the project through the continual participation of local residents, the suitability of the project and the impacts of the project based on the project results.

The focus of this evaluation was primarily placed on the sustainability and self-manageability of the project, necessitating evaluation from the technical, organizational, social and economic viewpoints. Given the participatory character of the project, the intentions and opinions of local residents were taken into consideration to ensure the comprehensive evaluation of the project.

## **2.3 Implementation of Appropriate Policies and Master Plan through Organizational Strengthening**

### **2.3.1 Organizational Strengthening Based on Master Plan Targets**

In the Dominican Republic, forest and forestry administration has gone through a transition under which the strict forest protection policy which was a reaction to disorderly cutting in previous times was replaced by a policy to insure rational as well as sustainable forest use. Apart from the implementation of participatory forest management projects by NGOs and others, the Forest Law (Law No. 118-99) was enacted in 1999, declaring sustainable forest use by means of forest development to be an important target for the forest and forestry administration. In 2000, the Law to Establish Secretariat of State for Environment and Natural Resources (Law No. 64-00) was enforced and the Under-Secretariat for Forest Resources was created under the Secretariat of State for Environment and Natural Resources, indicating gradual improvement of the institutional set-up. As a result, the planning and execution of policies based on the idea of rational forest management can be expected to take place.

### **2.3.2 Examination of Implementation of Master Plan**

The implementation body of the Master Plan to be formulated by the Study is the Under-Secretariat for Forest Resources of the Secretariat of State for Environment and Natural Resources. This Under-Secretariat is the main administrative body dealing with forest and forestry affairs in the Dominican Republic. As the Under-Secretariat is responsible for forest management, which is the main element of watershed management, it is deemed to be the most suitable administrative body to implement the Master Plan.



The budget for the Master Plan should, in principle, be appropriated under the budget for the general account of the Government of the Dominican Republic and external funding by foreign governments and international aid organizations and the use of the National Forest Fund, etc. should be considered if necessary. The possibility of securing loans from agricultural banks to finance agroforestry and other agriculture-related projects was also examined. Use of the income from the sale of seedlings at community nurseries was also considered to provide the necessary funds for community development.

The project implementation period naturally varies depending on the planned contents of a specific project. However, as reforestation and agroforestry are believed to be the main projects under the Master Plan, their respective periods are determined taking the species to be planted or cultivated and the period required to harvest the crops into consideration. The planting of not only local species but also fast-growing species is examined to plan as early a harvest as possible. As harvesting based on agroforestry is possible during the period of tree growth, the project implementation period was principally examined on the basis of the period required for the harvesting of trees.

## **2.4 Evaluation of Master Plan**

For the evaluation of the Master Plan, the conservation effects in the upper reaches of the Sabana Yegua Dam are conceptually identified to examine the likely effects of watershed conservation as a result of the implementation of the Master Plan.

The watershed conservation effects are classified into the internal economic effects arising from agricultural and wood production and the external economic effects, including the headwater conservation effect, soil discharge prevention effect and CO<sub>2</sub> absorption effect. The latter is also described as the public benefit function of which the beneficiaries are not only people in the subject area of conservation but also the general public.

In areas such as the Study Area where there is an urgent need for forest restoration, the focus must be placed on the importance of the public benefit function rather than the economic efficiency of investment. While the anticipated effects of the implementation of the Master Plan are quantified as much as possible, those effects of which quantification was difficult were assessed qualitatively.

The economic impacts of the implementation of the Master Plan on local residents were examined in line with the policies and contents of the various plans to be formulated under the Master Plan.

## **2.5 Utilisation of GIS Technologies**

For efficient assistance for the formulation of the Master Plan covering a wide area, a GIS database was created. The main objective of applying GIS technologies to the Study was not restricted to the creation of a Master Plan support database but also include monitoring utilising the said database. In addition, the transfer of system operation and maintenance techniques was considered in view of the possible upgrading of the database in the future.

There were several types of work involving GIS: (i) selection and installation of hardware and software, (ii) base map input and output, (iii) input of village distribution and road map, land use and forest type map, potential land use and forest type map, soil map and watershed map, (iv) structural configuration and creation of the database, (v) decision on retrieval criteria and analysis using such criteria and (vi) support for the planning of the Master Plan, including the preparation of the Master Plan maps. These Master Plan maps incorporated watershed boundaries, administrative boundaries, legislative boundaries, forest categories, agroforestry practice, farmland, roads and villages, community nurseries and others and a sheet listing these items was attached.

## **2.6 Technology Transfer and Improvement of Capability of C/Ps**

For the proper implementation of the Master Plan by government organizations in the Dominican Republic, the C/Ps assigned to the Study must acquire not only the necessary technical expertise to formulate watershed management plans but also sufficient capability to implement such plans. It is this requirement which necessitates the transfer of techniques, etc. to the C/Ps through OJT on the formulation of the Master Plan, survey on technology transfer in a third country and technology transfer seminar, etc. This technology transfer is conducted through direct guidance and workshops during the field survey period and the subject technologies/techniques to be transferred are determined for the specialist field of each member of the Study Team.

Although it is extremely difficult to evaluate the degree of achievement of technology transfer based on quantitative criteria, possession of the basic knowledge and capability to conduct a field survey was evaluated for each subject field of technology transfer at the beginning and end of the Study to check for any improvement. For this evaluation, the state of learning of technologies and techniques, etc. at the end of the Study was also checked.

**CHAPTER 3    CURRENT CONDITIONS OF  
FORESTS AND FORESTRY IN  
THE DOMINICAN REPUBLIC**

## **CHAPTER 3 CURRENT CONDITIONS OF FORESTS AND FORESTRY IN THE DOMINICAN REPUBLIC**

### **3.1 Forest and Forestry Policies**

#### **3.1.1 Forest Resources**

The latest data on forest resources can be found in the “Inventory Study on Land Use and Vegetation in the Dominican Republic (1999)” (Estudio Sobre el Inventario de Uso de la Tierra y Cobertura Vegetal en la República Dominicana). According to this study, the country has a total forest area of 13,266 km<sup>2</sup>, accounting for 27% of the national land area. The forest area consists of some 3,025 km<sup>2</sup> of needle-leaved forests, some 6,306 km<sup>2</sup> of broad-leaved forests, some 3,677 km<sup>2</sup> of dry forests and some 256 km<sup>2</sup> of wet forests. Based on this data, forests in the Study Area cover some 964 km<sup>2</sup>, accounting for approximately 7% of the national forest area. The forest ratio in the Study Area (1,670 km<sup>2</sup>) is approximately 57%, consisting of some 220 km<sup>2</sup> of needle-leaved forests, some 220 km<sup>2</sup> of broad-leaved forests and some 157 km<sup>2</sup> of dry forests. Compared to the national picture, the ratio of needle-leaved forests is high.

#### **3.1.2 Forestry Law**

The Law Concerning Conservation of Forests and Fruit Trees (Law No. 5856) was enacted in 1962 for the promotion of forestry and the conservation of forests and became the foundation for forestry administration in the Dominican Republic. At the same time, the Directorate General of Forestry was established pursuant to this law within the Secretariat of State for Agriculture. Following the enactment of the law, several laws relating to forests and forestry were enacted, culminating in the enactment of the Law Concerning Environment and Natural Resources (Law No. 64-00, promulgated on 18<sup>th</sup> August, 2000) which aims at preserving, protecting and/or improving the environment and natural resources for their sustainable use. This law upholds forests as an important component of the environment sector. Special consideration of forest preservation, protection and production are called for to achieve integrated forest management and sustainable forest use.

### **3.1.3 Forest Management Plan**

#### **(1) Current Situation**

The formulation of policies regarding rational forest management is relatively new as policies biased towards restrictions on cutting and the use of forests have long been pursued. The Law to Establish the National Institute of Forestry Resources enacted in December, 1999 stipulates that “A forest management plan is an entire body of technical criteria for the preparation of a plan and the utilisation, protection and restoration of forest resources to ensure permanent production based on the principle of the sustainable use of natural resources.” It is believed that this concept will remain unchanged under the new Forest Law after the ongoing review of the existing Forest Law based on the Law Concerning Environment and Natural Resources (Law No. 64-00) is completed.

The General Rules of Law No. 64-00 include a chapter on management plans, mainly specifying the rules to be referred to by private enterprises when they intend to formulate a forest management plan. The existence of such a provision suggests strong expectations of the role to be played by the private sector as an implementation body for commercial reforestation and forest conservation as a part of overall forest management. Following the introduction of these general rules for forest management, criteria for sustainable forest management and others have been prepared and await the approval of the superior authority.

#### **(2) Principal Ideas, Criteria and Indicators of Sustainable Forest Management**

The description of sustainable forest management refers to eight principal ideas, including the responsibility involved in forest management, the benefits of forests and the impacts of forest management. Criteria and indicators based on these ideas are also described. For Criteria 3.3 – Benefits for Local Residents under Principal Idea 3 which features the relationship between forest workers and local residents in particular, the relevant indicators include the creation of employment opportunities, communication with local residents and the protection of important sites for local communities, implying the importance of consideration for local residents in forest management.

#### **(3) Technical Criteria for Forest Management Plans**

The technical criteria for forest management plans are put forward based on the general rules, criteria and indicators mentioned above. The main technical criteria are outlined below.

1) Forest Survey

The criteria for compartments, size of a standard plot, mapping scale, forest survey method, management categories and data processing method are described as they are all necessary for the planning of a forest management plan.

2) Evaluation of Forest Management Plans

The review period of a plan, decision on the allowable annual cutting volume, state of regeneration and annual operation plan are described to allow examination of the plan contents.

3) Approval of Forest Management Plan

The procedure to formulate and implement a forest management plan is described. The approval of a forest management plan is left to an evaluation committee which is established for this purpose.

## **3.2 Reforestation**

### **3.2.1 Quisqueya Verde Plan**

This is a national greening plan which aims at improving the forest ratio and at restoring degraded land. This plan commenced in 1997 with the regreening target of some 314,500 ha of land in 20 years. In the four year period from 1997 to 2000, 28,890 ha of land were planted.

Planting is conducted by (i) NGOs, village communities, farmers' groups and other local residents, (ii) volunteers from churches and schools and (iii) foundations receiving a grant from the government budget. Planting tools and seedlings are provided free of charge to these groups and local residents are paid a wage.

This plan has been implemented in some villages in the Study Area, contributing to the rehabilitation of degraded land and a qualitative improvement of the local standard of living. Nevertheless, some technical and operational problems remain, including a poorly performing reforestation site at Las Lagunas in the Las Cuevas watershed due to the incorrect selection of the planting species and insufficient tending after planting.

### **3.2.2 National Reforestation Plan**

This new reforestation plan is due to start under the Secretariat of State for Environment and Natural Resources created in 2000. In FY 2001, planting is scheduled to be conducted over some 16,000 ha of land. Although the objectives and implementation method of this plan are similar to those of the Quisqueya Verde Plan, one difference lies with the funding method. The Quisqueya Verde Plan is funded by the Presidential special budget while the National Reforestation Plan is funded under the general account of the government. Negotiations are currently in progress to revise the budget as the original budget for this plan has been reduced due to financial difficulties faced by the government.

The Under-Secretariat for Forest Resources is due to commence implementation of the plan in three areas in the Study Area with the direct involvement of local residents. These three areas are (i) Padre Las Casas (approximately 410 ha), (ii) Sabana de San Juan (approximately 660 ha) and (iii) Arroyo Cano (approximately 350 ha). The planting species considered for the plan include such species for commercial forestry as pine (*Pinus caribea*, *Pinus occidentalis*), mahogany (*Swietenia mahogoni*) and cedar (*Cedrela odorata*) as well as fruit trees.

In February, 2001, the President announced socioeconomic development and employment promotion policies and a budget of 300 million Dominican pesos (approximately ¥2.1 billion) has been appropriated for reforestation.

### **3.2.3 Forest Preservation and Reforestation Promotion Measures**

#### (1) Forest Fund

The Forest Fund stipulated in Article 71 of Law No. 64-00 has five funding sources as listed below. This fund constitutes a funding source for the conservation of forest resources, promotion of agroforestry, forest fire prevention, promotion of forest and forestry-related studies and training and the development of forestry in addition to contribution to the general account.

#### ① Forest Fund Account

Fines from illegal cutting and income from cutting are paid into this account.

#### ② Seedling Project Account

Income from the sale of seedlings produced by forest management bureaus is paid into this account.

③ Los Gajito Project Account

Income from the sale of sawn timber is paid into this account. At present, no government sawmill is in operation and this account cannot be used.

④ Solidarity Fund

Donations and contributions made by the private sector and international organizations are channelled through this account to finance the work to rehabilitate hurricane damage and other purposes.

⑤ Project Investment Fund

In the budget for the Quisqueya Verde Plan, payments related to the Under-Secretariat for Forest Resources have been made through this fund.

### **3.3 Forest Products Industry**

#### **3.3.1 Wood Production**

Wood production in the Dominican Republic has continually declined since 1962 when a decree prohibiting cutting was issued and domestic wood consumption since the 1990's has been entirely dependent on imports. It is, therefore, essential for the Dominican Republic to improve its self-sufficiency rate by promoting reforestation projects in the coming years.

Hardly any market for domestically produced wood exists at present. Under the New Forest Plan, however, there are moves to clarify the rules for the transportation and sale of logs and the transportation routes in preparation for an improved wood production self-sufficiency rate.

#### **3.3.2 Firewood Production**

The consumption volume of charcoal has shown a rapid decline since 1991 due to the government policy of introducing alternative energies. The reality in some villages in the Study Area is that firewood is still collected from nearby forests for domestic consumption, presumably constituting one factor for forest degradation.



### **3.4 Human Resources Development System and Institutional Set-Up in Forestry Sector**

#### **3.4.1 Human Resources Development System**

##### **(1) School System in Dominican Republic**

Local public bodies, such as provincial governments and municipal authorities, are not directly involved in school education in the Dominican Republic as the Secretariat of State for Education is responsible for public education.

The school education system consists of (i) pre-school education (for 1 – 5 year olds), (ii) primary education (eight years starting at six years old), (iii) secondary education (four years starting at 14 years old) and (iv) higher education (university). Compulsory education lasts for nine years and consists of pre-school education for one year and primary education for eight years. There is no tuition fee for compulsory education at state schools.

Secondary education consists of two phases. In the first phase of two years, basic general knowledge is taught. The second phase of two years is divided into the general study course, i.e. preparatory course for higher education, and the technical course in which specialist skills are taught. There is no tuition fee for secondary education at state schools. In addition to general schools, secondary education has schools of commerce and technical schools.

There is a total of 32 universities nationwide with a total of some 250,000 students. The duration of higher education depends on the specific faculty or course, ranging from two years to six years. The Autonomous University of Santo Domingo is the only state university.

##### **(2) Training of Forestry Engineers**

The Instituto Superior de Agricultura (ISA) provides a forestry engineering course. Although this institute was originally established to train agricultural engineers, forestry-related subjects were introduced in the 1980's, leading to the introduction of the forestry engineering course in 1996. The ISA was created in August, 1962 in Santiago for the purpose of training experts on agricultural management and agricultural techniques. In addition to such courses relating to agriculture and forestry as agricultural science, veterinary science, forestry, food processing, biotechnology, agroforestry and management of natural resources, the ISA now also provides tourism business and

electronic engineering courses. Its campus is complete with dormitories, student canteens, sports grounds, experimental farms and other facilities.

Students of the ISA come from not only the Dominican Republic but also from neighbouring Haiti and other Caribbean countries. At present, the ISA has a total of some 450 students and some 2,000 students have so far graduated.

Forestry-related courses are also available at the UAFAM (Universidad Agroforestal Fernando Arturo de Meriño), the CDEP (Centro Dominicano de Estudios Profesionales) and the UNPHU (Universidad Nacional de Pedro Henriquez). The UAFAM has an agroforestry course while the CDEP has an agroforestry engineering course. Meanwhile, the UNPHU offers a master's degree course in forest science.

The ESNAFOR (Escuela Nacional Forestal) which is directly run by the Under-Secretariat for Forest Resources is a school specialising in forests and forestry. The ESNAFOR is located at Jarabacoa and was established in 1968 with the assistance of the FAO (Food and Agriculture Organization of the United Nations). It aims at training forestry engineers. Its main facilities are classrooms, library, dormitory, teachers' accommodation, experimental farm, cold storage (for seeds), sawmill, canteen and sports ground, etc. It has two courses to train forestry engineers and forest guards respectively. All students board at the school and both the tuition fee and boarding fee are paid in full by the government.

#### 1) Forestry Engineer Course

This course aims at producing forestry engineers and lasts for two and a half years (five terms of six months each). The enrolment requirements include the completion of secondary education, 25 years of age or younger and passing of the entrance examination. 30 – 35 applicants out of some 600 successfully enrol each academic year but only 20 – 25 complete the course. The institute has so far produced 120 graduates, all of which have been employed by the Under-Secretariat for Forest Resources on a preferential basis.

#### 2) Forest Guards Course

This course is designed to train field staff members of forest management bureaus and offices and lasts for three months. The enrolment requirements include the completion of primary education and 40 years of age or younger. Some 260 staff members have so far undergone this course.

Moreover, there are a large number of Dominican forestry engineers who underwent training at forestry related educational institutions in Honduras, Columbia, Chile, former Soviet Union, USA, etc.

### (3) Internal Training Systems

The training of staff members of the Under-Secretariat for Forest Resources is conducted by the Training and Extension Bureau of the said Under-Secretariat. The existing internal training systems are the forest guard course at the ESNAFOR mentioned above and the training course provided by the CECARENA (Centro de Capacitacion en Recursos Naturales).

Like the ESNAFOR, the CECARENA is located in Jarabacoa and has such facilities as an experimental forest, nursery and accommodation on its 8 ha of land. The training at the CECARENA mainly aims at the retraining of forest guards and workers among the staff members of forest management offices. The facilities were originally used for the training of staff members of the Secretariat of State for Agriculture but were transferred to the Under-Secretariat for Forest Resources following the reorganization of the Secretariat of State for Environment and Natural Resources in August, 2000. However, their further transfer to the Secretariat of State for Environment and Natural Resources is planned in the near future.

The internal training described so far is irregular training and there is currently no regular training for staff members of the Under-Secretariat for Forest Resources. Given the frequent transfer of staff members to different positions, the Under-Secretariat for Forest Resources does not have a systematic training system. As the transition to forest and forestry administration ensuring the rational and sustainable use of forests is in progress at present, the provision of systematic training for staff members is essential to not only improve the awareness of these staff members but also to enable them to acquire the capability to implement forest and forestry policies so that this transition backed by appropriate policies can be successfully achieved.

#### **3.4.2 Current Technical Level of the Counterparts**

Thirteen staff members, i.e. nine from the Under-Secretariat for Forest Resources, three from the Under-Secretariat for Water and Soil and one from the National Institute of Water Resources, were assigned to the Study as counterparts (C/Ps). All of them have at least a bachelor's degree, are currently working at government offices related to watershed management and are excellent personnel with experience of work related to watershed

management. Although they have been assigned to their current positions as appropriate experts, the details of their past work obviously differ from one to another. As a result, their technical level as counterparts also varied at the commencement of the Study.

The general technical expertise of the C/Ps is described below based on the findings of an interview survey conducted with them during the first field survey period in the second year of the Study.

In general, all of the C/Ps have sufficient basic knowledge of watershed management and various surveys and are capable of conducting not only the planning and preparation of surveys but also the actual implementation of surveys. However, they appear to be weak in data gathering and processing. In particular, they have little experience of quantitatively analysing survey data and of compiling the analysis results in the form of a manual, etc., indicating the necessity for the priority transfer of techniques in these fields. In regard to specialist and individual fields, their experience of (i) implementing integrated measures where individual techniques related to forest fire prevention and agroforestry, etc. are applied to actual sites, (ii) preparing forest type maps and vegetation maps and (iii) the advanced use of GIS appears to be insufficient. Improvement of the technical level of the C/Ps is desirable as a result of smooth technology transfer through the Study and the demonstration project over a period of one year and several months.

### **3.4.3 Institutional Set-Up**

#### (1) Administrative Structure of Central Government

##### 1) Administrative Structure of Dominican Republic

The administrative system of the Dominican Republic is headed by the President under whom 16 Secretariats of State, including those for Finance, Foreign Affairs, Education, Agriculture and Environment and Natural Resources, etc. are set up.

Both the President and the Vice-President are directly elected to serve a term of four years. Although they are not allowed to stand for re-election, they can again run as candidates after a four year absence. The Secretary of each Secretariat of State is appointed by the President and the centralised administrative structure is also underlined by the direct control of each Secretariat of State which has 7 – 8 local offices each.

## 2) Local Administrative Structure

The local administrative structure in the Dominican Republic consists of one National District and 30 provinces. In each province, there are municipalities, municipal districts, sections and villages (Paraje).

Provincial governors are appointed by the President while the heads (Sindico) of municipalities and municipal districts are directly elected as in the case of the President. In addition, councillors (Regidor) are elected in municipalities and municipal districts to discuss administrative affairs. The heads of municipalities and municipal districts appoint heads (Alcardo) of sections and villages and provide guidance on and supervise the administrative affairs of sections and villages. As such, local administration in the Dominican Republic is practically in the hands of municipalities and municipal districts. There is an organization called the National Council of Municipalities (Liga Municipal) established by municipalities and municipal districts nationwide. This council acts as a window for its members to the central government. Some 12% of the central government budget is channelled through this council for allocation to municipalities and municipal districts. Provinces are not essentially involved in administrative activities and play only a coordinating role between the municipalities and municipal districts in each province. As there is no formal administrative link involving provinces, provinces do not provide either guidance or subsidies, etc. for municipalities or municipal districts.

The main functions of municipalities and municipal districts are (i) construction and maintenance of roads, (ii) fire service, (iii) construction of housing and supply of the relevant equipment and materials and (iv) cleaning and garbage collection. School education, the police and health care and hygiene services are provided by local offices of the Secretariat of State for Education, Secretariat of State of the Interior and Police and Secretariat of State for Public Health respectively.

## (2) Administrative Structure for Forestry

Up until the end of 1999, the forestry administration of the Dominican Republic was in the hands of the CONATEF (National Technical Forest Commission) and the DGF (Directorate General of Forestry). In December, 1999, the National Institute of Forest Resources (INAREF: Instituto Nacional de Recursos Forestales) was established through merger of the above mentioned two organizations pursuant to Law No. 118-99 which inherited the entire roles and authority of these two organizations. Further administrative reform was carried out in 2000 in connection with the establishment of the

Under-Secretariat for Forest Resources. Following the enactment of Law No. 64-00 in August of the same year, the said National Institute became part of the Under-Secretariat for Forest Resources of the Secretariat of State of Environment and Natural Resources along with the former Under-Secretariat for Natural Resources and the Directorate General of Parks of the Secretariat of State for Agriculture, the Department of Environment of the National Planning Office, the National Institute of Environmental Protection and the Land Protection Office of the Secretariat of State for Public Works.

The newly established Secretariat of State for Environment and Natural Resources consists of five Under-Secretariats responsible for environmental management, water and soil, conservation of biological diversity, coastal and oceanic resources and forest resources respectively, integrating the former government offices related to the environment and natural resources.

The Under-Secretariat for Forest Resources consists of two units in charge of legal affairs and management/finance respectively and five administrative departments. However, work is still in progress between as well as within each Under-Secretariat of the Secretariat of State for Environment and Natural Resources to determine the scope of jurisdiction. On its part, the Under-Secretariat for Forest Resources is reviewing its own jurisdiction and internal organization with a view to their formalisation in the form of a new forest law.

The internal organization of the Under-Secretariat for Forest Resources as of March, 2002 is shown in the following table.

Forest Planning and Policy Administration	<ul style="list-style-type: none"> <li>• Department of Forest Policies</li> <li>• Department of Planning</li> <li>• Department of Institutional Development</li> <li>• Department of Information</li> </ul>
Reforestation Management Administration	<ul style="list-style-type: none"> <li>• Department of Watershed Management</li> <li>• Department of Reforestation and Management</li> <li>• Department of Seedling Production</li> <li>• Department of Natural Forest Management</li> </ul>
Investigation and Training Administration	<ul style="list-style-type: none"> <li>• Department of National Forest School</li> <li>• Department of Extension</li> <li>• Department of Investigation</li> <li>• Department of Training</li> </ul>
Forest Protection Administration	<ul style="list-style-type: none"> <li>• Department of Forest Fire Prevention and Control</li> <li>• Department of Diseases and Pest Control</li> <li>• Department of Forest Surveillance</li> </ul>
Forest Operation Administration	<ul style="list-style-type: none"> <li>• Department of Coordination (8 Forest Management Bureaus)</li> </ul>

### (3) Organizational Structure and Functions of Forest Management Bureaus and Offices

#### 1) Organizational Structure

The bodies responsible for forestry administration and operation in local areas in the Dominican Republic are the eight forest management bureaus (Gerencia) of the Under-Secretariat for Forest Resources. Each of these bureaus controls 4 – 8 forest management offices (Sub-Gerencia) and forest stations (Zona) are established under the forest management offices if necessary. There is a total of 37 forest management offices and 12 forest stations nationwide. These offices and stations differ from each other in terms of the responsible area for management, size of organization and degree of relative importance.

#### 2) Functions

As described above, the forest management bureaus have personnel in charge of reforestation, production, extension and forest fire control in addition to personnel responsible for general administration and legal affairs. At some forest management bureaus, forest management officers are deployed. Under the supervision of the forest management bureaus, the forest management offices and forest stations are mainly engaged in forest fire prevention, law enforcement to prevent illegal cutting and the promotion of reforestation.

For forest fire control there is the National Programme for Forest Fire Prevention and Management under which seven regional forest fire bureaus are established all over the country. These bureaus exist in the regional forestry bureaus and forest management offices where forest fires occur frequently. Moreover, more than one fire company is stationed at each forest management office. In addition, monitoring towers are located at strategic points for the prevention and early detection of forest fires. The burning of farmland by local farmers, which is a major cause of forest fires, must be notified in advance to a forest management office. The handling of such notifications and witnessing at burning sites constitute important duties of staff members of the forest management offices.

There are random patrols of villages and forests by staff members of the forest management offices to prevent illegal cutting in forests. When illegal cutting is discovered, the cut and hauled wood is confiscated and those responsible for illegal cutting are prosecuted.

There has been much emphasis on the promotion of reforestation in recent years and those in charge of reforestation and extension educate private forest owners and others on the importance of reforestation for soil conservation and headwater conservation. These officers also provide guidance on the method to prepare planting plans and the procedure to prepare applications for permits to cut planted trees in the future for those planning to plant trees. They also arrange the supply of free seedlings and volunteers for planting work.

Reorganization of the forest management bureaus is planned to establish several regional environmental bureaus which will be responsible for implementing the duties of the five Under-Secretariats as regional administrative bodies directly controlled by the Secretariat of State for Environment and Natural Resources. At present, discussions are in progress on the prospective jurisdiction, internal structure and other issues relating to these new bureaus.

### **3.5 Existing Projects**

#### **(1) Outline of Existing Projects**

Many different types of projects have been carried out through the cooperation of various aid organizations in the Dominican Republic. A survey was made of those projects with components that were similar or related to the main purpose of this Master Plan. The survey was done as a series of interviews and field visits made to the projects. A description is given below of the seven major projects surveyed. They fall within one of the six following formats. Table 3-1 lists the essential issues considered in the Master Plan.

- Project executed under Dominican government leadership with a loan from an international funding organization : PRODAS
- Project executed by bilateral foreign aid : PROCARYN
- Project executed by governmental land groups : Plan Sierra, Plan Cordillera
- Project executed by an international NGO : PRODAZ
- Project executed by a domestic NGO : ADESJO
- Project executed by community initiatives : ASADA



Table 3-1 Overview of Major Projects in Execution

	Location	Major Aid Institution	N	RF	AF	SI	MC	Main Characteristics
PRODAS	Sabaneta watershed region	IDB						Large scale; 5yr. period; Main focus on rehabilitation of dam and downstream region; Empowerment of community organizations
PROCARYN	Yaque del norte watershed region	GTZ						A new project; Purchase of community produced seedlings, and adaptation of reforestation incentives
Plan Sierra	Northern part of central mountain region	Government and international aid agencies.						Forestry, rural development, and long-term involvement in an integrated approach
Plan Cordillera	Northern part of central mountain region	Government and international aid agencies.						Emphasis on environmental education
PRODAZ	Cotui area	International NGO						Small scale forestry, farm forests in an integrated approach
ADESJO	Ocoa area	Church and GTZ, etc.						Rural development, slopland irrigation, long-term commitment in an integrated approach
ASADA	Los Dajao	International and national aid organizations						Oriented to self-help and self-development; continuous research on alternative agriculture and rural development

Note: N: Nursery, RF: Reforestation, AF: Agroforestry, SI: Slopland Irrigation, MC: Micro Credit

## (2) Self-help Effort and The Importance of Organization

ASADA (Asociacion Agricola de Los Dajaos), in Los Dajao, which is focused on self-help and self-development, presents the best example of community development. This community has a long history of shifting cultivation agriculture. However, it has achieved extraordinary results in its search for alternative agriculture that both conserves forest resources and improves living standards. The most important aspect of ASADA is seen in its ability to secure funds for its development. ASADA was not formed by any outside organization such as governmental or non-governmental institutions, but was created by the community itself. Through their own efforts, they have received aid from different national and international organizations.

A good example of community organization is seen in the efforts of ADESJO (Asociación para el Desarrollo de San José de Ocoa, Inc.). ADESJO's most important

results were its community oriented projects which encouraged communities to abandon shifting cultivation agricultural practices and charcoal production by laying PVC irrigation pipes to establish permanent agricultural production systems that could reduce the pressure to expand agricultural lands and in turn conserve forest resources. ADESJO emphasizes empowering community organizations when starting its project in a community as a means to ensure project results. The financing for PVC irrigation pipes has been provided by ADESJO. Communities that received financing from the NGO is now paying back their loan under a contract. The participating communities also provided the labor for laying the pipes with the NGO supervising the technical aspects. Some communities established as much as 14km of irrigation pipes. The process of developing this type of community involved projects helped to create community consensus among participants.

PRODAS (Programa de Desarrollo Agrícola en San Juan de la Managua) also shows a good example of community organization. PRODAS created an Agroforestry Development Committee (CDA: Consejo de Desarrollo Agroforestal) in each community when it started its activities. It uses this organizational mechanism in a community development scheme that combines micro credit, sheep breeding, and continuous community activities.

PRODAZ, a project by Enda Caribe, an international NGO, demonstrates a good example of strengthening community organizations. The project not only established a sawmill, but also established a lumber sales system by strengthening community organizations. It promotes community independence through self-help initiatives.

### (3) Conversion from Swidden Agriculture

From the viewpoint of watershed conservation, shifting cultivation agriculture is one of the main problems in the study area. The above-mentioned ASADA (Los Dajao) and ADESJO (Ocoa) are successful examples of the abandonment of shifting cultivation agriculture through the implementation of community based projects. Through the consensus of the entire village, these two communities abandoned the traditional agricultural method in exchange for implementing PVC irrigation on sloped land. ADESJO also developed organic farming systems in participating communities with the assistance of a JICA expert on the organic fertilizer, Bocashi. At the same time, ADESJO implemented a micro-credit system for purchasing seeds and agricultural material, such as fertilizer and equipment, in order to encourage the shift from traditional agriculture. The project also assists in improving agricultural techniques used by participating farmers when they introduce new crops.

Los Dajao has tried to shift to intensive agriculture in order to increase income from smaller land area by cultivating highly profitable products such as strawberries. Also, in Los Dajao, coffee production became profitable through emphasizing organic coffee and establishing their own original marketing network, in spite of the fact that in other areas many coffee producers had abandoned coffee production due to the collapse of coffee prices.

(4) Long-term and Flexible Project Management

The important characteristics of the successful projects mentioned above, such as Plan Sierra, PRODAZ by Enda Caribe and ADESJO, are their long-term commitment and their integrated approach to rural development. These organizations do not have a rigid timeframe for their projects and they are flexible in the application of the original plan. Their management is flexible and oriented toward local management, and their project plans have been executed with feedback from the constantly changing community needs and environment.

(5) Cooperation and Technologies Needed in Project Activities

The Study Team also visited many projects, organizations, and farmers outside the Study Area, and in the process acquired useful technologies and insights that could be applied in the implementation of this Master Plan. The following are several areas that hold promise for future cooperation with other organizations, and for introducing technological innovations.

1) Bocashi: Organic Fertilizer Manufacturing by JICA Pilot Project in Constanza

A JICA expert dispatched to Constanza established a 3-year pilot project for manufacturing Bocashi organic fertilizer starting in 1997. Currently, a large-scale factory for producing Bocashi is being constructed in La Vega. Since organic fertilizer is a very important element in promoting the shift from traditional agricultural system to permanent land-use agriculture, the know-how gained from the pilot project in Constanza should be applied in other areas. At the same time, the technology can also be used to produce pyroligneous acid by burning rice hull.

2) PRODEFRUD

PRODEFRUD is a subordinate organization of the Secretariat of State for Agriculture that specializes in fruit production. Demonstrative projects in six villages received free fruit seedlings from this organization. A study team confirmed that PRODEFRUD will cooperate with the Secretariat of state for Natural

Resources and Environment once the Master Plan is initiated. Cooperation also needs to be established with PRODEFRUD to obtain not only free fruit seedlings, but also seeds and technical assistance.

3) CODOCAFE

CODOCAFE is another subordinate organization of the Secretariat of State for Agriculture, similar to PRODEFRUD, but which specializes in coffee production. Los Frios, one of the six villages of the demonstration project, established a coffee nursery with CODOCAFE's support. The nursery became successful enough to hire local staff for its management. The Study Area is one of the major coffee production areas in the Dominican Republic, and coffee production contributes the major source of coffee farmers' income. CODOCAFE is actively promoting the establishment of new coffee nurseries in the Study Area. Thus, further cooperation should be sought with this organization.

4) Church Organizations

More than 90% of the population is Christian, and each community is strongly bound to its church which also provides for the community's social needs. For example, in Los Frios the church organization helped to build a community clinic and community center; in El Recodo it helped to construct a church and nursery school. For many communities, the clergy is their contact point with outside organizations that could potentially provide help to the communities. Thus, maintaining communication with the church will be important once the Master Plan enters into implementation.

5) Cooperation with Governmental and Non-Governmental Organizations

There are many governmental and non-governmental organizations that work for and assist community development in the Dominican Republic. For example, PRONATURA provides hydroelectric generators that can function by using PVC irrigation pipes; INFOTEC assists in teaching soil conservation and grafting techniques. The PLAN INTERNATIONAL gave financial support to the community of La Guama to build schools. This organization also provides assistance in securing water supply.

There are many such organizations, including Plan Sierra and ADESJO mentioned above, which normally receive financial support from both national and international organizations dedicated to assisting in community development.

Thus, cooperation with existing organizations will be an important part of promoting the improvement of community infrastructure and the extension of useful farming techniques.

6) Bamboo Cultivation and Handicrafts Supported by Taiwan International Cooperation

The government of Taiwan provides technical cooperation in bamboo cultivation and handicrafts in several regions of the Dominican Republic. Bamboo is a popular species among farmers. Since the Taiwan International Cooperation is currently planning to establish their extension work in the Constanza region, discussion will be needed for future cooperation in acquiring seedlings, establishing nurseries, and gaining knowledge in cultivation techniques, and processing technology. Regarding bamboo handicrafts, several JICA Oversea Volunteers to ADESJO have experience in this matter. Therefore, ADESJO could also provide technical support in this area.

7) Brick Making in the Forestry School and PROGRECIO

One of people's needs in the Study Area is the repair of their houses. However, it is difficult to acquire wood due to the lack of trees that can be used for construction purposes. Currently, material available for house repair is cement, blocks, tin, and dead trees. But farmers in the Study Area also have difficulty in purchasing these materials. Therefore, one of the problems is to find alternative construction material. Many farmers are interested in planting trees for the purpose of repairing their houses, but the long-term commitment needed from tree planting to harvest is one of the main factors discouraging people from planting trees.

One of the promising activities is brick making. The Forestry School in Jarabacoa, and PROGRECIO, a NGO, have simple brick-making machines that are operated manually. They have promoted this technology as a means to ease the pressure on illegal lumber cutting. Especially PROGRECIO has achieved success in its area of activity. Therefore, this technology should be introduced in order to meet people's short-term needs for construction material.

## **CHAPTER 4    PRESENT SITUATION OF THE STUDY AREA**

## CHAPTER 4 PRESENT SITUATION OF THE STUDY AREA

### 4.1 Present Situation of Sabana Yegua Dam

#### 4.1.1 Outline of the Dam

The Sabana Yegua Dam was completed in 1978 and began to store water the following year. The specifications of the dam are described below.

Purpose	Supply of water for irrigation and domestic use; power generation; flood prevention
Original Water Storage Capacity	$479.9 \times 10^6 \text{m}^3$
Type	Centre core-type rock fill
Size	Height: 94 m; Length: 1,159 m; crown elevation: 400 m
Reservoir	Length: approx. 7.2 km; width: approx. 4.6 km; water depth: approx. 60 m
Maximum Generated Energy	13,000 kW

Compared to the situation prior to its construction, it has significantly contributed to the mitigation of flooding in the lower reaches. The dam also supplies irrigation water for approximately 8,269 ha of land on both banks of Yaque del Sur River in its downstream, benefiting some 4,400 farming households.

#### 4.1.2 Sedimentation at the Dam

As described earlier, part of the sediment discharged by various types of soil erosion and landslides in the Study Area flows into rivers and is eventually deposited in the dam together with sediment originating from bank erosion, reducing the water storage capacity of the dam.

An INDRHI estimate puts the sedimentation volume at the Sabana Yegua Dam at approximately  $57.6 \times 10^6 \text{m}^3$  in the 13 years from 1979 to 1992. This figure is equivalent to some 12% of the original water storage capacity ( $479.9 \times 10^6 \text{m}^3$ ) of the dam and means an annual decline of the dam's water storage capacity by approximately 0.92%.

The INDRHI estimates that flooding caused by Hurricane George in 1998 deposited some  $25 \times 10^6 \text{m}^3$  of sediment at the dam. This means that a sediment volume which would normally be deposited at the dam over a period of 5.5 years was deposited at the dam in several days. Combining the deposited volume over 13 years and that caused by Hurricane George ( $57.6 \times$

$10^6\text{m}^3 + 25 \times 10^6\text{m}^3 = 82.6 \times 10^6\text{m}^3$ ), it is estimated that the original water storage capacity of the dam has now decreased by 17.2% ( $82.6 \times 10^6\text{m}^3 \div 479.9 \times 10^6\text{m}^3$ ).

Assuming an annual decrease of the dam's water storage capacity by approximately 0.92% from 1992 to 2000, excluding the sedimentation caused by Hurricane George, the capacity has decreased by 7.3% in these eight years, resulting in an overall decrease of the dam's water storage capacity by some 24.5% up to 2000 from its original capacity.

## **4.2 Natural Conditions of the Study Area**

### **4.2.1 Meteorology**

The Study Area is dominated by a maritime tropical climate although there are considerable variations from one area to another because of the specific climatic features associated with an island, the area's highly undulating topography with an elevation range of 400 m to 3,000 m and the strong influence of trade winds.

The Study Area is located to the southwest of the ridgeline of the Central Mountain Range which forms the backbone of Hispaniola Island and runs from northwest to southeast. The wet trade wind from the Atlantic Ocean lying to the northeast blows into the northeastern side of the Central Mountain Range, producing rain clouds. As a result, the highland area which is located in the north and the east of the Study Area and which is part of the Central Mountain Range has a cool and wet climate. However, most of the Study Area situated to the southwest of the Central Mountain Range is characterised by high temperatures and low humidity with lower rainfall despite the tropical climate as the trade wind has become dry by the time it reaches there. In general, the rainy season lasts from May to October while the dry season is from November to March. There is a minor dry season in July in the middle of the rainy season. Tropical depressions and hurricanes from the Caribbean Sea to the south hit the island in September and October.

The mean monthly temperature and the mean annual temperature at Constanza, which is located in the northeastern part of the Study Area in a basin (El. 1,164 m) along the Central Mountain Range, are 16 – 20°C and 18.5°C respectively. The area is relatively cool because of the mountain climate and the annual temperature fluctuation is small because of the influence of the tropical climate. The annual rainfall is 936 mm and the annual number of rainy days is 102 days with low rain intensity. The precipitation tends to rapidly increase towards the highland, reaching almost 2,000 mm a year in some years.



Meanwhile, the annual precipitation and the annual number of rainy days at Padre Las Casas, located on lowland (El. 510 m) in the southwestern part of the Study Area and near the Sabana Yegua Dam, are 725 mm and 75 days respectively. Although temperature data is unavailable, the mean monthly temperature is estimated to be around 23°C. Compared to Constanza in the northeast, Padre Las Casas is hotter and dryer and some rain is highly intense.

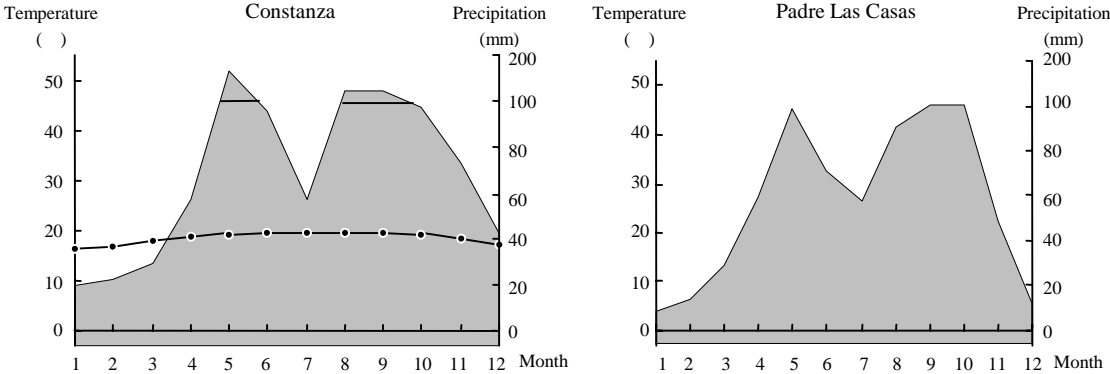


Fig. 4-1 Temperature and Precipitation (mean annual value)

**4.2.2 Forests and Vegetation**

(1) Forest Distribution

Forests in the Study Area reflect the different climatic conditions and are largely classified as needle-leaved forests, broad-leaved forests and dry forests.

Most needle-leaved forests are natural forests of pine (*Pinus occidentalis*) and are distributed from El. 800 m along the Central Mountain Range to Mt. Duarte (El. 3,175 m), the highest mountain in the range. Based on the crown density, pure pine forests are sub-divided into closed forests (crown density of 60% or higher), open forests (crown density of 40% or higher but less than 60%) and sparse forests (crown density of less than 40%). Pine trees are relatively low with a height of 10- 12 m near the summit of Mt. Duarte while pine stands in other areas frequently show a tree height of 18 – 20 m and spots with over-mature pine stands with a tree height of some 30 m are also observed.

Broad-leaved forests can also be classified into three types based on the elevation and climatic conditions. One type is cloud forests which have developed in areas covered by mist or gas (stratus) which emerges on the hillsides of the Central Mountain Range as air blown by the easterly wind undergoes an expansion and cooling process during its uplift

around the said mountain range. Another type is humid forests which are distributed in areas with an elevation of 500 – 2,000 m. Finally, semi-humid forests are distributed between cloud forests and dry forests. Except for those forests which have survived along drainages, the tree height of these forests is approximately 5 – 8 m. These forests have been formed at former shifting cultivation sites or former forest fire sites.

Dry forests are distributed below an elevation of 500 m, mainly between the dam site and Padre Las Casas.

Forests in the Study Area have been greatly reduced due to their conversion to farmland for shifting cultivation and to grazing land, etc. and sizable forests are only found in protected areas along the Central Mountain Range.

## (2) Stand Structure

In mature pine forests, many young naturally generated seedlings can be observed among the undergrowth. In contrast, the undergrowth mainly consists of shrubs and ferns in places with strong sunlight due to large gaps in the crown. In the case of stands damaged by forest fire or those where grazing takes place, not only young seedlings but also shrubs are hardly seen and the ground surface is covered by such plants with an extensive root system as jaragua (*Melinis enatiflora*) and Papon or ferns. Local pine trees are said to produce high quality seeds every 3 – 4 years. This means that once young and lower story pine trees have been destroyed by forest fire, their regeneration is difficult because of the thick growth of grass and ferns covering the ground surface before the regeneration of pine can take place.

Among broad-leaved forests, cloud forests are often dominated by Palo amarillo (*Exostema elegans*) and Anicillo (*Peperonia margina*). There is lush growth of tall ferns of 50 – 60 cm in these forests and the forest floor is covered by moss. In the case of humid forests, medium diameter species, such as Caoba (*Swietenia mahogani*), Guama (*Inga vera*) and Guacino (*Guazuma ulmifolia*), are observed along drainages. These species are, however, rare at abandoned shifting cultivation sites and former forest fire sites where trees of 5 – 6 m in height and shrubs grow side by side. Grazing is conducted in most semi-humid forests. Cattle love the leaves and fruit of Canburon (*Acacia macracantha*) and its seeds contained in the cattle dung germinate to cover these forest areas.

Dry forests are dominated by such shrubs as Guayacan (*Guajacum officinale*) and Bayahunda (*Prosopis juniflora*) which regenerate by sprouting. The height of these species is up to 3 – 4 m. The undergrowth often contains Wasabara with sharp thorns.

Table 4-1 List of Sample Plots

Forest Type	No. of Sample Plots	Land Conditions				Forest Conditions					
		Slope (°)	Elevation (m)	Bearing	Soil	Forest Layer Structure	Regeneration	No. of Trees (ha)	Ave. DBH (cm)	Average Height (m)	Volume (m <sup>3</sup> /ha)
Pine Forest	1	4	2,060	N	CMe	3	Natural Seeding	500	20.32	14.04	179.48
Pine and Savin Forest	2	22	1,200	SE	LPd	2	Planting	1,400	4.3	4.1	45.6
Broad-Leaved Forest (Cloud Forest)	3	24	1,615	SE	CMe	3	Natural Seeding	1,900	5.9	7.9	134.0
Dry Forest	4	10	450	N	LPd	1	Sprouting	6,300	4.1	5.6	28.4

### (3) Preparation of Land Use and Forest Type Maps

#### 1) Acquisition of Aerial Photographs

It was originally planned to use colour aerial photographs (scale of 1:20,000) to be newly taken by the INDRHI in order to prepare the land use and forest type maps for the Study Area. However, these new photographs were only taken for the southern area, including the Sabana Yegua Dam site, accounting for only one-third of the Study Area, because of bad weather and cumulus developing near the Central Mountain Range. As a result, false colour aerial photographs (scale of 1:24,000) taken by the National Park Administration in 1999 were used to cover the upper reaches of Yaque del Sur River. For the remaining areas of the Study Area, existing composite Landsat images used for the Inventory Study on Land Use and Vegetation in the Dominican Republic in 1999 and monochromatic photographs (scale of 1:40,000) taken by the Military Cartographic Institute in 1984 were referred to along with aerial verification of the present land use status by helicopter to complete the land use and forest type maps for the Study Area.

#### 2) Classification Categories and Photograph Interpretation Criteria

In order to establish the current state of land use in the Study Area, the situation of land use was largely classified into forest and non-forest and interpretation criteria were determined for each category. The classification categories were finalised through consultations with the C/Ps based on those used by the Inventory Study on

Land Use and Vegetation in the Dominican Republic. The classification categories and interpretation criteria are shown in Table 4-2 and Table 4-3 respectively.

### 3) Map Preparation Process

For the preparation of the land use and forest type maps, the new aerial colour photographs and existing aerial photographs were interpreted based on the categories and the interpretation results were then verified by a field survey before being transferred onto a topographical map.

Table 4-2 Land Use Categories and Photograph Interpretation Criteria

Categories		Symbol	Description	Photograph Interpretation Criteria	
Forest	Needle-Leaved Forests (Pine)	Closed	Pc	Crown density $\geq 60\%$	<ul style="list-style-type: none"> <li>• Uniform stands with uniform height</li> <li>• Conically-shaped crown with round top</li> <li>• Slightly obscured contours</li> <li>• Dark green on colour photographs</li> <li>• Dark grey on monochromatic photographs</li> </ul>
		Open	Pa	$40\% \leq$ crown density $< 60\%$	
		Sparse	Pd	Crown density $< 40\%$	
		Regenerated Site	Zr	Regeneration sites through planting or at a former forest fire sites	
	Broad-Leaved Forests	Cloud	Ln	Distributed on hillsides of high mountains	<ul style="list-style-type: none"> <li>• Low trees of similar height with obscure contours</li> <li>• Round crown and uneven contours for medium-diameter trees</li> <li>• Light green on colour photographs</li> <li>• Light brown on monochromatic photographs</li> </ul>
		Humid	Lh	Evergreen broad-leaved trees; distributed between El. 500 m and El. 2,000 m	
		Semi-Humid	Ls	Distributed between humid forests and dry forests	
Dry Forests		S	Distributed below El. 500m	<ul style="list-style-type: none"> <li>• Low tree height with obscure contours</li> <li>• Light brown</li> </ul>	
Non-Forest	Shrub Land		Za	Shrubs grown at abandoned shifting cultivation sites or former forest fire sites	• Shrubs of which the species is impossible to distinguish
	Grassland (Treeless)		Zm	Former forest fire sites or fallow land (including grazing land)	• Area covered by grass with visible demarcation lines for cultivation or grazing; former forest fire sites
	Farmland		Ta	Permanent farmland, shifting cultivation sites and orchards, etc.	• Demarcated land for permanent farming or shifting cultivation; ridges often appear as lines
	Intensive Grazing Land		H	Grassland used for grazing	• Large-scale grazing land near community sites
	Coffee Plantations		Ca	Land where coffee is grown	<ul style="list-style-type: none"> <li>• Guama, a broad-leaved species, is planted as upper-story trees to create the shade preferred by coffee trees</li> <li>• Round crown with uniformly spread contours</li> </ul>
	Bare Land		Td	Exposed surfaces, such as landslide sites and rocky land	• Landslide sites or rocky land not covered by vegetation
	Community Sites		C	Concentration of houses and public buildings	• Includes trees and houses, public facilities and factories, etc.
Water Bodies		E	Rivers, lakes and dam reservoirs, etc.	• Yaque del Sur River, other rivers and the reservoir of Sabana Yegua Dam	

Table 4-3 Classification by Height and Crown Density

Classification Criteria		Symbol
Height	High (more than 20 m)	A3
	Medium (more than 10 m but less than 20 m)	A2
	Low (less than 10 m)	A1
Crown Density	Dense (60% or higher)	D3
	Open (40 – 60%)	D2
	Sparse (less than 40%)	D1

4) Area by Land Use and Forest Type Category

The completed land use and forest type base maps were scanned by an input device, such as a scanner, and converted to vector data with layers through digitalisation of the images to produce the intended thematic maps (land use and forest type maps). The area and area ratio by land use category are shown in Table 4-4.

Table 4-4 Area and Area Ratio by Land Use Category

Classification		Symbol	Total Area	Ratio	
Forest	Pine	Closed	Pc	27,528	16.5%
		Open	Pa	13,838	8.3%
		Sparse	Pd	10,697	6.4%
		Regeneration Site	Zr	1,088	0.7%
		Total		53,151	31.9%
	Broad-Leaved	Cloud	Ln	5,475	3.3%
		Humid	Lh	10,509	6.3%
		Semi-Humid	Ls	14,335	8.6%
		Total		30,319	18.2%
	Dry Forest	S	4,061	2.4%	
	Sub-Total		87,531	52.5%	
Non-Forest	Shrub Land	Za	6,301	3.8%	
	Grassland (Treeless)	Zm	51,724	31.0%	
	Farmland	Ta	10,355	6.2%	
	Intensive Grazing Land	H	2,580	1.5%	
	Coffee Plantation	Ca	3,656	2.2%	
	Bare Land	Td	287	0.2%	
	Community Site	C	1,268	0.8%	
	Water Body	E	2,912	1.7%	
	Sub-Total		79,083	47.5%	
Total (Forest + Non-Forest)			166,614	100.0%	

### 4.2.3 Topography, Geology and Soil

#### (1) Topography

The Study Area extends 50 km in both the east-west and north-south directions. The northern and eastern sides are enclosed by the ridge lines of the Central Mountain Range while the western and southern sides are enclosed by branches of the Central Mountain Range. The Central Mountain range which encloses the Study Area from the north and the east has many 2,000 – 3,000 m class mountains, including Mt. Duarte (El. 3,175 m) which is the highest mountain of the Caribbean islands. The Central Mountain Range acts as the watershed and Yaque del Sur River, Las Cuevas River and Grande del Medio River run down towards the reservoir of Sabana Yegua Dam of which the full water level elevation is 380 m.

From the topographical point of view, the Central Mountain Range and its branches which form the middle and upper reaches of these rivers are classified as steep mountainous land with considerable undulations. This area is dissected by deep V-shaped drainages and the gradient is generally more than 32% (18°) with some slopes being as steep as more than 60% (31°). Rivers meander through these steep slopes. Despite such steepness, there are some gently sloping summits and ridges. At these places, gently undulating plateaus and basins surrounded by gentle mountainous land can be observed even though their sizes considerably vary. In some cases, terraced flat land or gently sloping land is formed at the upper section of the hillsides. Monad rocks or cropped rocks can be seen at these sites. Moreover, these sites are often surrounded by solid rocky mountains.

Meanwhile, the area around the dam reservoir is characterised by gently undulating mountainous land along the upperstream and hills along the downstream. Low to high river terraces have developed along the river channel. There is an expanse of flat land along Las Cuevas River near the dam reservoir

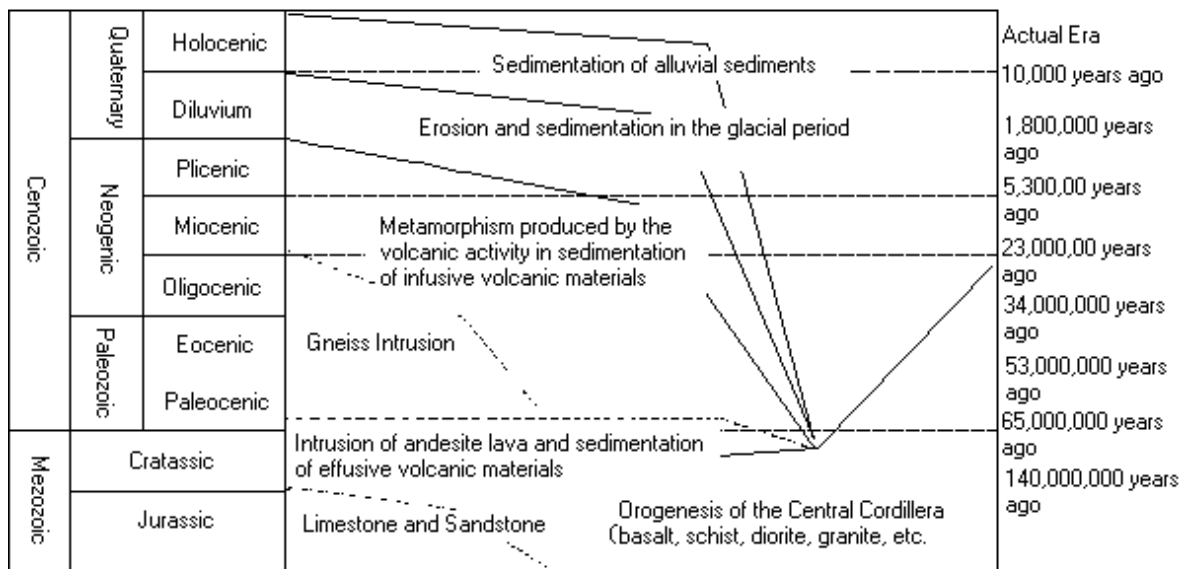
#### (2) Geology

The geology of the Study Area has undergone a fairly complicated process of formation as the area has experienced a series of volcanic activities and the formation of volcanic and metamorphic rocks associated with volcanic activities with further metamorphism by erosion and sedimentation in subsequent years.

The Central Mountain Range was formed by orogenic movement in the Cretassic and late Eocenic periods and is composed of volcanic rocks and metamorphic rocks which

are surrounded by such sedimentary rocks as limestone and sandstone, etc. from the Paleozoic and Mesozoic. There is intrusion by volcanic materials, mainly andesite lava, from the same periods of orogenic movement. The lava itself is intruded by metamorphic rocks, mainly gneiss. In subsequent years, volcanic activities continued together with metamorphism and the fall and sedimentation of volcanic ejecta associated with volcanic activities. The last diastrophism by volcanic activities is said to have taken place in the Quaternary. As progressive erosion in the Ice Age and sedimentation in the Alluvium continued during these years, the generally complicated geology of the Study Area was formed.

Table 4-5 Geological Periods and Formation Process of Stratum



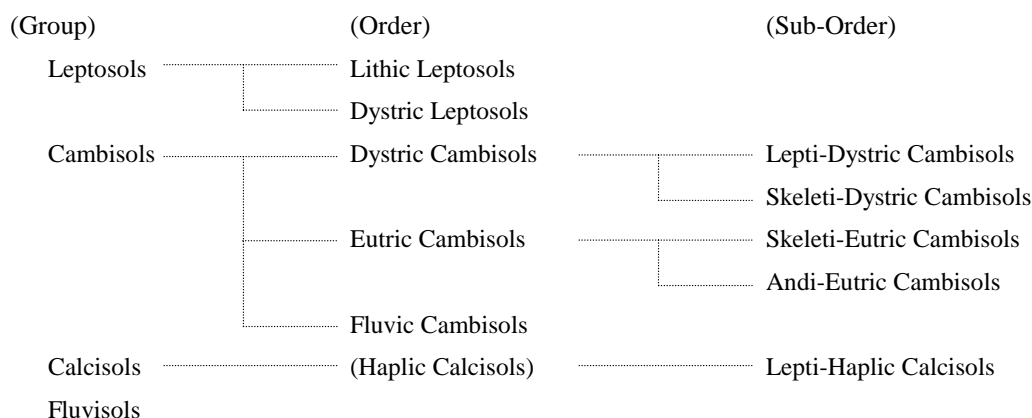
The overall geological picture shows the distribution of limestone along the ridgelines of the Central Mountain Range in the uppermost reaches of Yaque del Sur River and Grande del Medio River and the wide distribution of such volcanic rocks as andesite lava and basalt, such metamorphic rocks as schist and gneiss and volcanic ejecta, including tuff, in the middle to upper reaches to the south of the ridgeline area. In the Constanza Basin, alluvial deposits mixed with volcanic ash are found while strongly weathered granite is found to the north. Meanwhile, such sedimentary rocks as sandstone and sandy mudstone, etc. are distributed to the south of the Constanza Basin in the area from the Las Cuevas River basin to the dam reservoir. Such intrusive volcanic rocks as effusive andesite and porphyry are found near the boundary between the Grande del Medio River basin and the Las Cuevas River basin. These igneous rocks and metamorphic rocks are relatively young in terms of the geological chronology, forming steep topography.

Unconsolidated alluvial deposits incorporating conglomerates or a gravel layer are distributed in the area from the dam reservoir to the upstream, forming river terraces and hills.

### (3) Soil

For the preparation of the soil maps, the aerial photographs and topographical maps (scale of 1:50,000) used for the preparation of the land use and forest type maps were used to establish the land use and topography of the Study Area. In addition, a soil profile survey and a simple drilling survey to complete the soil profile survey were conducted. The survey items of the soil profile survey were the horizons, thickness of each horizon, humus, colour, state of Ao horizon, structure, hardness, soil texture, gravel, hypha and pH value. The FAO/UNESCO classification system was used for soil classification purposes. A table of comparison between the FAO/UNESCO classification system and the US classification system is included in the Appendix. During the course of the Study, the soil profile survey was conducted at 20 sites composed of forests, farmland and grazing land, etc. (see the soil map in the Appendix for the survey sites).

The soil in the Study Area has not fully developed because of loss of the top soil caused by the generally steep topography and disturbance caused by tree cutting, shifting cultivation, grazing and forest fires, etc. Most local soil is classified as shallow, gravelly Leptosols or slightly deeper Cambisols. Minor areas of Fluvisols and Calcisols are found along the lowerstream of rivers and at some mountainous land respectively. These soil groups can be sub-divided into the following orders and sub-orders based on several characteristic properties.<sup>1</sup>



<sup>1</sup> For the classification of major soil groups and orders, the Revised Soil Map of the World (FAO-UNESCO, 1990) and the World Reference Base for Soil Resources (ISSS-ISRIC-FAO, 1999) were used.



1) Leptosols (LP)

Leptosols are a soil group where the soil thickness is restricted to less than 30 cm due to a continual hard rock and consolidated layer and has few fine soils (the fine soil ratio up to 75 cm below the surface is less than 20%) with the presence of many gravels. Lithic Leptosols and Dystric Leptosols are observed in the Study Area.

a. Lithic Leptosols (LPq)

Lithic Leptosols have a limited depth of less than 10 cm below the surface because of the presence of crack-free hard rock beneath. As the A horizon is extremely thin, the conditions are extremely hard for plant growth due to insufficient scope for the growth of roots and the retention of usable water. This type of soil is formed above unweathered hard rock. When the soil is found in minor depots on cropped rock, the area can be described as cropped rocky land. Lithic Leptosols are mainly distributed at mountain summits, mountain ridges and steep escarpments immediately below such summits or ridges. The vegetation is restricted to herbs and shrubs with hardly any trees. This soil type is shown on the soil map together with cropped rocky land.

b. Dystric Leptosols (LPd)

Dystric Leptosols have a limited depth of 10 – 30 cm below the surface because of the presence of a continuous hard rock or consolidated layer beneath. The A horizon is black and there is no B horizon. The base saturation is low. In places where the parent materials are alluvial deposits, there is no continuous hard base rock but the soil is rich with gravels, showing a consolidated gravel layer from around 10 cm below the surface. While most gravels are less than 10 cm in diameter, boulders of more than 30 cm in diameter are also present. The A horizon is either blackish brown or dark brown with rich humus. The fine soil texture is either loam or clay loam with a granular or blocky structure, indicating the alternation of wet and dry conditions. This type of soil has little capacity for root growth or water retention which, coupled with compaction by livestock, mean that plant growth is poor. The soil is mainly covered with herbs although shrubs and pine (*Pinus occidentalis*) are also observed to have extended their root systems through the minor cracks of the base rock or between gravels. Dystric Leptosols are distributed along the ridgelines of steep mountains, at the upper sections of hillsides and on convex slopes and hills around the Sabana Yegua Dam. Despite the largeness of the distribution area,

Dystric Leptosols actually exist in a mesh-like manner in narrow strips. They are, therefore, combined with Lepti-Dystric Cambisols on the soil map.

## 2) Cambisols (CM)

Cambisols are a type of soil which has a truly characteristic horizon or properties associated with other soil groups and clay, accumulated carbonate and others are classified in this group. Cambisols can be described as a type of soil showing transitional properties to more developed soil types. As they are not created from a specific parent material, they contain a wide range of soils. As such, Cambisols appear universally throughout the world. Even though they are described as being in a transitional stage, they do not eventually develop into another type of soil. To be more precise, Cambisols maintain their present state because of the constant supply of fresh parent materials while being subject to the soil formation process with advanced weathering and metamorphism as well as the erosion process. Dystric Cambisols, Eutric Cambisols and Fluvic Cambisols are distributed in the Study Area.

### a. Dystric Cambisols (CMd)

Dystric Cambisols do not have such characteristic properties as aquatic properties, presence of a large amount of carbonates and low cation exchange capacity, etc. but do have a black brown A horizon and B horizon with low base saturation. The B horizon is slightly degenerated by weathering and its colour is either brown or reddish-yellowish brown. The texture has a wide range, from sandy loam to clay loam and further to sandy clay. There may be a large quantity of gravels or no gravel at all, depending on the type of parent materials, degree of weathering and topography. The structure is granular, blocky or angular blocky, reflecting the influence of dry conditions. When gravels are contained, the gravel size tends to be 2 – 5 cm in diameter. The soil thickness, inclusive of the A horizon and B horizon, is around 30 cm – 1 m and changes in accordance with the micro-topography as it is shallow at convex sites and steeply sloping sites and deeper at concave sites, the bottom of slopes and gently sloping land. The thickness of the A horizon is not uniform, changing from around 10 cm to some 50 cm. The soil may be consolidated or soft, presumably originating from differences in land use and vegetation, the existence or non-existence of grazing and surface erosion resulting from grazing, etc. The A<sub>o</sub> horizon is generally shallow. In pine forests in the highland humid zone, the A<sub>o</sub> horizon is bonded by hypha and covers the ground surface. This is because the fallen leaves of needle-leaved trees are essentially slow to decompose and

the activities of small animals are restricted by the strong acidity shown by semi-decomposed organic materials and the cool but wet climate, leaving much of the decomposition of organic materials to fungi. At such sites, pine leaves and the wax and fat contents of fungi repel water, disrupting the swift permeation of rainwater into the soil as in the case of consolidated top soil.

Dystric Cambisols are found in a wide area and are most widely distributed throughout the Study Area. In most cases, they are distributed on the lower parts of sloping land where Dystric Leptosols are found. The criteria to distinguish Dystric Leptosols from Dystric Cambisols are only the soil thickness with a border line of 30 cm and the existence of a thick weathered and degenerated B horizon. In other words, both the shallow Dystric Leptosols distributed from the mountain ridge to the piedmont and the Dystric Cambisols with a thickness of some 1 m show a very similar texture and structure, etc., indicating a continuous soil type with an ever changing thickness. From the viewpoint of soil productivity, the Dystric Cambisols found at the upper sections of slopes are more similar to the Dystric Leptosols found at mountain ridges than the Dystric Cambisols found at the lower sections of slopes. As an intermediate type of these two soil types, Dystric Cambisols with a thickness of 30 – 50 cm are classified here as Lepti-Dystric Cambisols (CMD-le). In short, Dystric Leptosols are distributed on ridges, the upper sections of slopes and convex slopes, Dystric Cambisols are distributed at the lower sections of slopes and gentle hillsides and Lepti-Dystric Cambisols are distributed in the middle areas. Pine forests, broad-leaved forests and grassland (grazing land) are spread over slopes with shallow soil while farmland is created in places with relatively thick soil.

Very gravelly soil which falls short of being Dystric Leptosols (the fine soil ratio up to 75 cm deep is less than 20%) is classified as Skeleti-Dystric Cambisols. This soil type is mainly found at talus or flat land or at such gently sloping land as river terraces. It is unsuitable for cultivation because of the presence of many large gravels and boulders. Nevertheless, this kind of gravelly soil is not necessarily disadvantageous for tree growth. In fact, the good moisture conditions, including good drainage due to the topography, promise good tree growth and the reforestation of sites with this type of soil is possible.

b. Eutric Cambisols (CMe)

Eutric Cambisols show similar soil properties to Dystric Cambisols but have a darker or black A horizon as well as a B horizon with high base saturation. The

structure is either blocky or nodular and is relatively thick. As Eutric Cambisols are believed to contain volcanic ash, the texture is slightly silty. This type of soil is distributed in the northeastern part of the Study Area where forests have survived without being exposed to harsh dry weather. Extremely gravelly and deep Eutric Cambisols are found along drainages surrounded by forests and this type are classified as Skeleti-Eutric Cambisols (CMe-sk). This soil type is unsuitable for cultivation because of its gravelly nature but is good soil for tree growth. Because of its localised distribution in very small areas, this type of soil is not used as a mapping unit on the soil map.

Weakly stratified soil which is strongly affected by volcanic ash is distributed in the Constanza Basin while soil with a black organic layer originating from true grass species is distributed at flat summits in the upper reaches of Las Cuevas River. Although both types of soil belong to Eutric Cambisols, they are classified as Andi-Eutric Cambisols (CMe-an) because of their similarity to Andosols.

c. Fluvic Cambisols (CMf)<sup>2</sup>

Fluvic Cambisols are a type of Cambisols with the characteristics of Fluvisols and are distributed at flat land along rivers, such as the Constanza Basin. While containing gravels, Fluvic Cambisols have a thickness of more than 1 m. The fertility is believed to be high and areas with this type of soil are used for intensive farming.

3) Calcisols (CH)

Calcisols have an accumulated lime layer as a characteristic horizon and normally appear under dry conditions. The Calcisols found in the Study Area have a soft powdery line attached to the structure and gravels. As the base rock, limestone is found at a relatively shallow depth. As the thickness is generally less than 50 cm, this soil type is classified as Lepti-Haplic Calcisols (CHh-le) for the present purposes and its distribution is localised around the reservoir of the Sabana Yegua Dam and along Las Cuevas River. For this reason, it is included in Lepti-Dystric Cambisols on the soil map.

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<sup>2</sup> The soil map prepared by the DERENA was used as the reference material.

#### 4) Fluvisols (FL)<sup>2</sup>

Fluvisols are formed by the sedimentation of parent materials which have been supplied at regular intervals and new parent materials. In the Study Area, Fluvisols are distributed on lowland along rivers near the reservoir of the Sabana Yegua Dam. Although the moisture conditions are excellent, this soil type is constantly exposed to a risk of flooding.

#### 4.2.4 Fauna and Flora<sup>3</sup>

The fauna and flora of Hispaniola Island are characterised by (i) the little presence of ground mammals, including carnivores, which are widespread throughout the world, (ii) the extreme rarity of ophidians and (iii) the predominance of indigenous species. This situation reflects the long isolation of the island from the continent and is the result of specialisation to adapt to the various as well as harsh environmental conditions brought about by the Central Mountain Range of which the peak elevation exceeds 3,000 m.

Excluding domestic animals, ground mammals in the Dominican Republic consist of 20 naturally bred species and 12 imported species. The naturally bred species are one species of Solenodontidae, one species of Capromyidae and 18 species (15 genera of six families) of Chiroptera. Of these, the first two species and one species of Chiroptera are indigenous to Hispaniola Island. The existence of 19 species, except for one species of Chiroptera, and four imported species is recorded in the Study Area. The imported species are mongoose (*Herpestes auro-punctatus*), wild boar (*Sus scrofa*), goat (*Capra hircus*) and white-tailed deer (*Odocoileus virginianus*). The northern part of the Study Area near the Central Mountain Range provides the main habitat for naturally bred species. The species found represent the surviving species in the Dominican Republic, showing the reality of mammals on Hispaniola Island that the number of extinct species is higher than that of surviving species. Solenodontidae consist of an Insectivora which only exists in the Antilles and which has undergone its own unique evolutionary process. Among the existing species of Insectivora, that in question is the largest and is a protozoan. Three species of Nesophontes and three species of Solenodontidae have been recorded but all of the former and one of the latter are already extinct, leaving only the Haitian solenodon (*S. paradoxus*) on Hispaniola Island and another on Cuba Island as the surviving species. The Haitian solenodon is nocturnal and inhabits forests. It has a total body length of 50 – 60 cm and used to be one of the dominant carnivores on the island. However, its number has sharply declined due to the presence of a new

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<sup>3</sup> For the description of local fauna and flora, reference was made to materials owned by the Secretariat of State for Environment and Natural Resources, the National Museum of Natural History, the National Botanical Gardens and the National Animal Park.

predator, i.e. imported dogs, and the destruction of its habitat coupled with its low breeding rate. At present, it is facing competition from rodents. Similarly, Capromyidae represents large rodents which are only seen in the West Indies. Several species used to inhabit Hispaniola Island but only the Haitian hutia (*Plagiodontia aedium*) can be seen today. The Haitian solenodon and Haitian hutia are registered species in the Red Data Book (RDB) compiled by the International Union for Conservation of Nature and Natural Resources (IUCN).

In regard to birds, more than 260 species, including migratory species, are observed in the Dominican Republic. Of these, some 50 are indigenous species. More than 90 species are confirmed in the Study Area, mainly around the Central Mountain Range to the north. However, more species are believed to inhabit the Study Area given the diverse environmental conditions in the lower reaches provided by forests, communities, farmland and the dam reservoir, etc. as some species prefer such an environment. Among these, seven species, including hispaniolanosli (*Buteo ridgwai*) are listed in the ICUN's Red Data Book. Of these seven, six are indigenous except for *Aratinga chloroptera* which is a type of parakeet. Species of Falconiformes, Psittaciformes, Strigiforme and Trochilidae are listed in CITES II of the Washington Convention and their international trade is restricted. The number of parrots (*Amazona ventralis*) and hispaniol cros (*Corvus leucognaphalus*) outside natural reserves is rapidly declining.

There are more than 120 reptile species throughout the Dominican Republic, at least 110 of which are indigenous to Hispaniola Island. Seven indigenous families (25 species and seven sub-species), mostly Iguanidae, are recorded in the Study Area. The number of Ophidians is generally small and only two species of two families inhabit the Study Area. Of these, *Epicrates striatus* of Boidae is listed in CITES II.

There are 34 amphibian species in the country, of which 32 are indigenous with two species, including bufo (*Bufo marinas*), being imported species. Nineteen species and one sub-species of three families inhabit the Study Area. All of these except for bufo (*Bufo marinas*) are indigenous. *Hyla vasta* of Hylidae is listed in the IUCN's Red Data Book.

In regard to flora, some 5,600 species are found in the Dominican Republic, of which some 1,800 species are said to be indigenous to Hispaniola Island. At least 20 families (30 species) of Pteridophytina and 80 families (440 species) of Spermatophyta are recorded in the Study Area. The local vegetation is characterised by little variety of trees because of the dominance of pure pine forests and the strong presence of shrubs and epiphytes. While various species of

Agavaceae, Cyatheaceae and Orchidaceae, etc. are listed in CITES I and II, their habits are being lost due to the cutting of forest trees and burning to create farmland.

#### 4.2.5 Current Situation of the Watersheds and Land Degradation

##### (1) Classification of Watersheds

###### 1) Basic Concept

The INDRHI divides the country into 36 watersheds which are then further divided into sub-watersheds and micro-watersheds for the purpose of formulating watershed management plans. The watershed of Yaque del Sur River in the Study Area is considered to be one of the highest priority areas for watershed management.

###### 2) Divisions and Areas

The Study Area is divided into sub-watersheds and micro-watersheds. The area of each watershed is measured on the topographical map (scale of 1:50,000) using GIS and is shown in Table 4-6.

Table 4-6 Areas of the Study Area, Sub-Watersheds and Micro-Watersheds

Study Area	Area (ha)	Sub-Watershed	Area (ha)	Micro- Watershed	Area (ha)
Upper Reaches of Sabana Yegua Dam	166,885.8	Yaque del Sur River	39,398.6	Lower reaches of Yaque del Sur River	14,543.4
				Blanco River	12,305.8
				Upper reaches of Yaque del Sur River	12,549.4
		Grande del Medio River	68,912.9	Lower reaches of Grande del Medio River	34,952.8
				Yaquesillo River	10,694.3
				Upper reaches of Grande del Medio River	23,265.8
		Las Cuevas River	58,574.3	Lower reaches of Las Cuevas River	16,048.4
				Guayabal River	6,805.6
				Upper reaches of Las Cuevas River	35,720.3

##### (2) Characteristics of Watersheds

###### 1) Rivers

Three rivers in the Study Area, i.e. Yaque del Sur, Grande del Medio and Las Cuevas, originate in the Central Mountain Range, run southwest and merge at the

Sabana Yegua Dam. Yaque del Sur River, the main river, meets San Juan River, the largest tributary, some 3 km downstream of the dam and eventually empties into the Caribbean Sea. The current conditions of these three rivers and their main tributaries are shown in Table 4-7.

Table 4-7 Current Conditions of Three Rivers and Their Main Tributaries in the Study Area

River	River Width (m)	State of Riverwater		Average Gradient (%)	Scale of Bank Erosion (m)	Depth of Unstable Sediment	Remarks
		Width (m)	Depth (m)				
Yaque del Sur River	60–150	9–12	0.40–0.55	4.5	Length: 1,200 Height: 1.5–4.0	More than 1 m	Five houses and farmland along the river were destroyed at La Guama due to bank erosion, in turn caused by Hurricane George
Blanco	-	-	-	4.5	Length: 1,000		
Grande del Medio	60-80	10-15	0.25-0.45	2.4	Length: 800 Height: 1.2-2.5	Less than 1 m	
Yaquesillo	20-22	3.0-3.5	0.20-0.30	2.5	-	None	
Las Cuevas	60-80	12-15	0.20-0.25	2.4	Length: 1,300 Height: 1.0-2.0	More than 1 m	
Guayabal	20-30	3.5-5.0	0.2	2.3	Length: 200 Height: 1.0	None	

Note : The figures in the table (excluding gradient) show the range for each item recorded at 23 river survey sites.

## 2) River Systems

As shown in Fig. 4-2, the entire Study Area, each sub-watershed and each micro-watershed show dendritic (tree-like) river pattern, indicating that soil erosion in the Study Area is conditioned by the weathered surface layer and not by such geological structures as faults.

## 3) Drainage Density

The drainage density is closely related to the geology of the bedrock which determines the topography. A high drainage density is used as an indicator for erosion by water flow as it increases the number of landslides and the amount of sediment discharge. The drainage density in the Study Area is 9.3 km/km<sup>2</sup> with the sub-watershed of Yaque del Sur River showing the highest drainage density of 10.4 km/km<sup>2</sup>. Among micro-watersheds that of Blanco River has the highest drainage density of 12.3 km/km<sup>2</sup>.



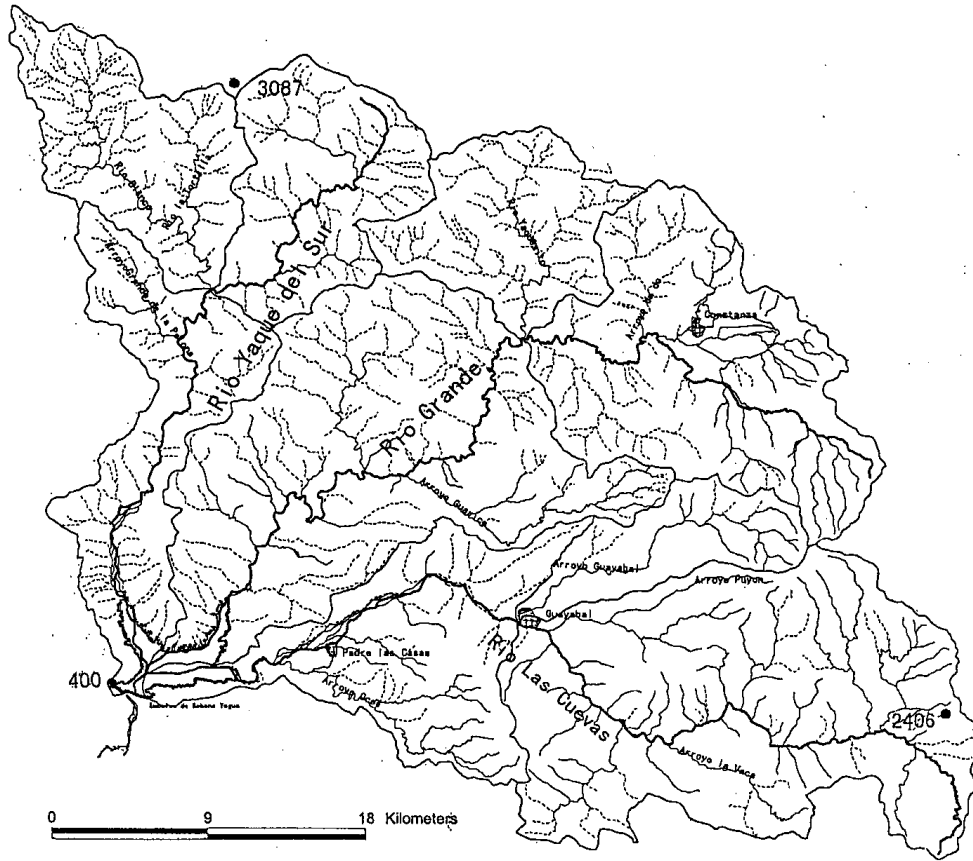


Fig. 4-2 River System Map of the Study Area

Table 4-8 Drainage Density in the Study Area

Sub-Watershed	Micro-Watershed	Area (km <sup>2</sup> )	Total Length of Drainages (km)	Drainage Density (km/km <sup>2</sup> )*
Sub-Watershed of Yaque del Sur River	Lower reaches of Yaque del Sur River	14.5	137	9.4
	Blanco River	12.3	151	12.3
	Upper reaches of Yaque del Sur River	12.5	122	9.7
	Sub-Total	39.4	410	10.4
Sub-Watershed of Grande del Medio River	Lower reaches of Grande del Medio River	34.9	330	9.4
	Yaguesillo River	10.7	102	9.5
	Upper reaches of Grande del Medio River	23.3	215	9.2
	Sub-Total	68.9	647	9.4
Sub-Watershed of Las Cuevas River	Lower reaches of Las Cuevas River	16.0	130	8.1
	Guayabal River	6.8	45	6.6
	Upper reaches of Las Cuevas River	35.7	327	9.2
	Sub-Total	58.6	502	8.6
Entire Study Area		166.9	1,559	9.3

\* These are calculated by dividing the total drainage length in the subject micro-watershed by the area of the same micro-watershed.

### (3) Hydrology

#### 1) River Flow

The INDHRI measures the flow of the three main rivers at three sites in the upperstream of the dam. A hydrograph has been produced for the Study based on data from 1978 to 1994. The peak flow is recorded in May to July, September and October during the rainy season for all of the rivers.

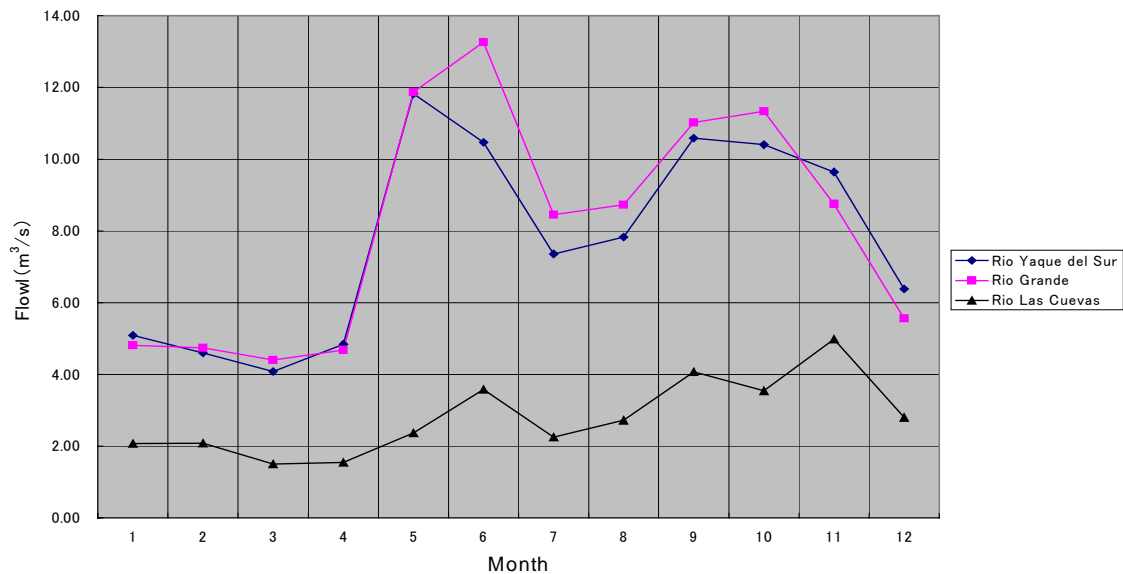


Fig. 4-3 Hydrograph for Yaque del Sur, Grande del Medio and Las Cuevas Rivers

Note: Data was unavailable for some months. For example, 1978 data for Grande del Medio River was only available for December while no data was recorded for Las Cuevas River in 1991 and 1992.

#### 2) Precipitation

The mean annual precipitation in the Study Area and its surrounding area varies from 673 mm in Azua to 1,129 mm in Guayabal. The peak months are from mid-April to June and from August to November. Meanwhile, burning for shifting cultivation on steep slopes in the Study Area is conducted in two cycles from February to April and from July to September. Because the precipitation peaks immediately after burning, harsh soil erosion is believed to occur at burned shifting cultivation sites where the vegetation cover has been lost.

#### 3) Water Resources

Water resources in the Study Area consist of rainwater, surface water and groundwater. Tin-roofed houses collect rainwater in tanks for use as domestic water as well as drinking water for domestic animals. The surface water from the three

main rivers and their tributaries is used as irrigation water and domestic water. Spring water, which is groundwater, is also used as domestic water. In Constanza, spring water is guided to farmland through pipes using the gravity method and is used as irrigation water for sprinklers during the dry season.

#### (4) Current Situation of Land Degradation

##### 1) Survey Method

The current situation of degradation in the Study Area was surveyed by means of a field survey, aerial photograph interpretation (infrared colour photographs with a scale of 1:24,000 and monochromatic photographs with a scale of 1:20,000) and an interview survey with local residents. In addition, the aerial photograph interpretation results were verified in the field (by spot checks). For those places for which corresponding aerial photographs were unavailable, a field survey was conducted when access was available.

##### 2) Classification of Landslide and Gully Erosion Sites

Landslide sites were classified into those of less than 1 ha (sites which can be controlled by local residents) and those of 1 ha or larger (sites requiring major civil engineering work) from the viewpoint of “whether or not local residents could implement control measures using locally obtainable materials”. The same criterion was applied for gully erosion sites to classify them into those with a depth of less than 2 m and those with a depth of 2 m or more.

##### 3) Aerial Photograph Interpretation Criteria

The criteria used to interpret landslide, gully erosion and other eroded sites on the aerial photographs are shown in Table 4-9.

Table 4-9 Aerial Photograph Interpretation Criteria

Type of Erosion		Interpretation Criteria
Landslide (Area)	< 1 ha	Former site where the vegetation has not completely recovered appears white with a narrow, long shape.
	≥ 1 ha	Former site where the vegetation has not completely recovered appears white with a generally concave shape.
Gully (Depth)	< 2 m	Appears like a long strip of several hundred metres in length and 2 – 3 m in width. Short and narrow sites are difficult to identify on the photographs (scale of 1:20,000)
	≥ 2 m	The banks of some sites appear like the blade of a saw compared to smaller gully erosion sites which appear like long, thick strips.
Torrent		Because of being much wider than gully erosion sites, the sediment on the riverbed appears white despite the presence of trees and shrubs nearby. As torrents are characterised by bank erosion, the banks appear like the blade of a saw.
Unstable Sediment on Dry Riverbed		The regeneration of vegetation is observed at dry riverbeds which have not shifted since the flooding caused by Hurricane George. These appear grey on the aerial photographs. Meanwhile, dry riverbeds which have been frequently shifting after the flooding caused by Hurricane George appear white as no vegetation has regenerated.

#### 4) Current Situation

Using the survey methods described above, the distribution of degraded sites in the entire Study Area was studied as long as such study was possible by means of aerial photograph interpretation and/or a field survey. Based on the study findings, a watershed map was prepared. The number of landslide, gully erosion and torrent sites in the Study Area and by sub-watershed and micro-watershed is shown in Table 4-10.

Table 4-10 Landslide, Gully Erosion and Torrent Sites in the Study Area

Sub-Watershed	Micro-Watershed	Landslide		Gully Erosion		Torrent		
		Less than 1 ha	1 ha or more	Less than 2 ha	2 m or more	Torrent	Bank Erosion	Unstable Sediment on Dry Riverbed
		60 (0.41)	10 (0.07)	-	4	1	2	8
	Blanco River	214 (1.74)	76 (0.57)	-	-	1	-	3
	Upper reaches of Yaque del Sur River	65 (0.52)	10 (0.08)	7	6	-	-	-
	Sub-Total	339 (0.86)	96 (0.24)	7	10	2	2	11
Grande del Medio River	Lower reaches of Grande del Medio River	24 (0.07)	1 (0.002)	7	25	-	-	2
	Yaquesillo River	7 (0.06)	1 (0.009)	3	4	-	-	-
	Upper reaches of Grande del Medio River	4 (0.02)	5 (0.02)	8	1	-	-	-
	Sub-Total	35 (0.05)	7 (0.01)	18	30	-	-	2
Las Cuevas River	Lower reaches of Las Cuevas River	30 (0.18)	-	-	19	2	5	4
	Guayabal River	4 (0.06)	2 (0.03)	-	1	-	1	-
	Upper reaches of Las Cuevas River	153 (0.42)	56 (0.01)	5	14	6	3	5
	Sub-Total	187 (0.32)	58 (0.10)	5	34	8	9	9
Total		561 (0.34)	161 (0.10)	30	74	10	11	22

Note : The figures in brackets indicate the area per 100 ha, showing the landslide density.

The Blanco River micro-watershed has the largest number of small-scale landslide sites of 214 and large-scale landslide sites of 76. The landslide density is also high in this micro-watershed at 1.74 ha per 100 ha for small-scale landslide sites and 0.57 ha per 100 ha for large-scale landslide sites. The second largest number of landslides is recorded in the micro-watershed consisting of the upper reaches of Las Cuevas River. In contrast, the sub-watershed of Grande del Medio River shows the largest number of large and small-scale gully erosion sites.

#### 5) Causes and Scale of Erosion

The sites and main causes of landslides, gully erosion and torrents are shown in Table 4-11.

Table 4-11 Sites and Main Causes of Soil Erosion

Type and Scale of Soil Erosion		Sites	Main Causes	State of Erosion
Rill and Surface Erosion		Shifting cultivation sites and dry farmland located on steep slopes without water and soil conservation measures	Direct impact of rain; uncontrolled surface erosion	In progress
Gully Erosion	Depth < 2 m	Shifting cultivation sites and dry farmland on steep slopes	Increased surface erosion due to the loss of vegetation	In progress
		Grassland on steep slopes	Increased surface erosion due to excessive grazing	In progress
		Roads with a steep gradient	Insufficient drainage facilities and poor construction	In progress
	Depth ≥ 2 m	Degraded dry forests (particularly along the road between Bohechio and Padre Las Casas and along Ocoa River, a tributary in the lower reaches of Las Cuevas River)	Increased surface erosion due to the degradation of dry forests and inappropriate road drainage facilities; unconsolidated, deep soil	In progress
Landslide	Area < 1 ha	Along the cut sections of roads and rivers	Erosion by water flow	Some sites see the natural regeneration of vegetation while erosion is still in progress at many sites
	Area ≥ 1 ha	Particularly in the upper reaches of Yaque del Sur and Las Cuevas Rivers; also seen in the middle and lower reaches of these rivers	Downpour by Hurricane George; steep topography; fragile geology	Natural regeneration of the vegetation is taking place at most sites, indicating that the process of recovery is in progress
Torrent		Particularly in the upper reaches of Las Cuevas River	Bank erosion and landslides along the channel	In progress

a. Typical Examples

Typical examples of large-scale and small-scale landslide as well as gully erosion sites are described in Tables 4-12 through 4-14.

Table 4-12 Typical Large-Scale and Small-Scale Landslide Sites

Location	Scale			Gradient (°)	Cause	Land Use Nearby	Remarks
	Depth (m)	Width (m)	Length (m)				
Los Frios (Lower Reaches of Yaque del Sur River)	1.2	18	50	32	Torrential rain by Hurricane George and very steep slope	Pine forest	
El Recodo (Upper Reaches of Las Cuevas River)	1.8	40	80	38	Torrential rain by Hurricane George and very steep slope	Pine forest and farmland	Natural regeneration of pine and other vegetation is observed at the site
La Finica (Upper Reaches of Las Cuevas River)	4.5	125	180	35	Torrential rain by Hurricane George and very steep slope	Grassland and shrub land	
Cerca de Pinal Bonito (Upper Reaches of Grande del Medio River)	3.5	110	150	32	High precipitation during the rainy period in 2000 and very steep slope	Grassland	Natural regeneration of the vegetation is difficult because of the present use of the site as a quarry

Table 4-13 Typical Large-Scale and Small-Scale Gully Erosion Sites

Location	Scale			Gradient (°)	Cause	Land Use Nearby	Remarks
	Depth (m)	Width (m)	Length (m)				
Near Pinal Bonito (Upper Reaches of Grande del Medio River)	0.7	1.5	55	17	Loss of the top soil due to excessive grazing and increase of the loss due to compaction by animal trampling	Grassland	
	1.3	2.3	140	19			
Arenaso del Cilón (Upper Reaches of Grande del Medio River)	3.5	3.5	150	10	Torrential rain by Hurricane George; drainage from roads	Farmland (abandoned due to gully erosion)	
Along Ocoa River (Lower Reaches of Las Cuevas River)	15	11	300	5	Forest degradation due to extensive grazing and disorderly cutting to obtain fuelwood; deep unconsolidated soil	Degraded dry forest	

Table 4-14 Typical Torrent

Location	Scale		Gradient (°)	State of Bank Erosion	Land Use Nearby	Cause
	Width (m)	Length (m)				
La Guama (Lower Reaches of Las Cuevas River)	16 – 24	3	7	On both banks Height: 1.6-2.0 m Depth: 0.5-0.8 m	Forest Grassland Farmland	Roads were damaged by sediment discharged by the torrent at the time of Hurricane George

b. Sediment Discharge Estimation

The INDHRI estimates the average annual volume of sediment discharge per ha due to surface erosion in the Study Area using the Universal Soil Loss Equation (USLE) formula. Based on this INDHRI data, the volume of sediment discharge in the Study Area due to surface erosion was estimated as shown in Table 4-15.

Table 4-15 Volume of Sediment Discharge by Surface Erosion in the Study Area

Sub-Watershed	Average Annual Volume of Sediment Discharge (tons/ha/year) A	Sub- Watershed Area (ha) B	Average Annual Volume of Sediment Discharge in Sub- Watershed (tons/year) A x B
Yaque del Sur River	67	39,398	2,639,666
Grande del Medio River	97	68,913	6,684,561
Las Cuevas River	208	58,574	12,183,392
Study Area Total		166,885	21,507,619

The volume of sediment discharge by large-scale and small-scale landslide sites, mostly caused by Hurricane George, is shown in Table 4-16.

Table 4-16 Volume of Sediment Discharge from Large-Scale and Small-Scale Landslide Sites in the Study Area

Area Size of Landslide	Average Scale of Landslide				Volume of Sediment Discharge from One Site (m <sup>3</sup> ) A	Total No. of Landslide Sites in Study Area B	Total Volume of Sediment Discharge (m <sup>3</sup> ) A x B
	Length (m)	Width (m)	Area (m <sup>2</sup> )	Depth (m)			
< 1 ha	60	30	1,800	2	3,600	561	2,019,600
> 1 ha	180	120	21,600	5	108,000	161	17,388,000
Total							19,407,600



The volume of sediment discharge in the entire Study Area is estimated to be 27,170,640 tons (19,407,600 m<sup>3</sup> x 1.4 (soil density factor)). This means that the volume of sediment discharge from landslide sites caused by Hurricane George is larger than the annual volume of sediment discharge caused by surface erosion due to precipitation. Most of the sediment produced by landslides which has been discharged to rivers due to flooding in the area has eventually been deposited in the reservoir of Sabana Yegua Dam. As a result, hardly any residual sediment is seen at the feet of these landslide sites today.

From the viewpoint of sediment production, the sediment produced in the Study Area is largely classified into two categories, i.e. sediment produced by landslide sites and sediment produced by surface erosion or gully erosion at shifting cultivation sites or dry farmland which are located on steep slopes and where no soil conservation measures have been implemented and at grassland where excessive grazing is in progress. The former accounts for the majority of sediment discharged by hurricanes while the latter accounts for almost all sediment discharged during the rainy season each year.

### **4.3 Socioeconomic Conditions of the Study Area**

#### **4.3.1 Social Conditions**

There are approximately one hundred sixty villages (which are called as "Paraje") in the Study Area that covers one hundred sixty-six thousand hectares. Upper administrative structure at the village level is defined as Seccion (Seccion), and there are twelve Seccion in the Study Area. Furthermore, three Municipals (Municipios), Padre Las Casas, Bohechio and Constanza, exist for upper administration of the Sections (the number of municipals is eight, if sub-municipals are included).

The socioeconomic survey covering thirty villages was conducted by local NGOs at the first phase of the Study. The following description of socioeconomic conditions is based on the survey, interviews by the Study Team, and data from government organizations.

## (1) Socio-culture

### 1) Population

The Study Area has approximately sixty thousand inhabitants<sup>3</sup>. It is estimated that the urban area including Padre Las Casas and Constanza has a population of eighteen thousand, and there are forty-two thousand in rural/mountainous areas. There is also a small population of Haitians working in coffee fields in the Constanza area. Population of each village varies from less than fifty to two thousand in a village.

### 2) Religion

Majority of the population is Catholics, and some five percent are Protestants. Most villages have their own churches and villages without welcome priests every week from neighboring villages. Christianity provides guidance for the daily lives of the population in the area. Some villages have church-based community groups, and some of them are very active in the communities (see "Community Group").

### 3) Literacy Rate

The socioeconomic survey shows that nearly seventy percent of adults can read and write. In fact, however, the actual literacy rate is much lower according to results of face-to-face interviews and workshops after the survey. Local people themselves fully recognize that the illiteracy problem can be an obstacle to community development. Some villages claimed the importance of adult education as one of the priorities in the Needs Ranking of the PRA workshop. In some cases churches and NGOs provide adult education in some villages.

## (2) Social Infrastructure

The Infrastructure conditions of the 30 village's subject of the socioeconomic survey are as shown in Table 4-17.

### 1) Water

Condition of water infrastructure shows varies from village to village. In some cases local philanthropists have laid water pipe, and NGOs and foreign donors have constructed wells. Water infrastructures of many villages along the Yaque del Sur River remain broken since Hurricane George hit the area.

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<sup>3</sup> The number is estimated from the national census data as of 1993.

## 2) Electricity

Most villages are outside areas where electricity is laid, apart from Padre Las Casas, Constanza, and their neighboring villages. Although some richer people in villages possess electricity through use of batteries or solar panels, most of the population in the Study Area does not have access to electricity.

## 3) School, Hospital/Clinic

Most villages have their own schools, though most schools only offer classes until the fourth grade – ten years old. Therefore children wishing to take lessons beyond the fourth grade often must visit neighboring villages. In fact, many find it too difficult to continue after the fourth grade due to intolerable distances to schools. As for hospitals or clinics, they visit neighboring core villages where hospitals or clinics exist.

Table 4-17 Condition of Infrastructure in the Study Area

Infrastructure	Las Cuevas Watershed (12villages)		Grande del Medio Watershed (13villages)		Yaque del Sur Watershed (5villages)		Total (30villages)	
	# of villages	%	# of villages	%	# of villages	%	# of villages	%
Water* (Pipe&Well)	10	83	10	77	0	0	20	67
Electricity	6	50	2	15	3	60	11	36
Primary School (below 4th grade)	11	91	12	92	4	80	27	90
Junior High School (beyond 5th grade)	3	25	4	30	0	0	7	23
Clinic	3	25	4	30	0	0	7	23

\* The table considers villages where more than half of respondents answered that they have access to water, as villages to be installed water infrastructure.

## (3) Community Group

The community groups in the Study Area show similarities in terms of their variety. The following represent the community groups.

Farmers' Group(Junta de Asociacion Agricultora, Santa Maria<sup>4</sup> etc)

Church(Religious group)

<sup>4</sup> Many farmers' groups have their own names, which do not use the word "agriculture". e.g.) Asociacion de San Antonio, Asociacion de San Miguel.

PTA (Asociacion de Padres, Madres, Tutores y Amigos del Escuela)  
Women group

As for farmers' groups mentioned in above, several groups exist together in one village. The reason for coexistence of the same type of groups are: 1) support from different political parties, 2) differences between new immigrants and long-term residents, 3) differences in residential zones, and 4) differences in agricultural produce.

Support from different political parties was found as the major reason several farmers' groups can exist in the same village. It is seemingly because political parties approach farmers' groups with intention of collecting votes for election. Therefore, as a result, three farmers' groups with twenty members per one hundred households are an example in villages. Reason 4 given above, differences in agricultural produce, signifies coffee. In the case of coffee, a cash crop, relatively well-organized farmers' groups inclined to profit can be found.

Major activities of farmers' groups are volunteer work such as the cleaning of roads and water management. Only a few groups undertake cooperative purchase of agricultural produce and sale of fertilizer and seeds. Some farmers do not join farmers' groups because they cannot see merits to join.

Churches can be found in nearly all the villages, being free from internal politics and interests within the villages. Activities of churches cover not only religious work but also education, health, sanitary, maintenance of roads, and housing.

The PTAs, organized in most villages, principally support activities of schools.

Women groups support festivals, education for children and religious activities and rarely do business such as sales of their own handcrafts. It is also observed that most women are reluctant to be involved in decision making on topics of activities inside villages, leaving this to men. This is caused partly because women believe their responsibility should focus on household work. Women also feel hesitation to be involved in important decision making because do not participate in business activities, which they believe are a prerequisite for involvement.

#### (4) Village Administration

Village administration is centered on a village chief, called as an Alcalde. All villages have Alcaldes. Deputy Alcaldes are not allocated in most villages, and village meetings

are held irregularly with only a small number of residents. Moreover, the Alcalde is assigned by direct appointment by the mayor, not through election or mutual consensus among village people. The assignment, therefore, may demonstrate strong political intention.

(5) Rural Society

A recent concern is the increasing number of the younger generation moving to cities because of their admiration for big cities, or abundant opportunities to acquire jobs and education. Some parents who desire their children to continue education after the fourth grade move to bigger towns utilizing compensation for sales of their farmland or make daily roundtrips.

Some villages located along rivers in dangerous zones are required or suggested to move out to other safer places, and some of them actually have already done so. e.g.) a neighboring village of La Guama along Las Cuevas river. Some villages showed significant decrease in population. Those villages may be dragged in a vicious circle; as their volume of business decreases due to smaller populations, business opportunities move away. As another example, some villages are abandoned due to harsh climate conditions that make it impossible to continue farming. e.g.) Palomino, Grande del Medio river.

(6) Land Tenure

1) Scale and owners of land tenure

According to the agricultural census (1998), farmers in Padre Las Casas, Bohechio, and Constanza, 4,042 households in total, are separated as follows by scale of land tenure: 16.3% of the total have less than 1 hectare, 55%: 1 to 5 hectares, and 19%: 5-10 hectares. As a result, approximately 90.30% of the total is laid below 10 hectares.

Table 4-18 Number of Farming Households by Scale of Land Tenure

	Padre Las Casas		Bohechio		Constanza		Total	
	# farming household	%	# farming household	%	# farming household	%	# farming household	%
> 1ha	186	10.0%	122	10.9%	350	32.9%	659	16.3%
1-4.9	1,052	56.6%	658	58.8%	519	48.8%	2,231	55.1%
5-9.9	389	20.9%	254	22.7%	118	11.1%	762	18.8%
10-19.9	170	9.1%	68	6.1%	61	5.7%	299	7.4%
20-49.9	45	2.4%	16	1.4%	7	0.7%	68	1.7%
50-99.9	14	0.8%	1	0.1%	8	0.8%	23	0.6%
100ha <	3	0.2%	0	0.0%	1	0.1%	4	0.1%
total	1,859	100.0%	1,119	100.0%	1,064	100.0%	4,045	100.0%

Source : Agricultural Census (1998)

The following table shows the number of livestock farmers, 928 in total, by scale of land.

Table 4-19 Number of Livestock Farming Households by Scale of Land Tenure

	Padre Las Casas		Bohechio		Constanza		Total	
	# of household	%	# of household	%	# of household	%	# of household	%
> 1ha	92	16.3%	16	12.9%	13	5.5%	121	13.0%
1-4.9	176	31.1%	51	41.1%	76	31.9%	303	32.7%
5-9.9	112	19.8%	28	22.6%	47	19.7%	187	20.2%
10-19.9	65	11.5%	18	14.5%	33	13.9%	116	12.5%
20-49.9	50	8.8%	7	5.6%	27	11.3%	84	9.1%
50-99.9	36	6.4%	4	3.2%	27	11.3%	67	7.2%
100ha <	35	6.2%	0	0.0%	15	6.3%	50	5.4%
total	566	100.0%	124	100.0%	238	100.0%	928	100.0%

Source : Agricultural Census (1998)

According to the census, only 10% of all the farmers have land titles, 42% of them have farmland without land title, 11% engage in farming on state land, seemingly pointing out Valle Nuevo National Park, and 4.4% of them borrow farmland. Farming for ten years automatically gives farmers right to apply for land title, however, it is quite difficult to follow the actual situation to determine how many eligible farmers exist, and moreover, have acquired titles through this rule. In addition the census does not show land scale in each category. It is, therefore, impossible to see land scale from the viewpoint of land tenure condition.

## 2) Problems Derived from Registration of Land Titles

In spite of the regulation that landowners are obliged to register land, only a small number of owners have registered mainly because registration requires high costs in land survey and registration fees. Farmers lacking land titles find it difficult to receive loans from agricultural banks, and have ceaseless anxiety about inheritance of land in the future (however, land inheritance has been made without any hindrance so far, according to the socioeconomic survey).

## 3) Inheritance of Land

Land in the Study Area is inherited by children by the same proportion. However, as mentioned earlier, currently many of the younger generation flow out to cities necessitating adjustment of land inherited among brothers and sisters in order to allocate land to those who will actually engage in farming.

## (7) Landless Farmers

Landless and small-scale farmers are concentrated in the northern part of the Study Area, Constanza, which is renowned as the largest horticultural zone in the nation. Big landowners constantly offer local farmers plenty of working opportunities with one hundred to one hundred fifty pesos a day the average daily wage. It is widely seen that managers, who are employed by landowners, control the farming land. It is, therefore, rare to find tenant style farming in the Constanza area, although it is seen more the further one moves from Constanza. Farmers in Constanza area, therefore, move around their own villages or center of Constanza with an antenna raised to catch job opportunities.

Contrary to the situation in the Constanza area, most farmers have their own farmland regardless of size in southern area centered on Padre Las Casas. However, as such, the Padre Las Casas area provides local farmers with fewer job opportunities, as farmers have no choice but to work their own farmland. Evidence that there are more migrant workers in urban areas than in the northern area proves the job opportunity condition.

### **4.3.2 Economic Conditions**

#### (1) Economic Activities

##### 1) Padre Las Casas Area

Regional economies rely nearly one hundred percent on agriculture except in some areas of Padre Las Casas and Bohechio. Agricultural produce in the region shows

similar variety such as cassava, habichuera, guandule, and maize. Differences in the regions can be seen in production of coffee, which requires mountainous area to produce. Fruit produce also can be found, however, it is quite limited in terms of quantity and quality (avocado is currently becoming popular).

Pasture spreads in Bohechio, Las Lagunas, and other areas, and marketing of cattle functions through middlemen. Goats and sheep are popular owing to donations made by churches and NGOs.

As to agro-industry in the area, factories can be found as follows: two coffee processing factories in Padre Las Casas, one in Guayabal; rice milling factories in Padre Las Casas and Bohechio. There are sawmill factories in Las Canitas, run with support of NGO, and a private one in El Tetero. The sawmill in Los Frios, run with support from a church, is currently out of operation. The area traditionally has been indifferent to handcraft and in this context, women face fewer opportunities to work in villages.

## 2) Constanza Area

Constanza, which prospers by vegetable production, has many types of small agriculture retailers engaged in sales of fertilizer, agricultural machinery, and coffee processing and sales. This situation is, limited to central Constanza and villages remote from central area fully rely on farming.

Some private companies operate flower businesses where conditions are permissible for the cultivation of flowers. It is popular in some villages to cultivate flowers in the backyard of homes, providing women with job opportunities, and these activities have received support from NGOs. As with Padre Las Casas there is no tradition for the creation of handcrafts.

## (2) Household Income

In Constanza area thirty-five percent of households earn more than 40,000 pesos a year, while in the Padre Las Casas area only fourteen percent surpasses this mark, according to the socioeconomic survey on five hundred seventy households. This indicates that in the Constanza area, more farmers practice farming in larger plots. Also, the income of thirty-five percent of households in the Padre Las Casas area falls below 9,000 pesos a year implying the presence of more farmers who have smaller plots. It shows that despite they own no land, owing to plentiful job opportunities, farmers in Constanza have



more earnings than farmers in Padre Las Casas, the majority of whom have their own farmland.

Incomes fluctuate yearly due to unstable market prices. Unstability is seen especially in the price of coffee. According to responses by coffee producers to the survey, their income fluctuates yearly more than fifty percent due to insect damage and the global market price. There are presently more farmers shifting their primary crops from coffee to avocado, which is believed to be more profitable and stable.

#### **4.4 Agriculture and Forestry in the Study Area**

##### **4.4.1 General Situation of Forestry**

While the Study Area used to be a major wood production area in the Dominican Republic, only sawing work is conducted in Sabana de San Juan today. The only relatively large reforestation sites are those under the Quisqueya Verde Plan and the site of a Spanish company mining gypsum near Bermúdez.

Seedlings are produced at permanent nurseries of the Constanza Forest Station and the Azua Forest Station. The species produced are pine (*Pinus occidentalis*), cypress (*Cupressus lusitanica*) and sabina (*Juniperus gracilior*), etc. which are supplied for the Quisqueya Verde Plan as well as to local residents. Planting is conducted in May ~ June and September ~ October when the main rainy season starts and no tending, such as pruning and thinning, is conducted.

In regard to forest protection, pest damage to pine trees is reported and the damaged trees are disposed of by means of cutting and burning. No damage by wild animals is reported.

Under the Quisqueya Verde Plan, planting is conducted over an area of 165 at Bohechio, La Guama and Arroyo Cano in San Juan Province and also over an area of 654 at Guayabal, La Siembra, Naranjo and Las Lagunas in Azua Province. For the implementation of the Quisqueya Verde Plan, the Under-Secretariat for Forest Resources and the INDRHI provided assistance for the formation of planting groups by local residents and planting is conducted at land owned by local residents in exchange for wages.

As far as wood production is concerned, there is a sawmill at Sabana de San Juan which is run by the San Juan Forest Station to sell sawn wood produced from trees damaged by Hurricane George. While there are no special facilities for the production of non-wood forest products,

the production of small construction logs, bee-keeping and the production of medicinal herbs are conducted in Azua Province under the Rational Management Project for Dry Forests of the GTZ.

#### **4.4.2 Agricultural Overview**

##### **(1) Agricultural Overview**

###### **1) Characteristics of Agricultural and Land-use Practices**

The characteristics of the agricultural activities in the upper watershed region of Sabana Yegua Dam can be divided into three major types. The first type is capital-intensive, modernized agriculture, which is characterized by the use of large-scale irrigation infrastructures, such as sluice gates and water channels. The use of agricultural chemicals such as fertilizers, pesticides and herbicides in large quantities is also characteristic of this first group. This type of agriculture is seen in the basins in the upland watershed, such as in the Constanza Basin and the La Culata Basin, and the plains around Sabana Yegua Dam. The second type of agriculture is based on slopeland irrigation using PVC pipes laid from the river's headwaters to the hilly agricultural lands. This type of activity could be classified as "transitional agriculture", that is between traditional agriculture and capital-intensive modern agriculture. Finally, there is the traditional agriculture, which does not depend on any irrigation system, but is characterized by shifting cultivation practices and the reliance on rainwater for watering the land. This traditional form of agriculture depends primarily on the climate and the land's inherent productivity.

The capital-intensive agriculture with large-scale irrigation systems requires a large investment in fixed assets. As a result, the agricultural land-use system is permanent, the same land being used repeatedly. By comparison, the slopeland agriculture also requires investing in irrigation infrastructure, but the PVC irrigation pipes are removable and are not a permanent fixture. This type of agriculture does not require permanent land-use. When farmers need to expand their land area, or re-cultivate lands which had been idle for a certain time, they can move the PVC pipes to irrigate newly opened or re-cultivated lands.

The traditional agriculture, on the other hand, has no fixed agricultural land and in order to increase agricultural production farmers tend to depend on expanding their cultivation area. Thus, farmers constantly shift their cultivation sites in search of more fertile lands; normally lands that were left idle for several years and which had

recuperated some vegetation cover. However, it has become increasingly difficult for farmers to find naturally forested areas near the villages. Thus, there are many cases where shifting cultivation agriculture is taking place on grasslands where soil fertility is very low.

## 2) Relationship between Agricultural Land and Village Formation

Another important characteristic observed in the agricultural practices of the Study Areas is the relationship between the formation of villages and the location of agricultural lands. Usually farmers do not live on their own agricultural lands, but rather build their houses close to each other along the main roads. Therefore, their agricultural lands are usually located on the outskirts of the villages, and many farmers even have to go to their farmlands on foot or by horse. Some people travel for more than 3 hours to get to their lands. Also, some farmers build temporary huts on their remote lands and temporarily migrate to their lands during the busy farming seasons, such as during land preparation, planting and harvesting.

If agricultural lands were located close to the villages, farmers would be able to use the same lands repeatedly. Likewise, if farmers had access to draft oxen, they could adopt labor-intensive agriculture and there would be more likelihood that they would abandon shifting cultivation agricultural practices. However, since farmers have remote lands requiring them to spend a great deal of time commuting, their agricultural practices are of necessity less intensive due to the limited time allotted to taking care of crops. Such a scenario naturally leads to the use of shifting cultivation agriculture for cultivating beans and pigeon pea, which require less labor inputs from the farmers. The great distance from villages to the agricultural lands is one of the primary factors preventing farmers from abandoning shifting cultivation agricultural practices in remote areas.

It is also true that these remote areas are on forest margins or even inside the National Parks' forests. Thus, fire spreading from shifting cultivation practices is a major cause of forest fires in the national parks.

## 3) Decrease in Younger Population and Increase in Elder Population

One of the important characteristics of rural agricultural communities in the Study Area is the decrease in the younger population and the increase in the aged labor population. The migration of the younger generation to urban areas and the aging of farmers are general trends observed in every rural community.

Agricultural activities on hilly terrain are not suitable for machinery use. They also require more labor in comparison to agriculture on the plains due to repeated ascents and descents on the slopeland. This topographical condition creates difficulties for aged farmers. Yet, it would be difficult for the aged farmers to abandon their shifting cultivation practices and adopt intensive agriculture that requires new types of labor and knowledge and the input of new technology.

The aged farmers own large tracts of land inside and adjacent to the villages, lands that they inherited from the area's early colonization period. But many aged farmers do not use a large part of the grasslands that lost their fertility from a long history of repeated shifting cultivation agriculture. The aged farmers often make their living by cultivating, according to their own ability, small pieces of land and lending the remaining lands to farmers who have no land.

#### 4) High Demand for Irrigation Water

The capital-intensive modern agriculture that depends largely on irrigation has created a high demand for irrigation water throughout the Study Area, especially in the Constanza basin and the plains around the Sabana Yegua Dam. A large quantity of water comes from the Valle Nuevo National Park via the Rio Grande Medio River to irrigate agricultural lands in Constanza. Another major source of water is the forested areas surrounding the Constanza basin that also supplies the irrigated sloped agricultural lands through a small sluice gate and PVC pipelines. The water coming from Rio Cuevas and Yequé del Sur rivers is used for daily necessities by households and also for irrigating the sloped agricultural lands. It is important to note that most of the water originating from this watershed is used before reaching the dam.

#### 5) Overview of Shifting Cultivation

Shifting cultivation agricultural practices are taking place mainly in the grasslands and shrub areas that are far from villages. One of the main reasons for this is that labor-intensive agriculture can be adopted on the agricultural fields close to villages. This is due to the availability of irrigation water and the employment of draft oxen. However, the greater the distance to the fields, the less time available for farmers to do agricultural work. Since much of the sloped agricultural land is located far from the villages, and not all slopeland has access to irrigation water, it is difficult to apply labor-intensive agriculture on slopeland, even though the land has that potential. Therefore, shifting cultivation agriculture is naturally more attractive to farmers with remote lands.

The crops grown in such practices are not vegetables needing high labor inputs, such as cabbage which requires frequent attention, but beans or pigeon peas which are easily transported, stored and converted to cash.

## (2) State of Agroforestry in the Study Area

A general survey of agroforestry in the Study Area resulted in the identification of only three practices which could be classified as agroforestry. They are as follows:

- Traditional shifting cultivation agriculture
- Traditional coffee cultivation (coffee combined with shade trees)
- Cattle grazing in natural dry forest stands (traditional silvopasture)

It is interesting to note, however, that none of the above three agroforestry practices were introduced based on knowledge of the merits of recently developed agroforestry methods. Rather they are traditional production methods that were simply passed down and continued until today.

Through interviews and studying literature on the subject, it became clear that the newly developed concept of agroforestry has a short history in the Dominican Republic, having been introduced only in the later half of the 1980's. The reality is that many farmers and government personnel still have the mistaken concept that agroforestry means creating fruit orchards. However, it is encouraging to see that the Forestry School in Jarabacoa has an agroforestry program with various demonstrative forests incorporating animals and organic fertilizers.

Next to the Study Area, a church related NGO known as ADESJO has a project with hedgerows of *Leucaena* (*Leucaena leucocephala*) or *Calliandra* (*Calliandra calothyrsus*) planted in contour lines to conserve farmland soil. The project made a contract with local residents to lay PVC pipes to bring water to farmland concentrated in one area, and to establish hedgerow agroforestry in exchange for the farmers ceasing shifting cultivation agriculture. The project is based on local participation in slopeland irrigation agriculture. The newly established and irrigated hillside field located near the village is more productive than the old shifting cultivation land, saving farmers' travelling time and making it possible for them to practice labor intensive agriculture.

The project's comprehensive application of alley cropping with *Leucaena*, organic fertilizer and draft oxen to slopeland irrigation agriculture has proven to be a form of agroforestry that is a viable alternative to shifting cultivation agriculture.

### (3) Rural Finance

The Agriculture Bank (Banco Agricola) plays the principal role in providing public financing for agriculture. The bank's interest rate is 18%. Most of the hillside farmers in the Study Area have never received a loan from the bank. When the need for funds arises, the farmers almost always borrow money from relatives or friends, or sell cattle to secure the necessary funds. Some farmers even borrow money at high interest rates from unofficial lenders.

The majority of the bank's loans are made to farmers holding land titles or farmers without land titles, but ranked from A to E. Farmers who are excluded from receiving bank loans are those who do not have irrigation facilities, those who have PVC pipelines for irrigation but whose hillside lands are inadequate for farming, or whose lands are within the watershed conservation area. Farmers holding land titles may receive a loan for up to 70% of their land value; farmers without land title but in rank "A1" may receive 200,000 pesos, "A" rank farmers 150,000 pesos, and "B" rank farmers 70,000 pesos.

However, there are highly productive lands with irrigation facilities which cannot receive loans.

## **4.5 Realities of Forest Fires**

### **4.5.1 Situation of Forest Fire Occurrence**

#### (1) Situation of Forest Fires in Dominican Republic and Study Area

The annual number of forest fires recorded in the entire Dominican Republic in the period of 39 years from 1962 to 2000 is shown in Fig. 4-4. A total of 5,069 forest fires occurred during these 39 years and 271,273 ha of forests were destroyed. This figure far exceeds the size of the Study Area of 166,000 ha.

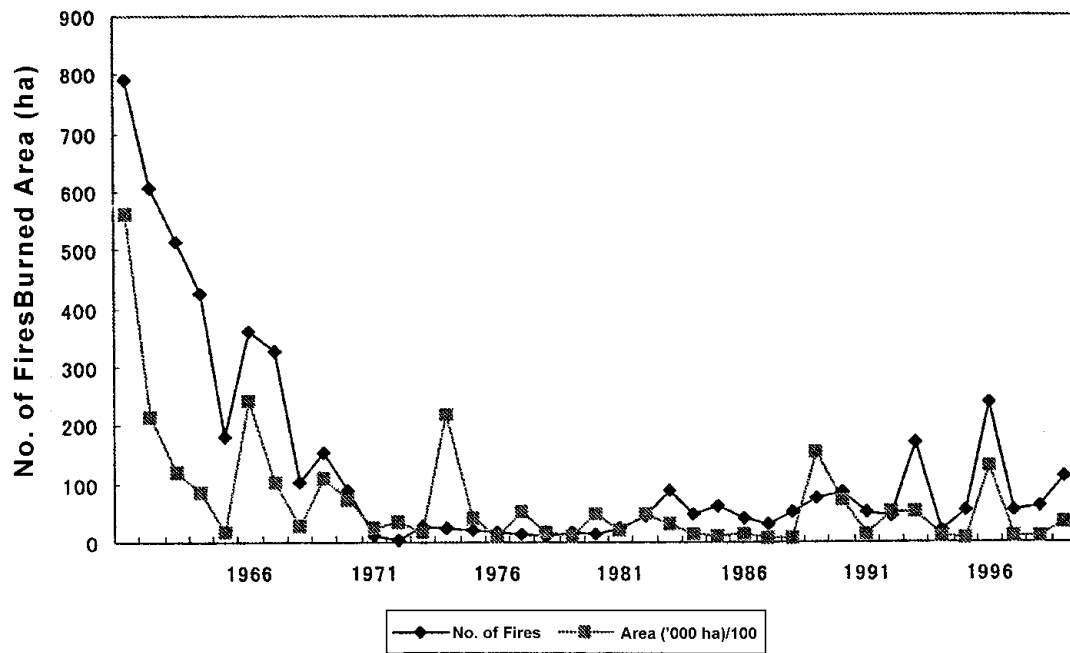


Fig. 4-4 Situation of Forest Fires in Dominican Republic

The annual number of forest fires showed a declining trend from the peak year of 1962 and this decline presumably reflected the facts that the Law No. 5856 on Conservation of Forests and Fruit Trees was enacted in 1962 under which Directorate General of Forestry as the regulator of forestry activities and the organization responsible for the management of forest resources was established and that the regime to prohibit cutting was further strengthened with the enactment of Law No. 705 in 1967 under which the Directorate General of Forestry was transferred to the Ministry of Home Affairs from the Ministry of Agriculture.

In 1973, the number of forest fires hit the bottom with only five recorded, followed by a low level of occurrence until 1982 when Law No. 318 was enacted, changing the regime to one which prohibited cutting in principle and allowed cutting under sustainable management, i.e. forest management under an adequate forest management plan, resulting in an increase of accidental fires.

In the subsequent year of 1990 when the increase of forest fires was evident, Law No. 5856 was revised to introduce a total cutting ban within a distance of 500m of a river in a headwater area and the level of forest fires continued to be low except in 1994, 1997 and 2000.

Such a situation in the past suggests that statutory regulation and law enforcement constitute a desirable factor in the decline of the number of forest fires.

Since 1971, the annual number of forest fires has been generally low except in 1994 with 170 cases, 1997 with 238 cases and 2000 with 114 cases. It is said that arsonists were very active in these years which were election years.

Meanwhile, in the Study Area, i.e. the upper reaches of Sabana Yegua Dam, 132 cases of forest fires were recorded in 1997 when statistics for the Study Area were first compiled, followed by 33 cases in 1998, 43 cases in 1999 (up to this year, the figure included some forest fires outside the Study Area) and 42 cases in 2000.

The ratio of forest fires in the Study Area in the nationwide number of forest fires was fairly high in 1997 at 55.5%, 1998 at 60.0%, 1999 at 70.5% and 2000 at 64.9%.

In the 20 year period since 1981, 1990 and 1997 stand out in terms of the forest area destroyed by fires with 15,259 ha and 13,101 ha respectively.

## (2) Causes of Forest Fires

There are no long-term national statistics or statistics for the Study Area on the cases of forest fires, partly because of the lack of a system to study forest fires. Given this situation, the forest fire records (summary) for the Study Area for 2000 for which the causes of the fires were relatively established were studied in detail. Out of the total number of forest fires (42 in 2000, the causes of 35 fires are known. In 18 cases (51%), the main cause was the spread of fire from shifting cultivation. Interviews with staff members of the forest management bureaus and residents of the Study Area to establish the causes of forest fires in detail found the following main causes.

- Spread of fire from shifting cultivation
- Spread of fire from burning to revive pasture or to expand pasture land
- Arson (to produce dead trees for various uses; grudge against the government or individuals)
- Carelessness on the part of forest users (hunters, bee-keepers, farmers, firewood collectors and charcoal producers)
- Fires of campers, etc., carelessness on the part of smokers and people using ovens
- Electric discharge (lightning and loose electrical cables, etc.)
- Spread of fire from burning designed to change the dominant species
- Accidental fire due to car accidents



### (3) Seasonal Fluctuations of Occurrence of Forest Fires

In regard to seasonal fluctuations of the occurrence of forest fires, there are two periods with a high level of forest fire occurrence, i.e. from February to April and from June to September, which coincide with the periods of low rainfall and farmland preparation. Table 4-20 shows the monthly breakdown of forest fires in 2000 in the Study Area.

Table 4-20 Number of Forest Fires in Study Area (2000)

Month	Azua		Jarabacoa		San Juan		Sub-Total		Total
	Forest	Pastureland	Forest	Pastureland	Forest	Pastureland	Forest	Pastureland	
Jan.	1					1	1	1	2
Feb.	3	3	2	2		6	5	11	16
Mar.	3	2	9	5	7	6	19	13	32
Apr.	3	1	4	4	4	3	11	8	19
May			1				1		1
June	1		3				4		4
July	2	3	16	2			18	5	23
Aug.	1	3	3			1	4	4	8
Sept.	1		3				4		4
Oct.			1				1		1
Nov.			3				3		3
Dec.			3				3		3
Total	15	12	48	13	11	17	74	42	116

Source : Report of the Secretariat of State for Environment and Natural Resources 2000

## 4.5.2 Present Situation of Forest Fire Control Measures

### (1) Laws Relating to Forest Fire Control Measures

Apart from the laws referred to in 4.5.1, laws relating to forest fire control measures include the Law Concerning Environment and Natural Resources (Law No. 64-00 promulgated on 18<sup>th</sup> August, 2000) which provides the basis for the annual National Programme for Forest Fire Prevention and Management. Forest fire control measures are implemented in accordance with this Programme.

Although these laws and Programme stipulate the general plan for forest fire control measures, they lack clear provisions for the forest fire protection system. Despite this, the Forest Fire Prevention and Management Work Plan (formulated by the Forest Protection and Fire Service Bureau of the Under-Secretariat of Forest Resources) for 2001 which is based on the National Programme for Forest Fire Prevention and Management often uses

the expression of “forest fire-fighters” but does not clearly set forth the system, position and duties of such forest fire-fighters.

The Law Concerning Fire Service Headquarters (Law Concerning the Establishment of Fire Stations, Law No. 2527 enforced on 2<sup>nd</sup> June, 1912) only stipulates the obligation of each municipality to set up a fire station and does not have any provisions describing the geographical area of jurisdiction of each fire service headquarters or fire prevention and extinguishing systems.

## (2) Forest Fire Prevention System

Article 1 of the Resolution Based on Notification by the Director-General of Forestry, President’s Office of the Dominican Republic (25<sup>th</sup> December, 1999) stipulates that “the National Programme for Forest Fire Prevention and Management shall be approved and executed”. The Forest Fire Prevention Programme for 2001, formulated on the basis of the said provision, calls for the strengthening of the educational programme in areas facing a forest fire hazard coupled with forest fire prevention activities designed to improve the awareness of local residents.

The Programme for 2001 also calls for the creation of a collaborative network for forest fire prevention and management with the participation of the military, the police, civil defence organizations, the Red Cross and agricultural banks, etc.

Given the facts that forest fires frequently occur and that hardly any outdoor notice boards carrying forest fire prevention messages are observed in villages, at entrances to and along roads running through forests or forest roads and at camping sites, etc. in either the Study Area or its surrounding area, the forest fire prevention system appears to be far from satisfactory. There are, in fact, problems regarding improvement of the fire prevention awareness of local residents, networking for forest fire prevention and manpower and budgetary allocation for forest fire prevention at the time of burning at farmland.

As far as shifting cultivation, which is the main cause of forest fires, is concerned, the slash and burn method of agriculture is strictly regulated. In principle, the slash and burn method is prohibited as a dangerous act which could cause forest fires and which is only permitted when the relevant conditions are met.

Permission for shifting cultivation falls under the jurisdiction of the forest management bureaus. When an application is submitted, the documents are examined by a staff

member of the bureau. Burning is only permitted when a field investigation to check the compliance of the applicant with the safety requirements for shifting cultivation finds that these requirements/conditions are fully met.

Nevertheless, many farmers conduct burning without applying for permission, leading to forest fires. To prevent such a persistent practice, forest management offices send officers to provide guidance for local farmers on the shifting cultivation application procedure and important points for burning. These officers also provide the necessary guidance at the time of monitoring and through forest fire prevention workshops.

Forest management officers provide guidance for farmers planning to burn their farmland on burning methods, including the introduction of firebreaks by means of grass cutting prior to burning. In addition, the timing of burning is set either early in the morning or in the evening when the risk of the fire spreading is minimum. In many cases, the entire villagers participate in burning while forest fire-fighters often control or supervise burning for shifting cultivation purposes.

### (3) Forest Fire Extinguishing System

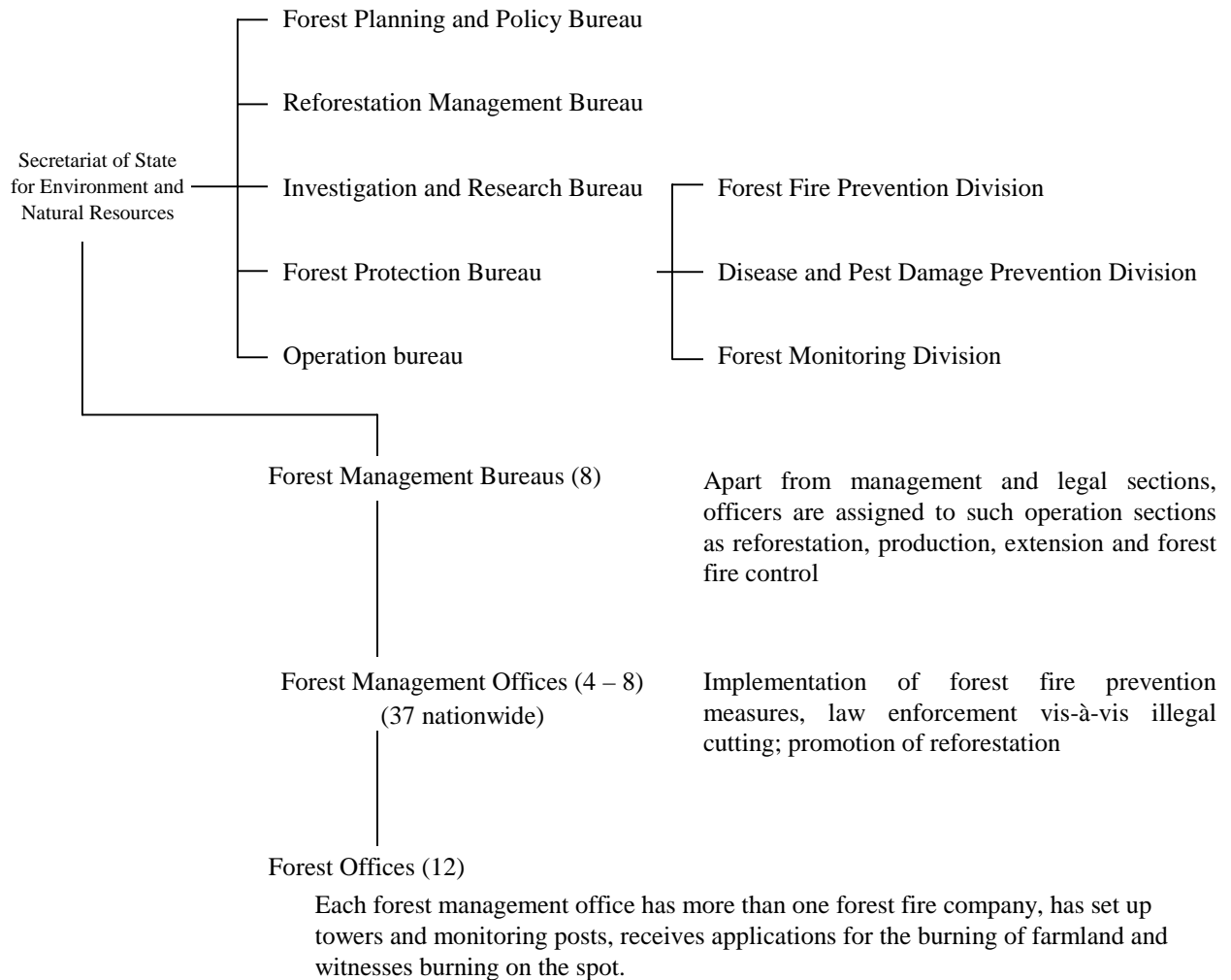
Even though the Study Area is an area with frequent occurrences of forest fires in the Dominican Republic, not many forest fire-fighters are deployed. The present forest fire prevention and extinguishing system appears to be inadequate in terms of the organization, facilities and equipment of the forest management bureaus and local forest management offices.

Moreover, the flow of forest fire-fighting operation, starting from the discovery of a fire to reporting, dispatch, arrival at the fire scene and fire extinguishing and command activities, is neither clearly defined nor systematically carried out.

#### 1) Organization

Forest fire officers are deployed at forest management offices and forest offices in the Study Area and fire companies are organized to fight forest fires. No volunteer fire corps has been organized. The organizations relating to forest fire control in the Dominican Republic are shown in the diagramme below.

## Organizations Relating to Forest Fire Control



### 2) Forest Fire Companies and Number of Fire-Fighters

In the Study Area, nine forest fire officers, five forest fire companies and 86 fire-fighters are assigned to nine forest management offices. The scale of forest fire-fighter deployment by district is 15 for Constanza, 10 for Azua, 17 for Ocoa, 18 for Padre Las Casas and 26 for San Juan. However, none of these fire-fighters are full-time and they are also involved in other types of duties, including reforestation and nursery management.

### 3) Equipment

The three forest management offices in the Study Area possess radio communication equipment, various fire protection equipment and trucks for the transportation of personnel and equipment, etc. However, the trucks are used for all types of work at the offices. There are nine base stations for radio communication. Five are installed

at the forest offices and the four others are installed at monitoring stations. In addition, there are 12 mobile radio communication units (5 W) (three units have been deployed by the Government of the Dominican Republic at three monitoring stations and nine units have been provided by the Government of Japan). At those monitoring stations which are not linked to the power grid, power is supplied by solar cells.

There is a total of 132 fire-fighting tools, consisting of 12 sickles, 12 hatchets, 21 broad-axes, 26 reaping hooks, 30 weeding hoes, 12 pickaxes, 18 fire-beaters and one backfire pot.

This means that when it is necessary to urgently transport fire-fighters and fire extinguishing equipment, etc. to the scene of a fire or when a forest fire occurs at a time when fire-fighters are engaged in other types of work, necessitating the dispatch of fire-fighters in separate groups, one truck is insufficient. In such a case, additional trucks are borrowed from local public-spirited people to conduct the necessary work.

No fire-fighting tools have been given to local residents. When local residents arrive at the scene of a forest fire prior to the arrival of forest fire-fighters (this is a fairly common occurrence), they use tree branches as fire beaters until the arrival of the forest fire-fighters. Following the arrival of forest fire-fighters, these local residents may use the surplus tools brought by the fire companies.

#### **4.6 Current Situation of Protected Areas**

Two national parks, i.e. the Jose del Carmen Ramírez National Park (40,038 ha) and the Valle Nuevo National Park (39,584 ha), are located in the Study Area. The total area of these two protected areas accounts for 48% of the Study Area. The forest area in these national parks accounts for some 65% of the total forest area of the Study Area (DIRENA, 2000).

Despite their status, illegal settlers are engaged in farming inside the national parks. The Valle Nuevo National Park in particular has relatively large hamlets, such as Pinal Bonito and others.

Although the National Park Administration is planning such measures as (i) the prevention of new illegal settlers and (ii) the co-existence of existing settlers with forests, no concrete criteria have been developed so far because of the historical background of illegal settlement

and the socioeconomic problems associated with these measures. No effective measures to restore devastated land and to implement reforestation projects inside the national parks have so far been put forward because of their implication vis-à-vis the protection of nature and such problems as accessibility to the subject sites.

While buffer zones have been introduced in each national park in recent years to preserve the ecosystem, the absence of legal foundations means that the target areas and technical guidelines, etc. have not yet been developed. In regard to forest fire control, the said Administration is planning the development of infrastructure, the introduction of a monitoring and communication system and the provision of training for local residents and is collaborating with the Under-Secretariat of State for Forest Resources.

In short, although there are vast protected areas in the Study Area, the illegal settlers living in these areas are causing the devastation of forests.

**CHAPTER 5 CAUSES OF WATERSHED  
DEGRADATION**

## **CHAPTER 5 CAUSES OF WATERSHED DEGRADATION**

The quantitative as well as qualitative decline of forests due to watershed degradation reduces the headwater conservation function and soil loss prevention function of forests, causing such problems as (i) soil discharge due to landslides, (ii) deterioration of the land productivity due to loss of the top soil, (iii) damage to dams and roads due to flooding and (iv) adverse impacts on agricultural production and the supply of domestic water due to drought.

In the present Study, the causes of watershed degradation are analysed from such aspects as forest management, natural environment and socioeconomy.

### **5.1 Causes Associated with Forest Management**

#### **5.1.1 Inappropriate Forest Use**

One major cause of forest degradation and depletion is believed to be the disorderly cutting of mahogany and pine from the second half of the 19<sup>th</sup> Century until 1967. To be more precise, the domestic road network was developed during the US occupation from 1916 to 1924, prompting the exploitation of pine forests in the Central Mountains where the Study Area is located. Under the dictatorship of General Trujillo which commenced in 1930, 198,300 m<sup>3</sup> of wood (average for 1931, 1932 and 1933) was produced annually, totalling some 2,368,000 m<sup>3</sup> of wood in the next 37 years until 1967 when the Law Concerning Prohibition of Tree Cutting (Law No. 206) was enacted.

The extreme forest protection policies introduced in 1967 (Law No. 206) and 1982 (Law No. 705) tightened the restrictions on forest use by landowners and local residents with these people losing their interest in and commitment to forestry work and forest preservation. The forest degradation and depletion were further aggravated by farming and grazing at cut-over sites.

Meanwhile, population growth and the presence of poor and/or landless farmers prompted disorderly shifting cultivation and farming on steep slopes. As a result, soil erosion and forest fires became a frequent occurrence, causing the degradation of forests.

Such inappropriate use of forests led to large-scale enclosure by large landowners, the illegal invasion of national parks and the illegal cutting of dry forests, preventing the implementation of rational forest management.



## **5.1.2 Absence of Rational Forest Management**

Although policies calling for rational forest management were absent for a long period of time because of the continual policy of a heavy bias towards restrictions on the cutting of trees and other usages of forests, Law No. 291 of 1985 gave impetus to the introduction of rational forest management policies. To be more precise, this law revised Law No. 705 of 1982 and permitted cutting with certain restrictions and the operation of sawmills. Trees which could be cut included trees damaged by a natural disaster, etc., trees of which the cutting was necessary for agricultural, industrial or tourism projects and trees planted in artificial forests. The approval of a forest management plan by the National Forest Technical Committee was required for the cutting of artificial forests.

Law No. 291 of 1985 alone, however, was insufficient to achieve rational and systematic forest management and Law No. 118 enacted in 1999 clarified the direction for forest management. The basic concept adopted by Law No. 118-99 is expected to remain unchanged by the new law to be introduced after its review pursuant to Law No. 64-00 enacted in 2000. This new law specifies the idea, criteria and indicators for sustainable forest management in a concrete manner together with technical criteria for the evaluation and approval of forest management plans and the forest inventory method.

The next major challenge for the Under-Secretariat for Forest Resources is how to ensure rational forest management for each watershed, such as the Study Area, with a view to contributing to watershed as well as forest conservation.

## **5.2 Causes Associated with Natural Conditions**

### **5.2.1 Hurricane Damage**

The Dominican Republic is chronically exposed to hurricanes and the Study Area, for example, suffered severe damage due to Hurricane David and Hurricane Frederick in 1997 and Hurricane George in 1998. When it landed on the Dominican Republic on 22<sup>nd</sup> September, 1998, Hurricane George was a Category 3 hurricane (wind velocity of approximately 58 m/sec) which ran across the country from east to west on the same day. This hurricane inflicted the greatest damage to the social and industrial infrastructure, homes, agricultural crops and forests, etc. in the last 20 years. In the Study Area, a concrete bridge over Yaque del Sur River and its approach roads at El Palmar were destroyed due to flooding and their reconstruction is still in progress today. In the case of El Recodo and neighbouring villages in the upper reaches of Las Cuevas River, most of the homes were destroyed and had

to be rebuilt. According to the Under-Secretariat for Forest Resources, some 5,200 pine (*Pinus occidentalis*) trees were either toppled or damaged in the Sabana de San Juan area alone and some 2,200 ha of forests were damaged. Fallen trees and damaged trees can still be seen in many places throughout the Study Area even two years after the disaster.

The damage caused by hurricanes has the largest impact on watershed degradation and is practically impossible to control by human means.

### **5.2.2 Vulnerable Natural Conditions**

The Study Area consists of steep mountainous land with an inclination of 40 – 60% and, therefore, is naturally vulnerable to sheet erosion. From the viewpoint of water and soil conservation, farmland development on such steep slopes should be avoided. However, the reality is that the surface vegetation is being destroyed by shifting cultivation, grazing and tree cutting and burning associated with these activities.

In general, surface vegetation contributes to levelling of the peak flow rate of a river by performing such functions as temporarily retaining rainwater with leaves, branches, trunks and the humus layer on the ground surface and returning part of the retained water through evapotranspiration or filtrating such water into the ground. When this surface vegetation is destroyed, the rain falls directly onto the ground surface, piercing the top soil. The rainwater runs down the ground surface while dragging soil grains and organic matters with it and rapidly flows into a stream. In a place like the Study Area which is characterised by steep slopes with a top layer compacted by domestic animals, there is no time for rainwater to infiltrate into the ground. As a result, rainwater tends to flow along the ground surface. Apart from soil loss, there is a possibility of a decline of the soil fertility because of the lack of infiltration of organic matters into the ground.

Despite the unfavourable conditions of steep mountainous land liable to soil loss, the Study Area has been subject to extensive agricultural development, including the creation of grazing land, and this situation has been worsened by burning and excessive grazing, resulting in a serious decline of the water and soil conservation function. This present situation suggests the necessity to preserve and enhance the humus layer as well as the undergrowth which retain water and facilitate the infiltration of water into the ground or to introduce alternative conservation measures.

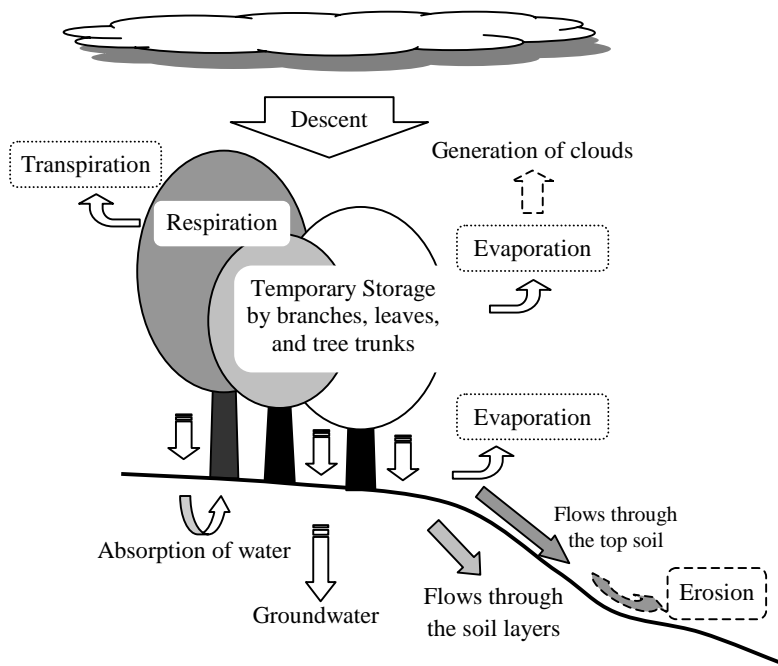


Fig. 5-1 Hydrological Cycle

Rainwater is temporarily stored in branches, leaves, and tree trunks, part of which returns to the air because of evaporation and the remainder of which reaches the top soil in the form of drops or travelling by tree trunks.

A third of the rainwater that reaches the top soil stays in the ground vegetation or in the humus layer and evaporates, another third infiltrates into the ground and the remaining third flows directly into the top soil.

A third of the rainwater that infiltrates into the ground is absorbed by vegetation and returns to the air again through transpiration. Another third flows through the soil layers while the remaining third deeply infiltrates into the ground to form groundwater.

The rainwater that flows through the top soil due to the force of the water causes soil erosion.

### 5.3 Causes Associated with Socioeconomic Conditions

#### 5.3.1 Forest Degradation Due to Shifting Cultivation and Grazing

##### (1) Forest Degradation Due to Shifting Cultivation

Shifting cultivation is a sustainable method of agriculture and is recognised as one form of agroforestry when there is a vast expanse of forest which has not yet been cleared and which has strong power of natural restoration coupled with (i) a feasible fallow period of several tens of years and (ii) the existence of a source of seeds in the soil or nearby. This is because abandoned farmland can restore a sufficient forest biomass volume during a long fallow period. The purpose of shifting cultivation is to burn biomass on the ground surface, particularly biomass in a forest, to reduce the nutrients accumulated in the biomass into soil in a form which can be absorbed by crops so that sufficient nutrients are available in the soil for the next round of cultivation. It has many advantages for farmers, including the fact that the hard work of removing vegetation from farmland is unnecessary. Accordingly, shifting cultivation has prevailed in the Study Area for a long period of time, devastating local forests to their present state. When the elders of every village were asked to remember their village's past as part of the PRA, the common recollection was that many forests used to exist in and around the village together with abundant rain and water but that these forests have eventually been degraded or depleted due to cutting, shifting cultivation and/or grazing.

Even today, many farmers in the Study Area are repeatedly involved in shifting cultivation by burning shrub land and grassland. Shifting cultivation at grassland where stands have not yet been restored causes a decline of the yield due to the physical deterioration as well as deterioration of the fertility of the soil. Any cultivation method involving burning is not generally refined and the level of yield per unit area is low. Accordingly, many farmers try to maintain or increase the level of the yield by means of expanding the area of cultivation.

If the farmland used for shifting cultivation is left fallow for a sufficient number of years to restore shrub land, shifting cultivation can be considered to be a sustainable method of agriculture. In the Study Area, however, much of the farmland is burned before it has been restored to shrub land or during the state of grassland. Under this condition, shifting cultivation is not a sustainable method of agriculture and is instead a type of farming which destroys land resources. Some farmers believe that returning the cut vegetation to the soil without burning it to ash cannot produce a reasonable harvest level while others simply think that there is no feasible farming method other than shifting cultivation. It is unfortunately a fact that burning is the only way to save the labour required to remove vegetation. The shrubs near dry forests are often thorny and the removal of trees after clearance by a means other than burning is difficult.

## (2) Forest Degradation Due to Grazing

Cattle grazing can be said to be an even greater cause of forest degradation and conversion to grassland than shifting cultivation. Livestock raising requires capital investment in cattle and extensive land. In general, ranches are run by large landowners with large income. Cattle are kept in herds that freely roam the land in search of grass. A long-term effect of grazing on the same land is hardening of the soil due to repeated trampling by cattle crisscrossing the same areas. When trees regerminate, the buds are eaten or trampled by the cattle, obstructing their growth. Furthermore, landowners usually cut down the trees on their property that could obstruct pasture growth.

In the case of hilly land, the repeated crossing of cattle has created a pattern of horizontal paths along the hillsides where the soil becomes compacted and bare and subject to erosion. During the rainy season, the grass sprouts on the bare ground but the cattle eat the new growth before it can reach a height where it would cover the soil to protect it from erosion, exposing the ground again. As a result, sloping land is particularly vulnerable to soil erosion during the rainy season and soil degradation continues to advance at such land.

Once a forest is converted to grassland, farmers burn the old grass just before the rainy season begins to encourage new growth when the rain starts. However, the fire damages the dormant tree seeds in the soil and, in these circumstances, the natural regeneration of a forest is difficult.

Grazing land has been formed over the course of many years. The process from forest to grazing land takes many forms. The original forest may have been cut to secure wood resources and the undergrowth then burned with the planting of grass seeds to form grazing land, grassland may have formed naturally after a forest fire or grass seeds may have been planted to form grazing land after abandoning shifting cultivation. Shifting cultivation sites are often dispersed in a spotted pattern throughout a forest. In contrast, grazing land incorporates large extensive areas. As mentioned above, this is due to large landowners who have the financial and land resources to manage grazing land. Another reason for the expansion of grazing land is that farmers who have to sell their land for one reason or another often sell to grazing land owners who have the financial resources to add to their grazing land holdings.

Large landowners often have political power through which they obtained forest cutting concession rights. After receiving such rights, timber harvesting commenced and continued until 1967. The owners of concession rights also claim that their concession area is registered as their property even though they do not conduct activities on the property. These landowners are usually absent from their property and many farmers have entered these absentee areas and established their own plots. The continuous and unsustainable use of the land by these farmers and the negligence of the owners often lead to extensive fires and these factors have also contributed to the creation of permanent grassland. All of these are causes of the vast expanses of grassland seen today.

### **5.3.2 Forest Degradation Due to Forest Fires**

The Study Area is one of the main areas known for the frequent occurrence of forest fires in the Dominican Republic. In the last few years alone, up to several hundred hectares of forest area have been damaged by each fire. Many forest fires occur in highland pine forests. Although forest fires have many different causes, the spread of fire from burning for shifting cultivation or burning to maintain grazing land is the principal cause of forest fires.

Damage is caused by either ground fires or crown fires and the extent is determined by the weather as well as site conditions at the time of a fire. The damage to trees by ground fires is less extensive than that by crown fires as it tends to scorch only the basal area. Ground fires

cause more extensive damage to the undergrowth than to standing trees. At a former forest fire site at Sabana de San Juan, a true grass species called Jaragua (*Melinis menatiflora*) is seen to have covered the ground surface. However, some former forest fire sites near Constanza have become bare land due to the absence of undergrowth, implying possible soil erosion. The damage by crown fires threatens the very existence of a forest, creating problems of soil loss and the surface flow of rainwater due to the loss of forest cover.

In any case, the negative impacts of forest fires on soil conservation and the regeneration of vegetation cause the major problem of forest degradation in watersheds. In order to prevent such impacts, the Protection and Control Administration of the Under-Secretariat for Forest Resources deploys staff members in charge of forest fires and fire companies at forest management offices and forest stations. However, as forest fires tend to occur in remote areas with poor accessibility, it is difficult to smoothly and efficiently conduct fire-fighting activities. Education on the negative impacts of forest fires on productive activities should be provided for local residents together with guidance on and the supervision of burning for shifting cultivation and the lack of effective educational as well as guidance activities due to limited manpower and budget is deemed to be one cause of the failure to prevent forest fires.

### **5.3.3 Watershed Degradation Due to Use of Firewood**

The Government of the Dominican Republic has been encouraging the wide use of gas by households while trying to strictly enforce the laws prohibiting tree cutting. Although gas is used in the Study Area, its popularity in villages has recently declined. 80% of local households actually use firewood as the domestic fuel. There is a strong possibility that trees are still being cut to produce firewood and this lingering practice is another cause of watershed devastation. As the increasing trend of firewood use appears to be the direct result of the increasing price of gas under the policy of the present government, there is real concern in regard to a further rise of firewood use unless the government policy on energy pricing is altered.

## **CHAPTER 6 DEMONSTRATION PROJECT**

## CHAPTER 6 DEMONSTRATION PROJECT

### 6.1 Forest Fire Control Measures

#### 6.1.1 Demonstration Project of Forest Fire Control Measures

##### (1) Objectives

During the first field survey period, a workshop on forest fire control measures was held to form a consensus on forest fire control measures among forest management officers and local residents in order to establish forest fire prevention measures. At the same time, guidance was provided on fire extinguishing skills to transfer such skills to the Dominican side.

##### (2) Workshop on Forest Fire Control Measures

A workshop on forest fire control measures was held at three villages in the Study Area where forest fires have frequently occurred in the past. Forest management officers and local residents were invited to participated in the workshop with a view to identifying effective forest fire prevention measures.

In each workshop, the participants were divided into three groups after the initial briefing by the counterparts. Each group consisted of forest management officers and local residents and a coordinator was selected for each group to lead the group discussions. Finally, a plenary session led by the counterparts was held to put the various opinions together. The workshops aimed at clarifying the following five main issues.

- ① Measures to promote forest fire prevention
- ② Establishment of a forest fire early detection and early reporting system
- ③ Important points and guidance method for the burning of farmland (shifting cultivation)
- ④ Measures to prevent the spread of fire (introduction of firebreaks, etc.)
- ⑤ Establishment of a fire extinguishing activity system

Further details of the workshops are given in Table 6-1 and Table 6-2.



Table 6-1 Implementation Schedule for Workshops on Forest Fire Control Measures

Details	San Juan	Constanza	Padre Las Casas
Date	15 <sup>th</sup> December, 2000 (Fri.)	22 <sup>nd</sup> December, 2000 (Fri.)	12 <sup>th</sup> January, 2000 (Fri.)
Total Duration	3 hours and 5 minutes	3 hours and 15 minutes	3 hours and 40 minutes
Location	Sabaneta Nursery	Constanza Forest Management Office	Quebas Village Hall
No. of Participants	23 (12 officers and 11 residents)	37 (19 officers and 18 residents)	26 (10 officers and 16 residents)

Table 6-2 Outputs of Workshop on Forest Fire Control Measures

Fire Prevention Promotion Measures	<ul style="list-style-type: none"> <li>• It is necessary to raise the awareness of local residents by means of erecting information boards, etc.</li> <li>• It is necessary to raise the awareness of local residents through the use of textbooks.</li> <li>• It is necessary to organize residents' meetings to promote prevention measures.</li> <li>• It is important to emphasise the importance of education for raising of the awareness for fire prevention.</li> <li>• It is necessary to clarify the causes of fires to prevent fires.</li> <li>• It is necessary to improve the collaboration system between the forest management offices and local communities (creation of fire prevention teams).</li> <li>• It is necessary for local residents to develop a sense of coexistence with the environment.</li> <li>• It is necessary for the forest management bureaus to improve their communication with villagers in order to prevent the destruction of forests.</li> </ul>
Early Detection and Early Reporting System	<ul style="list-style-type: none"> <li>• It is necessary to tighten the monitoring system by promoting the construction of monitoring towers.</li> <li>• It is necessary to provide donkeys as these are essential for people who do not have a radio communication system to report the occurrence of a fire.</li> <li>• It is necessary to develop a radio communication system (mobile stations).</li> </ul>
Important Points and Guidance Method for Burning of Farmland	<ul style="list-style-type: none"> <li>• The burning of farmland should be conducted with the presence of a forest management bureau officer.</li> <li>• The burning of farmland should be notified to the forest management bureau without fail.</li> </ul>
Measures to Prevent Spread of Fire	<ul style="list-style-type: none"> <li>• It is important to introduce firebreaks.</li> <li>• It is essential to create fire prevention forests.</li> </ul>
Establishment of Fire Extinguishing Activity System	<ul style="list-style-type: none"> <li>• It is necessary to strengthen the collaboration system between the forest management bureaus and local communities.</li> <li>• It is necessary for local residents to participate in fire extinguishing activities as volunteers through a communal organization.</li> <li>• It is necessary for local residents to form volunteer fire corps for more effective fire extinguishing activities than their present assistance which involves the use of only some tools and tree branches.</li> <li>• Volunteer fire corps can be quickly formed with the help of the village priest.</li> <li>• It is necessary to increase the number and quality of the equipment and tools for fire companies.</li> <li>• It is necessary to deploy vehicles for fire companies to respond to a fire.</li> <li>• Fire extinguishing tools should be provided for local communities as local residents are the first people to arrive at the scene of a fire.</li> <li>• It is possible to use irrigation water taps for fire extinguishing activities.</li> <li>• It is necessary to improve roads to have a quick access to fire sites.</li> <li>• It is necessary to deploy a bulldozer for road construction and improvement.</li> </ul>

As most of these outputs were common for all three workshops, it appears safe to assume that there is a common understanding of the required forest fire control measures with minor variations from one area to another.

(3) Formulation of Volunteer Fire-Fighting Organization (Volunteer Fire Corps)

The interview survey conducted during the workshops and at 16 villages in the Study Area with 386 people found that in many cases of forest fire, villagers are the first to arrive at the scene of a fire and that most of the villagers interviewed have had the experience of participating in fire extinguishing activities. Most of the villagers interviewed also expressed their willingness to participate in fire extinguishing activities as volunteers. Based on the understanding that collaboration with local residents is essential to implement forest fire control measures, a meeting was held in 21 villages in the Study Area to explain the need for and to provide guidance on the formation of a volunteer fire organization (hereinafter referred to as “volunteer fire corps”).

At the two villages listed below, a concrete explanation of the formation of a volunteer fire corps as a matter of priority was given because of the experience of being involved in forest fire extinguishing activities. Given the very positive response by the villagers, the conditions appear to be ripe for the formation of a volunteer fire corps.

1) Constanza

- ① Date : 5<sup>th</sup> June, 2001
- ② Location : Los Corralitos Village Hall
- ③ Contents : The purpose of forming a volunteer fire corps was explained and a promise was given to form such a volunteer fire corps with some 20 members together with agreement to control the equipment and tools by the volunteer fire corps. The use of a government building in the area as a storage place for the equipment and tools for the volunteer fire corps was agreed.
- ④ Participants : 16 villagers, including the village head

2) San Juan

- ① Date : 12<sup>th</sup> June, 2001
- ② Location : Los Frios Forest Monitoring Station
- ③ Contents : An explanation similar to that in Constanza was given and the village side said that the matter would be decided at a village meeting. It was agreed that the forest monitoring station would be used to store the equipment and tools of the volunteer fire corps.
- ④ Participants : 10 village officials

As of August, 2001, 20 males ranging from 17 to 60 in age have volunteered to participate in the volunteer fire corps in Constanza.

Efforts are in progress to form a volunteer fire corps in areas other than the two areas described above, suggesting a rising mood to form volunteer fire corps in the Study Area.

The study on the formation of volunteer fire corps which was conducted at the time of the workshop or village survey found that potential members of the volunteer fire corps were ready to manage and maintain the fire extinguishing equipment and tools in most villages once a storage place was established.

In short, there is an urgent need to examine possible ways of using local manpower in view of (i) the necessity for such manpower to ensure the maximum prevention of forest fire damage and (ii) the rising mood to form volunteer fire corps in the Study Area.

(4) Transfer of Fire Extinguishing Skills

As part of the demonstration project, guidance on fire extinguishing skills was provided for staff members of the forest management bureaus (mainly forest fire-fighters) and local residents at three locations in the Study Area using fire extinguishing equipment and tools provided by the Government of Japan. This transfer of skills involved training on the use of various equipment and tools, including training on discipline, joint training involving both forest fire-fighters and local residents and integrated training using all equipment and tools.

### Details of Training

- ① Targets : Fire-fighters of forest management bureaus and local residents
- ② Location : San Juan - Sabaneta Nursery  
Sabaneta Dam Site  
Constanza - Bermudez Nursery  
Padre Las Casas - Las Cuevas dry riverbed in Guaybal
- ③ Total Days : 14 days
- ④ Total Hours : 64 hours and 15 minutes
- ⑤ Participants : 517 (357 staff members of forest management bureaus and 160 villagers)
- ⑥ Equipment Used : Portable pump; backpack water shooter (fire hunter), collapsible water tank, dust protection mask and goggles, etc.
- ⑦ Dates : as shown in Table 6-3

Table 6-3 Transfer of Skills Using Fire Pump and Other Fire Extinguishing Equipment and Tools

Year	Date	Time	Location	Participants	Guidance Items
2000	30 <sup>th</sup> Nov.	08:00 13:30	Sabaneta Nursery	72 staff members	<ul style="list-style-type: none"> <li>• Training on discipline</li> <li>• Training on basic operation</li> </ul>
	13 <sup>th</sup> Dec.	09:00 13:40	Sabeneta Nursery	28 staff members	As above
	14 <sup>th</sup> Dec.	09:00 13:50	Sabaneta Nursery	27 staff members	As above
	20 <sup>th</sup> Dec.	10:00 13:00	Constanza: Bermudez Nursery	34 staff members 63 villagers	As above
	21 <sup>st</sup> Dec.	09:20 13:35	Constanza: Bel Moudes Nursery	26 staff members 6 villagers	As above
2001	10 <sup>th</sup> Jan.	10:00 14:20	Padre Las Casas dry riverbed	18 staff members 34 villagers	As above
	11 <sup>th</sup> Jan.	10:00 13:50	Padre Las Casas dry riverbed	13 staff members 24 villagers	As above
	6 <sup>th</sup> June	08:30 13:50	Cienaga Nursery	11 staff members 10 villagers	<ul style="list-style-type: none"> <li>• Training on discipline</li> <li>• Joint training</li> </ul>
	13 <sup>th</sup> June	08:00 13:10	Sabaneta Dam site	21 staff members	As above
	14 <sup>th</sup> June	08:00 13:10	Sabeneta Dam site	21 staff members	As above
	19 <sup>th</sup> July	08:00 14:00	Padre Las Casas dry riverbed	18 staff members 6 villagers	As above
	2 <sup>nd</sup> Aug.	09:00 14:00	Sabaneta Dam site	13 staff members	Integrated training
	8 <sup>th</sup> Aug.	09:00 14:30	Constanza	15 staff members 7 villagers	As above
	17 <sup>th</sup> Aug.	09:50 11:30	Pumping Operation Meeting at Sabaneta Dam site	40 staff members 10 villagers	Rehearsal for the meeting (salutation training)

### Guidance Results

As the forest fire-fighters and villagers participating in the training did not have any experience of using modern fire extinguishing equipment, such as power-operated equipment and pumps, portable water tanks and others, the training and guidance commenced with some doubt regarding the possible achievements of the planned transfer of skills. However, the active sense of participation, strong willingness to learn fire extinguishing skills and excellent natural ability to act in forests on the part of the participants resulted in major achievements in terms of the learning and upgrading of operational skills. It must also be noted that the continuous efforts and guidance by the counterparts played a major role in achieving the training targets.

## (5) Pump Operation Meeting

The final chapter of the demonstration project was a meeting to improve the transferred skills to operate various types of fire extinguishing equipment, to foster team work among fire-fighters and to demonstrate their newly acquired skills to the people concerned.

### 1) Outline of the Meeting

- ① Date : 17<sup>th</sup> August, 2001 (Friday), 11:50 – 14:00
- ② Location : San Juan, Sabaneta Dam site and Sabaneta Nursery
- ③ Participants : Forest fire-fighters of the San Juan, Padre Las Casas and Constanza Forest Management Bureaus and selected volunteers  
Total: 27
- ④ Operation and Team Formation : Operation of a portable pump by a nine member team, including a commander
  - Commander (forest fire-fighter) : 1
  - Portable Pump Company  
Company leader (forest fire-fighter) : 4  
plus mixed members of fire-fighters and volunteers
  - Fire Hunter Company  
Company leader (volunteer) plus : 4  
mixed members of fire-fighters and volunteers
- ⑤ Details : The drill operation method was created based on the special character and reality of forest fires in the Study Area. Technical skills and speed were competed to improve the fire extinguishing skills, including the operation of a portable pump, extension with five fire hoses, erection of a collapsible tank, nozzle operation and fire-fighting with a fire hunter.

### 2) Evaluation of Pump Operation Meeting

- ① The meeting, which was planned as part of the “visible achievements” sought by the Dominican side, followed initial doubts regarding the effective diffusion

of the method among forest fire-fighters and volunteers at the onset of the training. However, the suitability of the method and the achievements of the training conducted as part of the demonstration project to combat forest fires in the Study Area appear to have boosted the morale of the counterparts and training participants to successfully achieve the training targets.

- ② At the initial stage, it took 6 – 7 minutes to complete the basic operation during the integrated training. By the time of the meeting, however, this time had been shortened to just over two minutes, showing great progress.
- ③ The excellent movement of not only the forest fire-fighters but also the volunteers in mountainous areas coupled with their rigorous challenging spirit made it easier for them to learn the operating skills and to operate the fire extinguishing equipment inside forests. It is believed that much progress was made in mastering the necessary skills to operate a portable pump and fire hunter, etc.
- ④ It was found that there was a problem of securing a means of transportation (vehicle or motorcycle, etc.) for the participating members (from scattered village households in the case of the volunteers) to the training location.
- ⑤ The meeting was frequently interrupted due to the shortage of hoses for training and other reasons, indicating the important task of securing a sufficient quantity of such fire extinguishing equipment as hoses, portable pumps and nozzles.
- ⑥ It is highly desirable for the training on the operation of various pumps and other types of equipment to be repeated so that the transferred and learned skills can be further improved and spread.
- ⑦ Training must be continuously provided to train new fire-fighters and volunteers.

Although this meeting was the first of its kind, some 500 people, including such guests as the Minister of Environment, the Ambassador of Japan and the head of the JICA Office as well as the families of fire-fighters and local residents, attended the meeting to support the participants of the meeting. It must be noted that such strong attendance stimulated the morale of the participants, resulting in the successful completion of the meeting.

#### (6) Deployment of Fire Extinguishing Equipment and Tools

The fire extinguishing equipment and tools provided by the Government of Japan for the transfer of fire extinguishing skills under the demonstration project were deployed at

three forest management bureaus/stations in the Study Area at the request of such bureaus.

The equipment and tools have been subsequently maintained based on the equipment inspection and maintenance manual used for the transfer of skills during the first field survey period. They are currently stored in the equipment storage of each of these forest management bureaus/stations in the Study Area and their proper maintenance under the person in charge of maintenance was verified during the second field survey period.

Table 6-4 shows the state of deployment of the equipment and tools provided by the Government of Japan. Of these, the portable pump (V10F model) is small and light (approximately 25 kg) and can be carried by one person using a backpack over forest or sloping land. This mobility allows fire-fighters to easily approach the scene of a fire to conduct fire-fighting activities. During the first field survey, it was decided to use this V10F model with three 20 m hoses, i.e. 60 m in total, for a water discharge distance of up to 12 m.

Meanwhile, the V20D model portable pump is highly effective for water supply to a pump at the scene of a fire through extended hoses when the water source is far from the fire scene even though it is also suitable for fire extinguishing activities using its own water discharge. Two V20D model pumps were procured to secure the water discharge distance of the V10F model in the case where there is a problem of a distant water source. The procurement of the V20D model pumps made it possible to extend the hose up to 400 m.

Both models have sufficient horsepower and their demonstration has proven their value in the battle against forest fires.



Table 6-4 Deployment of Forest Fire Extinguishing Equipment and Tools

Equipment/Tools	Place of Deployment	Quantity	
< First Field Survey >			
V10F model portable pump (with backpack)	San Juan Forest Management Bureau	1	3
	Padre Las Casas Forest Management Bureau	1	
	Constanza Forest Management Bureau	1	
Hose	San Juan Forest Management Bureau	3	9
	Padre Las Casas Forest Management Bureau	3	
	Constanza Forest Management Bureau	3	
Canvas hose backpack	San Juan Forest Management Bureau	1	3
	Padre Las Casas Forest Management Bureau	1	
	Constanza Forest Management Bureau	1	
Nozzle	San Juan Forest Management Bureau	1	3
	Padre Las Casas Forest Management Bureau	1	
	Constanza Forest Management Bureau	1	
Fire hunter	San Juan Forest Management Bureau	20	60
	Padre Las Casas Forest Management Bureau	20	
	Constanza Forest Management Bureau	20	
Collapsible water tank	San Juan Forest Management Bureau	5	15
	Padre Las Casas Forest Management Bureau	5	
	Constanza Forest Management Bureau	5	
Dust and protective mask	San Juan Forest Management Bureau	20	60
	Padre Las Casas Forest Management Bureau	20	
	Constanza Forest Management Bureau	20	
Goggles	San Juan Forest Management Bureau	20	60
	Padre Las Casas Forest Management Bureau	20	
	Constanza Forest Management Bureau	20	
Portable radio transmitter			9
< Second Field Survey >			
VD20D model portable pump	San Juan Forest Management Bureau	1	2
	Constanza Forest Management Bureau	1	
Hose	San Juan Forest Management Bureau	20	40
	Constanza Forest Management Bureau	20	
Nozzle	San Juan Forest Management Bureau	1	2
	Constanza Forest Management Bureau	1	
Branch line	San Juan Forest Management Bureau	1	2
	Constanza Forest Management Bureau	1	
Binoculars	Sub-Ministry of Forest Resources	1	4
	San Juan Forest Management Bureau	1	
	Padre Las Casas Forest Management Bureau	1	
Reaping hook	San Juan Forest Management Bureau	2	6
	Padre Las Casas Forest Management Bureau	2	
	Constanza Forest Management Bureau	2	
Broad axe	San Juan Forest Management Bureau	2	6
	Padre Las Casas Forest Management Bureau	2	
	Constanza Forest Management Bureau	2	
Hatchet	San Juan Forest Management Bureau	2	6
	Padre Las Casas Forest Management Bureau	2	
	Constanza Forest Management Bureau	2	

## (7) Evaluation of Demonstration Project

The demonstration project aimed at transferring fire extinguishing skills was implemented using fire extinguishing equipment and tools provided by the Government of Japan. The successful achievement of the original aim owed much to the active participation and conscious efforts of not only the counterparts but also many forest fire-fighters and local residents.

During the workshops, strong interest was shown in forest protection while active proposals were made in the group discussions and plenary meeting, resulting in the useful collection of opinions.

The Study Team members strongly believe that these achievements of the demonstration project will be positively reflected on forest fire prevention and extinguishing activities.

## **6.2 Community Project**

### **6.2.1 Village Workshop**

#### (1) Objective of Village Workshop

Village Workshops were held in the first year of the study (November, 2000 - March, 2001), employing Participatory Rural Appraisal tools towards demonstration projects to be implemented in the second year. Workshops had the following three objectives

To share concerns/problems found in villages

To evoke feeling of "ownership" amongst villagers towards incoming demonstration projects

To establish a new community group free from political interest

#### (2) Program of Workshop

The workshops were held under the following schedule.

Table 6-5 Program of Workshop

Contents	1 <sup>st</sup> day	1) Introduction; 2) Resource Mapping (by group); 3) Institutional Analysis (by group); 4) Historical Analysis (by group); Presentation of 2)-4) in front of all
	2 <sup>nd</sup> day	1) Transect Walk; 2) Focus Group Discussion (Men and Women); 3) Needs Ranking (all); Form a new group, Select group leaders (tentative)
Participants	Residents in a village * The workshop was open to all because the workshop aimed to form a new community group.	
Methodology	Held focus group discussions on the second day with men and women separately. Proceeded with other activities maintaining a condition that both men and women discuss freely without hindrance. Due to the high illiteracy rate in villages illustrations were used as much as possible.	
Facilitators	Local NGO, CAD, took role as main facilitators with coordination by other NGOs, Cepros, Progressio, and school teachers.	
Duration	January 28, 2001 - February 8, 2001 (two days per village)	

### (3) Selection of Villages

The workshops were held in six villages in the Study Area. The villages were almost automatically strong candidates as locations for implementation of demonstration projects in the second year. The selection was made with the major premise that each watershed area be represented by two candidate villages making six villages in total. In addition, reflecting results of socioeconomic survey, selected villages must satisfy following points:

They recognize and have concern for reduction of forest resources

They face or have concern for problems of soil erosion

They remain in poverty, and have strong need to improve living condition

They are able to play a role as an exhibition village to show activities of demonstration projects to neighboring villages

Table 6-6 Selected Villages

Watershed Name	Village Name	Remarks
Las Cuevas	El Recodo	Heavily damaged by Hurricane George; the most upper area accessible along Las Cuevas river
	Las Lagunas	Core village of the region; expected to be an exhibition village.
Grande del Medio	El Convento	Adjacent to Valle Nuevo National Park.
	Los Corralitos	Poverty; highly concerned about reforestation
Yaque del Sur	La Guama	Poverty
	Los Frios	Adjacent to Jose Carmen Ramires National Park

(4) Outcomes of the Workshop

1) Local Needs in a Village

Two groups separated into men and women discussed problems existing in a village, and then from these picked 10 priority problems. Then, both groups got together and through intensive discussion of the results of both the mens and womens groups decided 10 priority Local Needs of the village. Table 6-7 shows the Local Needs the six villages. Needs Rankings by gender are shown in the Appendix.

Table 6-7 Local Needs Ranking

	Los Corralitos	El Convento	La Guama	Los Frios	El Recodo	Las Lagunas
1	Water	Electricity	Job	Credit	Road	water
2	Job (men)	Church	Irrigation	Nursery	Reforestation	Hospital
3	Road, Bridge	House rehabilitation	Electricity	Secure market	School	House rehabilitation
4	Reforestation	Credit	School	Agricultural Extension	Electricity	Reforestation
5	Clinic	Reforestation, Nursery	House rehabilitation	Rehabilitation of coffee plot	Truck (village owned)	Road
6	House rehabilitation	School	Road	Clinic	Irrigation	High school
7	Nursery	Land title	Reforestation	House rehabilitation	Nursery	Church (Parroquia)
8	Credit	Clinic	Clinic	School meals (morning)	water	Subsidiary
9	Electricity	Job (men)	Land title	Land title	INESPRE	INESPRE
10	School	Playground	Transportation	Job	Agricultural Extension	Soil Erosion
11	Church	Job (women)	Income raise (animal)			Nursery

Note : INESPRE: National Institution of Price Stabilization

Local needs comprise mainly the following three dimensions: 1) improvement of social infrastructures; 2) income generation; 3) environmental countermeasures

including reforestation, nurseries, and soil conservation. However, within the rankings in each village interesting examples were found. For example, in Los Corralitos and Las Lagunas, located in a semi-dry area, "water" was selected as the most important necessity among both men and women. Meanwhile in El Convento and Los Frios where local people already enjoy irrigation facilities, "credit" was ranked number one.

Differences between men and women were observed: men basically selected social infrastructure and job related needs, while women selected education and health-related needs.

## 2) Formation of Community Group

At the final stage of the workshop, encouragement was made for creation of a new community group to oversee the foreseeable demonstration project. The workshop elected ten leaders through recommendation and self-recommendation but did not elect a president. Considering the atmosphere where the workshop proceeded intensively in such a short term, selection of right person as a president requires more consideration. Therefore, a president was chosen seven months afterwards, in September, when the community group was more convinced as to who should lead the group.

### **6.2.2 Implementation of Demonstration Project**

#### (1) Objective of Demonstration Project

The primary objective of the demonstration project, which included reforestation, agroforestry and other components, was to reflect findings and lessons from the project onto the Master Plan with provisions for more feasible and sustainable approaches.

Because the Study Area covers a wide area, 166 thousand hectares, there are various types of climate, farming styles and economic conditions.

Taking into consideration this variety, the project selected six villages from three watersheds, to represent the natural and socioeconomic conditions of the surrounding areas as much as possible.

(2) Programs of Demonstration Project

Table 6-8 outlines components of the demonstration project, targeted villages, and implementation schedule.

1) Summary of Components

Table 6-8 Summary of Components of Demonstration Project

Components	Contents
Reforestation	<ul style="list-style-type: none"> <li>• Discussion about implementation ways of reforestation activities</li> <li>• Reforestation by use of Convite (mutual organization in a village)</li> </ul>
Agroforestry	<ul style="list-style-type: none"> <li>• Implementation of Seminars               <ul style="list-style-type: none"> <li>Small scale planting</li> <li>Farming Practice</li> <li>Contour Farming</li> <li>Tree grafting</li> <li>Use of Organic Fertilizer</li> </ul> </li> <li>• Agroforestry and Exhibition plot (along with )</li> <li>• Capacity Building of Core-farmers (follow-up in each plot)</li> </ul>
Village Nursery	<ul style="list-style-type: none"> <li>• Building a village nursery using by local people and materials available in a village</li> <li>• Maintaining a village nursery</li> <li>• Moving, enlarging a village nursery, if they wish</li> </ul>
School Forest and Student Volunteer Reforestation	<ul style="list-style-type: none"> <li>• Developing school forest with help of adults in a village</li> <li>• Reforestation activities by students over fourteen years old</li> </ul>
Soil Conservation	<ul style="list-style-type: none"> <li>• Loose stone check dam, log check dam and vegetative barriers along the contour lines (implemented in a village in the Constanza area)</li> </ul>
Organizational Strengthening of community group	<ul style="list-style-type: none"> <li>• Planning and Monitoring Workshop</li> <li>• Leaders Meeting</li> <li>• Evaluation Workshop</li> </ul>
Study Tour	<ul style="list-style-type: none"> <li>• One day trip; and Four nights and five days trip</li> </ul>

Note : Core farmers are those with a high awareness who are willing to actively and continually play the role of leaders to change the conventional production mode by implementing various activities, including nursery management. The selection of core farmers firstly takes place at the time of the selection of leaders for village nursery management. The core farmers are finalised when they are selected by the community for a study trip with lasts for five days.

## 2) Components by Villages

All components were carried out in each village except for school forest, junior and high school students' volunteer reforestation, and soil conservation, because of geographic constraints.

Table 6-9 Villages and Components

Component	Constanza Area		Padre Las Casas Area			
	Los Corralitos	El Convento	La Guama	Los Frios	El Recodo	Las Lagunas
Reforestation						
Agroforestry						
Village Nursery						
School Forest			-	-	-	
Student Volunteer Reforestation	-	-	-	-	-	
Soil Conservation			-	-	-	-
Organizational Strengthening of community group						
Leaders Meeting						
Study Tour						

Note : : Implemented,-:Not implemented, :Not implemented, but participated in a seminar

## 3) Schedule of Demonstration Project

The Demonstration Project was launched in June 2001 after a socioeconomic survey and the village workshops were carried out, and was terminated in December 2001. While the Study Team was absent in September 2001 for about a month, Counterparts of the Study Team and NGOs contracted for the project made follow up activities.

Table 6-10 Schedule of Demonstration Project

program	Year													
	First Year (1)					Second Year (1)					Second Year (2)			
	11	12	1	2	3	4	5	6	7	8	9	10	11	12
I . Componens														
Socio-Economic Survey		■	■											
PRA workshop				■	■									
Reforestation										■	■	■	■	
Agro-forestry					develop					■	■	■	■	■
Village Nursery					■	■	■	■	■	■	■	■	■	■
School Forest and Student Volunteer Reforestation													■	■
Soil Conservation										■				
Organizational Strengthening										■	■	■	■	■
Study Tour													■	■
Evaluation Workshop														■
II . Study team in Dominica		■	■	■	■	■	■	■	■	■	■	■	■	■

(3) Content of Each of the Components of the Community Project

1) Reforestation

a. Content

In considering management of the watershed, the reforestation is as much a factor important for forest recuperation as it is for the improvement of the functions for water conservation. Therefore, reforestation is one of the highest priority components in the community project. This activity has the purpose of clarifying the following points and to reflect in the Master Plan the results of such clarification.

To determine if the local inhabitants would take conscience notice or not of the importance of the forests and would participate actively or not in the reforestation.

To determine what problems local inhabitants have encounter when they reforest, and how they would find measures to resolve such problems.

To specify what type of support the Sub-secretariat of Forest Resources could provide for programs to be executed by the local inhabitants.



b. Results

Reforestation Workshop

A workshop was held and inhabitants's desires for the reforestation determined. Through results of this workshop, indicated in table 6-11, it was found support for reforestation increased among local inhabitants.

Table 6-11 List of Prospects for Reforestation

Zone	Name of Community	Prospects for the Reforestation*	Date of confirmation
Las Cuevas	El Recodo	15	9/8
	Las Lagnas	14	9/8
Yaque del Sur	Los Fríos	15	9/5
	La Guama	8	9/6
Grande del Medio	Los Corralitos	13	9/28
	El Convento	6	9/27

\* Prospects for reforestation shows the number of inhabitants who desire to reforest in their own lands, not the number of people who want to work as volunteer workers.

Investigation of the Candidate Sites to Reforest

Together with the local participants in reforestation and local forest technicians, the candidate sites to reforest were explored. In the investigation, required data such as desired species to be planted, soil conditions, access from the community were recorded in the survey sheets which were previously created and some problems for planting became clear. The description of the candidate sites to reforest is indicated in the next table. The various sites chosen for reforestation are abandoned cultivated terrains, post-pasture terrains, thicket terrains, many of which are topographically steep, and whose soils are shallow and hard.

As it is necessary to sprinkle the plants with water at the moment of planting, it will be necessary to take advantage of nearby water sources. Despite this, there are plantation sites located either near rivers with weak flow or far away from the rivers. Sites, are located in places 1 - 2 hours from the corresponding community. There are a few sites where it takes more than 2 hours to get to them.

Table 6-12 Review of the Prospects for the Reforestation (four villages only)

Name of Community	# of Prospects (persons)	Object of Reforestation	Desired Species	Surface to plant (acres) (reach of size)	Property
Los Corralitos	10	Wood Fruit	Pine, Cedro*1, Lemon, Avocado, Mango	454 (3-200)	Private
La Guama	3	Wood Fruit	Pine, Cedro, Mahogany, Churo, Avocado, Mango	20 (5-10)	Private
El Recodo	4	Wood	Pine, Oak wood, Casuarina, Cedro	510 (10-400)	Private
Las Lagnas	3	Wood Fruit	Pine, Lemon, Avocado	26 (1-15)	Private

\*1) Spanish Cedar

Table 6-13 Actual State of the Plantation Sites

Name of Community	Land Usage	Elevation (m)	Slope (°)	Soil	Water Supply	Distance from the Community
Los Corralitos	Agricultural Pasture	Around 1,200	5-20	Hard and shallow	River (low caudal)	Close (less than 30 minutes walking, it can be seen from the center of the community.)
La Guama	Agricultural Pasture	550-700	20-35	Hard and shallow (Horizon A: 6 cm)	River (high caudal) and wells	Moderate (around one hour walking, there is a farm road.)
El Recodo	Agricultural Pasture Thickets	Around 900	10-40	Hard and shallow (Horizon A: 2 cm)	River (high caudal)	Moderate (one hour walking, but it's necessary to cross the river.)
Las Lagnas	Agricultural	Around 1,000	20-30	Hard and shallow	River	Far (more than two hours waking)

### Practice of Reforestation

Results of the reforestation made in six communities are as described in the table 6-14. Seventyone participants from six communities took part. Each community had between 6 to 15 people. The sites varied in number of planted trees (13 to 1,500) and in size from 0.5 to 8 tarias. The planting sites were boundaries of fields, sides of the road, abandoned cultivated lands, and thicket terrains. The most planted species was cedro, followed by: pine, mahogany, and gracidia. The majority of young plants were sourced from nursery of the Forest Management Branch Office and some were from a community nursery that was built for community project.

Reforestation was undertaken half by volunteer workers and half by the families of the corresponding proprietors. Reforestation along field boundaries was done by the families of the proprietors. The time required by the participating inhabitants for the reforestation was between 2 and 6 hours. It is assumed that the difference was due to time required to get to the planting site and the number of participants.

Among the participants in reforesting, there were some that returned to their homes for lunch however most of them brought their food and worked at the site. Transportation of the nursery trees was provided by truck as far as was permitted and then by the participants or by animal (horse or donkey).

Table 6-14 Actual Results of Reforestation

	Owner Name	Tarea	Plants	Species	Plant Sources	Date	Help (Technical)	Participants	Horas	Others	
Las Corralitos 13 aspirantes	Apolinar		8	1500	pine, cypress	Community orchard	18/9	Forest office	10	3	The reforestation was finished in the morning
	Santos		2	200	cedar	and orchard of forest office	5/10	Forest office	family		
	Pascuala	Along the waterfall	100		cedar		5/10	Forest office	family		
	Savinion		16	1600	pine		6/10	Forest office	9	6	They had lunch after getting back home
	Gregorio	boundaries of the parcel	100		cedar		6/10	Forest office	family		
	Antonio	boundaries of the parcel	100		cedar		5/10	Forest office	family	2	
	Lupe Santos y otros	Along the waterfall	50		pine		6/10	Forest office	9	6	Reforestation together with the Savinion parcel
El Convento 6 aspirantes	Juel Flia		2	200	pine, cedar, neem	orchard of forest office	6/10	Hasn't been any	10		
	Paco		3	250	pine, cedar, neem		8/10	Hasn't been any	5		
	Tello		1	100	pine, cedar		8/10	Hasn't been any	2		
	Tito Pinales		2	200	pine, cedar		6/10	Hasn't been any	10		Reforestation together with the Juel parcel
	Radahmes		1	100	pine, cedar		6/10	Hasn't been any	2		
	Sonia		1.5	150	pine, cedar		6/10	Hasn't been any	3		
La Guama 8 aspirantes	Vincente		3	300	mahogany	mahogany (orchard of forest office)	6/10	Forest office NGO	6	6	Each participant carried his lunch
	Lolenso	boundaries of the parcel	135		mahogany, cedar	cedar (community orchard)	6/10	Hasn't been any	family		
	Herman La Cruz	boundaries of the parcel	135		cedar, gracitia		1/10	Hasn't been any	family		
	Alejandro	boundaries of the parcel	100		mahogany		6/10	Hasn't been any	family		
	Fulkar Delagado		1	105	mahogany, cedar		July	Hasn't been any	family		
Los Frios 15 aspirantes	Isidro Brioso		8	800	cedar	orchard of forest office	14/9	Forest office NGO	8	6	the wner is an exemployee of the sub-management and owns orchard
	Apolinar Delgado	boundaires of the parcel	100		cedar		15/9	Hasn't been any	family	4	
	Eliden		1.5	150	cedar, neem	orchard of forest office	20/10	Hasn't been any	5		
El Recodo 15 aspirantes	tierra de la iglesia		2	210	gracitia	community orchard	27/9	Forest office NGO	10	2	there was problem with the lunh
	Eugenio Pujols		1.5	150	cedar, mahogany		5/10	Forest office NGO	18		
					gracitia						
Las Lagunas 14 aspirantes	Josefa Lebron		5.5	970	mahogany, neem	mix (almost every plants)	27/9	Forest office NGO	13	3	The scholar breakfast was taken advantage of
	Ramon Diaz	boundaries of the parcel	200		mahogany, neem cedar	orchard of forest office	27/9	Forest office NGO	family		
	Felipe Galvan		5	570	pine, cedar		5/10	Hasn't been any	11	4	the reforestation ended in the morning
	Felipe Galvan		1	130	pine, cedar		12/10	Hasn't been any	10	4	plant transportation by horse and donkey
	Ventura Cuello		3	610	pine, mahogany, cedar		16/10	Hasn't been any	15	4	
	Erma Vincente	boundaries of the parcel	78		custard apple		3/10	Hasn't been any	family		
	Rafael Alamis		?	25	neem		29/9	Hasn't been any	family		
	Miguel Corsino	boundaries of the parcel	40		mahogany, cedar		4/9	Hasn't been any	family		
	Militu Tujeda	boundaries of the parcel	36		mahogany, neem		12/9	Hasn't been any	family		
	Luis Vincente	boundaries of the parcel	50		cedar, neem		-	Hasn't been any	family		
	Sucre	boundaries of the parcel	13		neem		-	Hasn't been any	family		

Note1 : this information is based on the interviews made from october 13 to december 2001

Note2 : the number of prospects for reforestation is the one notified in the meeting held by the NGO

Note3 : there are cases in which an unnatural relationship between the reforested surface and the amount of planted trees, despite this, the values expressed in the interviews are described in the table.

## Monitoring of the Reforestation Activities

Four monitors were selected from the participants in the reforestation of table 6-14 and monitoring was undertaken from the end of October until the beginning of November. The results are as described in table 6-15. The growth of the reforested young plants is generally good although there were some problems with poor young plants, inadequate watering, and trampling by cattle, etc.

Table 6-15 Results of Monitoring

Name of Community	Los Corralitos	El Convent	Las Lagnas	Los Fríos
Executor	Savinion	Sonia's Husband	Josefa Lebron	Isidro Brioso
Date of plantation	6/10/ 2001	6/9/2001	27/9/2001	14/9/2001
Species	P. caribia	P. occidentalis, Cedro, fruit trees	Cedro, Neem	Cedro
No. of planted trees	1,600	150	960	800
Sources of young plants	Forest Office of Constanza	Forest Office of Constanza	Forest Office of Azua	Forest Office of Azua
No. of participants	9	13	13	8
The geographical and social conditions of the locations	The site is located in a cultivated land with a soft slope at 15-mns-walk from the community. A road goes across in the part of it.	The site is 15-mins-walk from the community and located along a stream.	The site is 5-mins-drive away abandoned shallow farming land located on the mountain. It's full of jaragua.	A site used to be a cultivated land near houses. The slope is soft and the soil was plowed.
Plantation method	The trees are planted at intervals of 2m and each planting hole is 15 cm in depth. Canadian type nuesday plants are also used.	The young trees are planted at intervals of 3-5 m along the river.	The planting holes are small and shallow.	Potted young plants are used and planted along contours.
State of growth	Dried treetops were found with some of the young trees. The height of the young trees ranges between 10 and 25 cm.	They are growing well. The survival is high.	The growth is moderate. The jaraguas around the planted trees have grown thickly. They need to be mowed.	They are growing well. Cleaning thickets is planned to be done in a short period.
Others	They are planted in hard soil. Future maintenance is a problem.	Soil conservation of the riverbanks was the purpose of the reforestation. They reforested the trees also around fields.	It is necessary to pay attention to drying. There is great risk of livestock entering from pastures around the site.	The executor planted in his own land and also owns a nursery. He understands the reforestation methods fully.

c. Reforestation Problems

In a period of six months, a chain of work for reforestation including preparation, execution, and monitoring was undertaken. Problems that became clear in this process are as follows:

To promote reforestation, more time was needed to discuss the incentives to the local inhabitants.

Among the sites of reforestation, there are river reserves and very steep land with shallow soil etc. selected as sites for planting.

The preparation of the necessary devices and materials for the reforestation were late and lack of communication caused delay in the supply of nursery plants from the Forestry Office. Therefore the reforestation process did not progress smoothly.

In the preparatory stage, many local inhabitants showed their interest in the reforestation. However, at the start the actual reforestation, a decrease in the number of participants was seen.

The reforested plants in the plantation sites are not necessarily growing well. Technical problems such as selection of nursery plants, planting methods, delay in cleaning, etc. emerged.

There are communities that have not advanced to the establishment of the rules for their reforestation group. Some support from local consultants is needed for this and also for the future maintenance and administration of the group.

d. Lessons and their Reflection on the Basin Management Plan

The lessons obtained from the reforestation project and the points to be reflected to the Watershed Management Plan are as follows:

Many local inhabitants misunderstood that they can obtain fruit trees by confusing forest trees with the fruit trees. To avoid this, from now on, it

is necessary to clearly inform the local inhabitants of the objectives of reforestation.

In the use of volunteer workers, the character of the region must be considered. Even in the same region, the area where volunteer workers can be applied should be clarified. For areas located too far and difficult to use volunteer workers, application of the National Reforestation Plan can be considered.

To ensure inhabitants' participation in reforestation work, it is important to avoid overlap of the reforestation period and the busy farming season.

The reforestation group should be use not only for reforestation work but also in production of nursery trees, management of natural forests, and volunteers for measurements against forest fires, etc.

While considering incentives for the inhabitants, it is necessary to plan to plant fast growing species to restore benefits to inhabitants in a short period of time.

## 2) Village Nurseries

### a. Project Activities

The village nurseries were undertaken for the purposes of having farmers produce nursery plants and to deepen their understanding of the forest trees. In addition to these two basic purposes, the village nurseries were established with the confidence that their management would provide the following six benefits to the communities.

Structuring within communities

Training leaders

Strengthening group work in communities

Improving planning and regulatory abilities through nursery works

Promoting independent nursery management by villagers

Promoting independent tree planting by villagers (observing how grown seedlings are getting planted.)

Nursery training was held at the end of the first round of the field work in Dominica and Village Nurseries were established in each village. Later, workshops about management activities and maintenance for village nurseries was held, and then those activities were left to the villages' autonomy.

b. Results of Activities

a) Mid-term Results

Nursery training was held at the end of the first year of field work in Dominica, at which time nurseries were also made in each village. A total of 277 people participated from the 6 villages.

Table 6-16 Number of Participants in Nursery Training

Name of Village	Los Corralitos	El Convento	La Guama	Los Frios	El Recodo	Las Lagunas
No. of Participants	35	23	45	61	58	55

Note : The numbers indicate the number of people who attended the lectures, not the number of people who participated in the reforestation work throughly. Children are not included in the number.

At the start of the first phase of the second round of the Study, it was found that among the 6 villages participants of 5 villages except for El Convento close to Constanza were actively involved in nursery management. Table 6-17 shows a mid-term evaluation and characteristic of each village's nursery activities using a 5-grade system.



Table 6-17 Characteristics of Nursery in each Village

Name of Village	Access to water	Interest in Nursery	Location	Management	Women Participation	Note
Los Corralitos	1	3	5	2	4	Many blighted trees due to lack of water
El Convento	5	1	4	1	2	Low villager participation
La Guama	5	5	3	5	5	Well growing nursery plants
Los Frios	3	4	4	5	4	Well growing nursery plants
El Recodo	4	3	5	3	2	Relatively low usage for the size of nursery
Las Lagunas	2	3	2	3	2	Mid-level in the state of growing nursery plants

Note: 5 = high and 1 = low For Location, 5 signifies the center of the village

With the exception of El Convento where villagers' interest in the nursery is low, an on-site study confirmed that all the nurseries were being managed adequately. However, this did not mean that the majority of the population was involved in nursery management. The reality was that less than 10 central people in each of the communities were actively involved in nursery management.

During community meetings and on other occasions villagers were encouraged to build their own independent nurseries in the village. In the three villages of Las Lagunas, Los Frios and Los Corralitos, several villagers constructed their own nurseries. The purpose of these private nurseries was mainly to raise fruit trees; none of them were dedicated to growing forest trees.

#### b) End Results of Study

The greatest accomplishments in nursery activities were seen in the two villages located near Constanza, and Las Lagunas village to the south. Los Corralitos installed a water tank to resolve their water shortage problem resulting in reactivating their nursery management.

El Convento had shown little interest in the nursery at the mid-term evaluation. However, the village later moved their nursery site to the center of the village on their own initiative and became actively involved in nursery activities. Water shortage was also a big problem for the Las Lagunas village nursery. The nursery was located outside the village making it difficult for villagers to become actively involved. In order to resolve this problem, the villagers involved in nursery activities secured help from an NGO to lay PVC pipes from a spring to the nursery site. The nursery is being relocated and expanded at present.

c. Problems Encountered

A common problem encountered by all the villages was the tendency for villagers' interest in the nursery to wane, and for members to cease their involvement in nursery activities and management. Various causes could be attributed to this tendency, but the following three reasons were raised by the communities upon questioning.

Final planting site for the seedlings was unclear.

There was no apparent profit for those involved in nursery management

Lack of time and funds for planting trees

The problems encountered in each village are summarized in Table 6-18.

Table 6-18 Nursery Problems Encountered in Each Village

Village	Problematic Points
Los Corralitos	General lack of water for the entire village
El Convento	Flanks a National Park, poor relationship with government. Low interest in forest trees. Lack of leadership. Very busy with cultivating vegetables, no time for nursery.
La Guama	No problems in managing nursery or producing seedlings. Uncertainty about where the seedlings will go.
Los Frios	No problems in managing nursery or producing seedlings. Uncertainty about where the seedlings will go.
El Recodo	Low-interest among villagers. Nursery work is not consistent. Uncertainty about where the seedlings will go.
Las Lagunas	Nursery site is distant from village center making nursery care inadequate. Uncertainty about where the seedlings will go.

d. Lessons Learned from the Nursery Activities and their Application to the Watershed Management Plan

Clarifying the Purpose of Village Nurseries

Nurseries are made in the villages for the purpose of deepening the villagers' understanding of trees through their participation in the nursery, and also to make a foundation for planting trees in the future. It is hoped that a secondary effect of the villagers coming to realize that such nursery activities are indispensable to the village's development will also be seen.

Importance of the Process

Rather than counting on villagers to be able to satisfactorily carry out all the activities from nursery management to planting out, it is more important that the villagers grasp the importance of community organization and participation in solving the problems they face in the process of nursery management.

Making a Nursery Suitable to the Community

A nursery should be always made in a village when a new village enters into the project. By taking responsibility to manage their nursery the villagers will pass through a variety of experiences together with the project executing side. The size of first nursery should be small and manageable. Also, it is important that all the materials used in its formation are locally obtainable.

Importance of Training and Visit (T&V)

Villagers who participated in T&V renewed their interest in their nurseries after returning from their visit to an advanced area. Visiting advanced areas is possibly the most effective way of stimulating villagers' initiative in nursery activities.

### Importance of Coordinating with other Components

Each village expressed their desire to expand the size of their nursery at the end of this demonstration project. This was the result of the villagers' involvement in other components, such as forest planting, agroforestry activities and improving farm management. Therefore, it is important that nursery construction be coordinated with other components in a comprehensive manner.

### Fruit Tree Seedling Production

When looking at villager's response to seedling production, it is apparent that there is a high demand for fruit tree seedlings. It would seem possible that villagers would maintain their direct participation in the village nursery if the production of fruit tree seedlings were increased.

### Problems in Technology

Almost no technological problems were encountered in the seedling production process. That being said, it would be good for villagers to increase their experience in pre-germination treatment, improving germination rate, pest and disease control, root-cutting, selecting the moment for out-planting, and preparation of the production plan. By fine-tuning the guidance provided in these areas, it is hoped that nursery management will become more efficient.

### 3) Agroforestry

In the area of agroforestry, the greatest emphasis was placed on training core farmers with the aim of establishing a system of "extension by farmers to farmers". Consequently, 5 seminars were conducted where follow up was given through on-site assistance. In addition, an agroforestry demonstration forest was made.

a. Project Activities

a) Training

Training in Small-scale Planting Technique

Farmers were trained in a small scale planting technique so that they would know how to plant the seedlings from their nurseries once they had grown.

Seminars on Farm Management

Using PRA methods, farmers made a general review of their cultivation design which included using a simple format for calculating last year's harvest, identifying problems, preparing next year's plan, and improving agricultural land-use.

Training in Contour Cultivation and Alley Cropping

In order to preserve the soil on sloped terrain, soil conservation measures need to be taken such as planting along contour lines or making vegetation terraces. Therefore, the training sessions were focused on giving a simple understanding of contour lines and how to practice and use contour cultivation.

In alley cropping, fast growing *Leucaena* are planted in 10cm to 20cm intervals along contour lines. The trees can be cut 2 or 3 times a year to keep their height between 50cm and 1m. Using an agroforestry technique, the pruned branches and leaves are spread on the ground to fertilize the soil.

Training in Grafting

The fruit production based on seed germination is inconsistent. Therefore, training was given in grafting so that fruit species could be stabilized and high quality fruit could be produced.

### Training in Organic Fertilizer (Creating Bocashi)

Earthworms consume unused waste material, such as cattle manure, coffee pulp, raw waste from the kitchen, and convert it into organic fertilizer. This method of making organic fertilizer is easy to learn. Participants were instructed on the technique on a visit to an actual site. Even villagers who had shown no activity before the visit became involved in organic fertilizer production after visiting the site. All the villages are now building their own organic fertilizer production facilities.

#### b) Creating Agroforestry Demonstration Plots

The farmers who had participated in the "Contour cultivation and Alley Cropping Training" established agroforestry demonstration plots so that they could experience and learn land-use planning and tree planting distances and methods. Also, fruit trees were used in the training since farmers showed greater interest in fruit trees.

The fruit trees were planted in the demonstration plots in a 6m x 6m pattern. Big holes were dug for the fruit trees taking into account the low precipitation of recent years, and water catchment drains were dug around their bases. Fruit trees require several years before they can bear fruit. Therefore, crops can be grown in the alleys between the fruit trees until they reach a height where their crowns close in. Passion fruit (*Passiflora foetida*) was planted between the rows of fruit trees because it bears fruit in the same year of its planting as long as the right conditions prevail.

Farmers were instructed to always use fertilizer when planting fruit trees. In the case of the demonstration plots, organic fertilizer was hauled from the simple compost box built at the nursery and used to fertilize the trees.

The "A Level" was used to explain contour lines. However, during the training session and through conversations with farmers it became evident that when farmers till the land with oxen they can follow a pattern similar to contour cultivation. Since many farmers have experience tilling with oxen, the training was limited to emphasizing the importance of contour planting for soil conservation.

The purpose of ditches is to as much rainwater as possible as it flows down the slope, helping the water to gradually penetrate into the soil. Lemon grass (*Cimbopogon citratus*) was planted below the ditch embankments to further reduce soil erosion. Fig. 6-1 shows the layout of the demonstration plots.

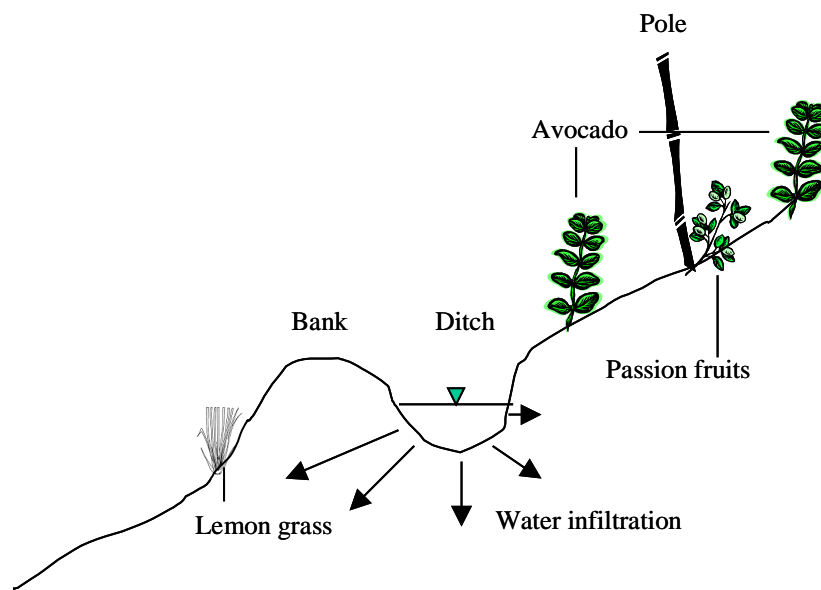


Fig. 6-1 Layout of the Demonstration Plots

c) Follow-up (On-site Assistance): Empowering Core Farmers

In accordance with the Project's objective of "extension by farmers to farmers", the above mentioned training sessions and visits to advanced villages were made with the aim of empowering and training core farmers. Since it is difficult for many farmers to take action only

from the knowledge they received through the seminars and on-site visits, they were given direct on-site guidance on the land where the agroforestry demonstration plots had been made. In addition, videos and photos explaining agroforestry methods were shown after visiting the advanced villages through T&V. The significance of the presentation was reviewed with participants, and even those villagers who did not participate received an explanation later of the contents by the village participants. In this way, attempts were made to increase the community's interest in agroforestry.

d) Experimenting with Core Farmers as Extension Workers

The Secretariat of State for Agriculture and the Secretariat of State for Environment and Natural Resources have a shortage of extension workers making it difficult to rely on the government for complete dissemination activities. The inaccessibility of the upland region adds to the difficulty of government extension workers in fulfilling their roles in the extension of natural resource conservation. Therefore, a trial system was set up where farmers with the ability to teach other farmers were designated as "extension farmers". If the extension farmers were successful in changing another farmer's farming method to one that preserved natural resources, then the extension farmers would receive a financial compensation. This test was to see if sustainable agricultural systems could be disseminated in this way.

b. Results of Activities and Problems Encountered

a) Implementation of Agroforestry (Contour Cultivation and Alley Cropping)

Among the agroforestry methods, special emphasis was made on contour cultivation and alley cropping, and farmers were encouraged to put them in practice on their own farmland. However, none of the farmers undertook alley cropping on their lands by their own initiative.



Even though alley cropping offers great benefits to farmers who cannot invest in fertilizers, or in conserving their slopeland soil, it is a labor-intensive system and difficult for farmers to execute on their lands. Instead of ally cropping, farmers should be instructed in vegetation terrace work or hedgerows, which are easier to implement. However, it seems that farmers do not feel a necessity for these methods, and in reality they do not readily apply them in their farming.

One idea for disseminating these techniques is to incorporate fruit trees in the system and to motivate the farmers with the idea of planting fruit trees on their land. In either case, it was felt that it would take many years for the farmers to adopt the new systems.

b) Level of Interest and Acquisition of Agroforestry

In the final evaluation workshop, many farmers themselves affirmed the importance of agroforestry. However, there is a general misconception among the farmers where they equate agroforestry with planting fruit trees. Their understanding of planting forest trees is limited to planting fruit trees.

c) Core Farmer Desertion and Viability of Core Farmers as Extension Workers

The objective of the demonstration project was primarily to identify individuals in each village who had the potential to become core farmers, and then to secure their help in extension activity. However, during the project's limited activity period, the core farmers' technical ability did not reach a level where they could disseminate their knowledge to other farmers. Thus, the period of the demonstration project ended without having been able to test the viability of using core farmers as extension workers.

c. Lessons Learned from the Agroforestry Activities and their Application to the Master Plan

a) Developing Agroforestry Centered on Fruit Trees

The majority of the farmers believe that agroforestry means planting fruit trees. Planting fruit trees is one of many agroforestry techniques, but planting fruit trees alone is not agroforestry. However, by capturing farmers' interest in planting fruit trees, the community could be stimulated to undertake tree-planting activities.

b) Necessity for Long-term Development

The farmers' concept of agroforestry has not advanced beyond the idea of planting fruit trees. A broad vision is needed in order to disseminate agroforestry practices. First, the farmers need to be educated about fruit and forest trees, and then different types of agroforestry techniques should be introduced step by step.

c) Income Stabilization through Diversification

Many farmers relied solely on commercial crops like beans, pigeon peas, and coffee for their livelihood, and their living conditions fluctuated according to their production or market prices. Until recently, they had not tried to diversify their income base to stabilize their living conditions. Through visits to the advanced villages, the farmers saw and directly heard from farmers who had incorporated fruit production into their farming and had succeeded in stabilizing their income to a degree. Through the visit, the village farmers gained confidence to use this method.

d) Creating Small-scale Demonstration Plots with the Farmers

It became clear from the demonstration project that it is difficult for farmers to understand agroforestry in a short time. Therefore, it is important that a long-term vision is held while using a combination of

small-scale demonstration plots, visits to developed sites, videos, and photographs to stimulate farmers' understanding.

e) Importance of Visiting Advanced Villages (T&V)

By visiting farmers who had been in the same circumstances as themselves, but who had applied agroforestry activity on their own initiative and had improved their livelihood, other farmers will realize that agroforestry holds utility for their own farms.

f) Importance of Audiovisual Aids

What was found to be most effective in villages with high illiteracy rates was to use photos or videos taken at the advanced villages and to have fellow villagers who had visited the sites to give an explanation while adding their own thoughts or opinions. In this case, the villagers themselves took the subjective role in the seminar.

To utilize this method, audiovisual recordings are made of what the farmers themselves see at the advanced villages. Videos can then be edited, and photos put in chronological order so that the overall framework for the seminar can be prepared. Then the farmers can share their experiences while showing the videos or photos.

g) Cooperation with other Organizations

The people of the Study Area had almost no experience in agroforestry practices. By strengthening our cooperation with other organizations, the experiences or know-how of those organizations can readily be transferred to the study area.

h) Empower Core Farmers

All the farmers of the villages can not be expected to take interest in, or have the ability to apply the knowledge offered to them. The most effective extension method is to empower several individuals in the

village to become core farmers, and then to gradually extend the knowledge horizontally through them.

4) School Forest and Student Volunteer Reforestation

a. Contents of Program

School forest aim at promoting for pupils understanding of the importance of forest conservation and the environment. Additionally, student volunteer reforestation was expected to bring hints as to whether relatively older students, over fourteen years, can be a labor resource for reforestation activities in villages. Feasibility was further checked by school administrations, as to whether reforestation activities can form an extracurricular course in a school curriculum.

The program was implemented in the following three villages in early November in a day (actually taking half a day).

Table 6-19 School Forest/Student Volunteer Reforestation

Village	School Forest			Student Volunteer Reforestation		
	Species	Number (trees)	Number (participants)	Species	Number (trees)	Number (participants)
Los Corralitos	Fruit (lemon, guava, etc) Tree (pine, cedro)	800	50 (5-10 years)	-	-	-
El Convento	Fruit (lemon, guava, etc) Tree (pine, cedar)	300	30 (5-10 years)	-	-	-
Las Lagunas	Fruit (orange, avocado, lemon, etc) Tree (Nim, cedro, corazon de paloma)	1,200	130 (8-17 years)	Tree (cedro)	300	30 (14-17 years)

b. Outcomes and Problems

Because school forest activity targeted younger children that inevitably required the help of adults, children took charge of conveying plants and soil; meanwhile adults and staff of local forest offices dug transplant holes. In the student volunteer reforestation program, students

themselves completed the whole processes from digging transplant holes to planting.

a) School Forest

Difficulty in acquiring land was a major obstacle for the implementation of school forest activities, which actually hampered its implementation in other villages in the demonstration project. Its difficulty is appeared mainly in the following: 1) shortage of land, whose location allows young children access without difficulty; 2) landowners hesitated to hand over land and even if they accepted handing over land, they were concerned about additional costs incurred for land registration/transfer; 3) frequent visits of children may damage farmland located near the site.

In reality, lands donated in three villages were: 1) idle land of a large landowner (Los Corralitos); 2) steep land of a landowner who had already moved to another village (El Convento); 3) land belonging to school (Las Lagunas).

b) Student Volunteer Reforestation

The Student volunteer reforestation program was accepted by school administrations owing partly to their familiarity with it and partly because they also sporadically implement reforestation programs in high school.

Problems emerged as there were a limited number of schools with students over fourteen years old. Therefore, in order to implement the program, third parties such as local forest offices or other concerned organizations had to fetch students from core village and bring them to the program villages. A recent example saw high school students in Constanza undertake reforestation in Los Corralitos with help from local forest offices and the military in transportation

and transplantation and eloquently shows sound feasibility in implementing the program as long as support is secured.

c. Lessons and Reflections on Master Plan

(Key point to implementation of school forest)

It is essential for the village to seek acquisition of land themselves, however, support of third parties such as local forest offices are also inevitable. This is because landowners that can donate land are, in a way, categorized in special strata, with which local people in a village have few chances to communicate. It seems true that the appearance of the Study Team contributed to promote land acquisition.

In addition, another key factor for the program is a teacher. In many villages, teachers attract respect from local people, some of who even "do because a teacher instructs them to do so". With this in mind, the school forest program selected teachers as key persons not only for maintenance of school forests but also for efforts to acquire land.

5) Introduction of Simple Soil Conservation Method

a. Contents

a) Target Community

The demonstration project for soil conservation was carried out in El Convento located in the area of Constanza from the 10<sup>th</sup> to the 17<sup>th</sup> of July 2001. This project was executed by 12 inhabitants of El Convento. The site land was a 1.4ha potato field.

b) Cause, Type, and Scale of Erosion Occurring in the site Land

Generally, when the live fence method is applied on a very steep plane with an interval of 8 to 10 meters, it works as a terrace and conserves water and soil. For example, with a combination of mulching, it prevents surface erosion and rill erosion. However, in the

demonstration site land, the intervals between the existing live fences were 57, 45, and 22 m. They were too far apart from each other and no other water and soil conservation methods were applied. Furthermore, due to the lack of maintenance work for live fences, each line had vacant spaces and was lacking function for erosion prevention. Therefore, surface erosion, rill erosion, and 2 gully erosions (A and B) are caused as shown in Figure 6-2.

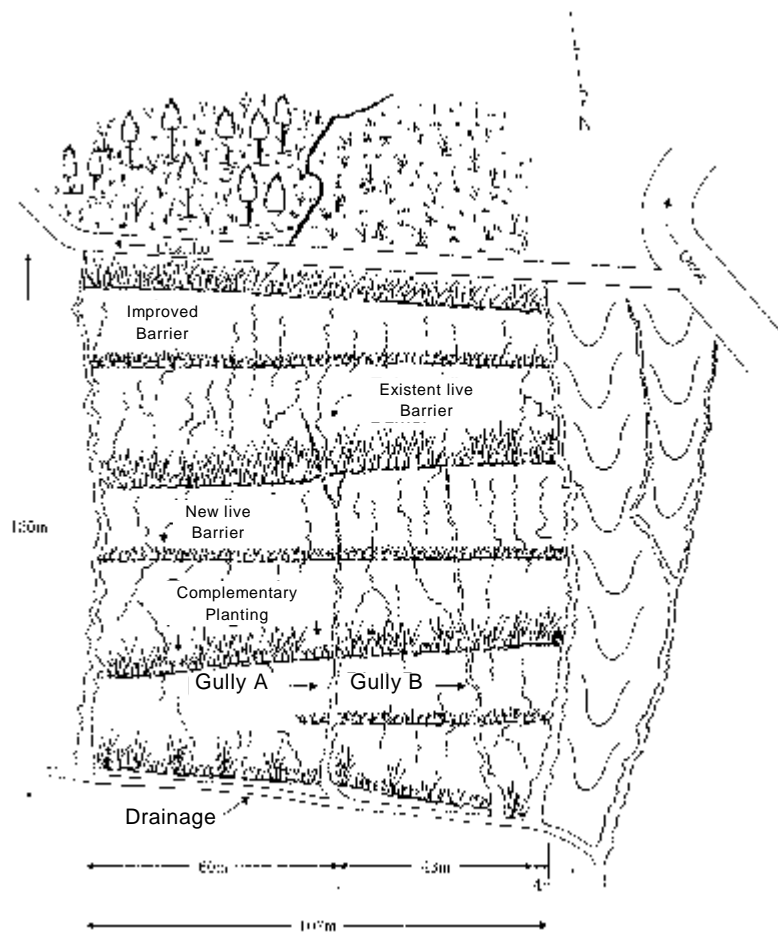


Fig. 6-2 Farmland where Soil Conservation Demonstration was Carried out

The concave shaped land located on the upper of the field can be considered as another cause of the gully erosion A and B. In this topography, gullies are created by concentrations of surface outflows. Both gullies were of a relatively small scale with a depth of 0.4-1.5 m and width of 0.5-1.2 m.

b. Results and Problems

a) Selection of the Site Land for Demonstration and Measures Implemented

The site area for the demonstration was selected with consideration for the following points: 1) the fertility of the field had fallen because of soil erosion, and there were sediments on nearby drainage channels and roads, 2) the land owner had understanding and cooperates in the conservation of water and soil and 3) the land had a demonstrative effect in the nearby communities.

For effective soil erosion control, measures combining civil engineering methods and vegetational methods (check dam of rocks, check dam of logs, and planting) were implemented as described in table 6-20.

Table 6-20 Measures for Gully and Surface Erosion Control Enforced in the Site Field

Type of Erosion		Measure	Quantity	Description
Gully	A	Log Dam	3	
		Stone Dam	6	
		Subtotal	9	
	B	Log Dam	10	
		Stone Dam	-	
		Subtotal	10	
		Total	19	
Surface and Rill		Improvement of existing live fences by cuttings and construction of new live fences	592m (2,380 cuttings)	

b) Progress after Implementation

In the farmland before the construction of these installations, there had occurred strong surface and rill erosions and the head part and both sides of the two gullies were actively eroding. It is considered that if this state continued, the field could not be used for agriculture in the future. It is expected that due to the effects of these installations, the



erosion during the rainy season would be minimized, the two gullies would be stabilized, and the amount of sediment outflow at the lower part of the field would be reduced.

From the perspective of participation, inhabitants actively participated in this work and many of them even built dams and created live fences by themselves while this construction was going on. Therefore, it can be said that this demonstration gave good results with regard to inhabitants' technical improvement and awareness for the soil conservation.

c) Problems

Some large land owners did not agree to implement soil conservation on their land even though strong gully erosion had occurred on their farmlands or grasslands. Their reasons were as follows: the facilities for gully control would reduce the production of crops, check the cultivation, and limit the transportation of cattle, etc.

c. Lessons and Reflection to the Master Plan

It was determined that demonstration plots for erosion control need to be planned at a couple of sites in the study area so that local inhabitants and large land owners can actually participate in the project and learn how to build simple civil engineering and vegetational soil conservation facilities.

6) Organizational Strengthening of Community Group

a. Contents of Program

It is essential that a village have a community group with sufficient membership and capacity when implementing watershed management plans as well as when promoting rural development. The demonstration project conducted capacity building through "village nursery" and "reforestation" programs, which by nature require cooperative work, meetings, and workshops.

The Study Team managed the program with special attention to obstacles that local people encounter that sometimes hinder promotion of organizational strengthening. The main components of the program are as follows:

Planning/Monitoring Workshop (Village Nursery & Reforestation)  
Leaders' Meeting (Constanza area, Padre Las Casas area)

b. Outcomes and Problems

a) Planning/Monitoring Workshop

The Planning/Monitoring workshop utilized the matrices below. Taking into consideration that a majority of participants have difficulties reading and writing, the workshop stressed promotion of activities by allocating roles and with intensive discussion over filling in the matrices. Table 6-21 and Table 6-22 show results of the workshops.

Table 6-21 Action Plan of Village Nursery (extract) : Planning Workshop

Expectation	(Anticipated) obstacles	Activities	Deadline	Person in charge
Enlarge village nursery	Shortage of necessary materials (Victoria lawn, barbed wire, water tank, vinyl bag, etc)	To make a list describing necessary materials for enlargement of village nursery	Second week of July	Rafael Roa, Judy Martines (basically, two persons were allocated)
		To specify materials available in a village, and materials that can be substituted	First week of July	Two
		To ask patrons such as large landowners for donation of necessary materials	Second week of July	Two
	Damage by livestock	To consider in discussion "shortage of necessary materials-barbed wire"	First week of July	Two
	Less people to work in the village nursery	To set up management rules of village nursery	Fourth week of July	Two
		To confirm people who have interests in village nursery (to make a participant list)	First week of July	Two
Make family nursery	-	To confirm people who would like to make family nursery (to make a participant list)	First week of July	Two

Table 6-22 Monitoring of Village Nursery (extract) : Monitoring Workshop

Activities done not yet	Obstacles	Lessons	New activities	Deadline & Persons in charge
Not yet made participants list of village nursery	Person in charge was out of village	If a person in charge is out of village, has to appoint a proxy	To make a participant list of village nursery (same as before)	two persons were allocated
Not yet made a list of necessary materials for village nursery	Not sure how much going to enlarge, and how much materials would be necessary	Before making a list of necessary materials, make a participant list	After completion of a participant list, start to make a list of necessary materials	
Collected less seeds than expected	Could not convey information to all because less came to meeting	To hold meeting after misa	Hold meetings after misa next Sunday	
		Representatives visit people who could not attend meetings	Person in charge will visit after meetings	
	- (right-hand column is a new activity)		Visit nurseries in neighboring villages to obtain fruit plants	
- (right-hand column is a new activity)		To gain information about "national fruit plan"		

b) Leaders' Meeting

Leaders' meetings in Constanza (two villages) and ones in Padre Las Casas (four villages) were held twice respectively. The meeting had the following purposes: to promote self-awareness as leaders; to build capacity for planning and management; to obtain opportunities to see their own activities and outcomes thus far through discussion with leaders of other villages. The table 6-23 shows the program of the leaders' meetings.

Table 6-23 Program of Leaders' Meeting

The first meeting	The second meeting
Self-introduction of themselves and villages	Confirm activities determined at the Planning exercise in the first meeting
Discussion <ul style="list-style-type: none"> <li>• Roles of leader</li> <li>• Facing problems as a leader</li> </ul>	Discussion <ul style="list-style-type: none"> <li>• Causes and counteractions for slash and burn farming</li> </ul>
Planning exercise <ul style="list-style-type: none"> <li>• Exercise in filling matrices of Planning through their favorite topics.</li> <li>• Topics were chosen from Needs Ranking in village "PRA" workshop</li> </ul>	Presentation <ul style="list-style-type: none"> <li>• Approaches of rural development taken in Los Frios: the way towards invitation of rural clinics</li> </ul>
Presentation <ul style="list-style-type: none"> <li>• Making presentation of</li> <li>• Comments and discussion</li> </ul>	

c) Changes in People's Behavior

Changes could be seen in activities of community groups owing to the several types of workshops, leaders' meetings, and other activities in the demonstration project. The changes in positive and negative direction are summarized as follows. The negative changes are described with relation to "lessons" afterwards.

## Positive Change

Increasing the number of organizational activities (cooperative management of village nursery)

A certain number of organizational activities could be seen in all the six villages, even though there were differences in terms of the level of their capacity to manage activities. A series of actions "meetings - sharing roles - action - monitoring - (re-planning)" in villages allows the Study Team to assure the change in their organizational activities. e.g.) a person in charge went to a neighboring village to purchase fruit plants as planned in meetings; a person in charge went to a local patron in order to request contribution of materials necessary for a village nursery. In addition, it was reported in the evaluation workshop that all the villages increased the number of spontaneous village meetings.

Increasing Spontaneous Activities and "Self-help" Philosophy

Spontaneous activities such as "going to local forest office to ask for contribution of plants on their own initiative", "going to local NGOs to petition assistance after the demonstration project ends" could be observed. Compared with their mentality before the project started, which basically relied on automatic incoming assistance from churches or government, they showed dramatic change to their current spontaneous spirit.

Capacity Building of Leaders

Although they do not use the matrices used in the workshops with the Study Team, it is evident that they enable to predict problems and countermeasures if problems actually occur. Moreover, the program achieved creating self-awareness in leaders' minds.

c. Lessons and Reflections on Master Plan

Table 6-24 summarizes negative changes and lessons in the project.

Table 6-24 Negative Changes and Lessons

Negative Changes		Lessons
<ul style="list-style-type: none"> <li>Condition of exclusivity occurred between regular participants and non-participants despite their wish to participate (Las Lagunas, La Guama)</li> </ul>		<ul style="list-style-type: none"> <li>Need to be cautious with internal politics</li> <li>Pay attention to sites for village meeting (in some cases, places for convenient for participants to gather are different from locations outsiders prefer in terms of available facilities for workshops)</li> </ul>
<ul style="list-style-type: none"> <li>Workloads became one-sided to leaders</li> </ul>		<ul style="list-style-type: none"> <li>Promote more participation by use of public opportunities such as misas.</li> </ul>
<ul style="list-style-type: none"> <li>Relationship between NGO and local people got worse</li> </ul>		<ul style="list-style-type: none"> <li>Take into consideration NGOs' political interests in some cases</li> <li>Need to provide local people with information on NGO leading to understanding without bias because they often judge NGOs only by rumors</li> </ul>
<ul style="list-style-type: none"> <li>gradually people left the project</li> </ul>		<ul style="list-style-type: none"> <li>Offer stimulus such as study tours</li> <li>Manage time schedule with consideration for farming season</li> <li>Keep in mind that some people leave village for work opportunities elsewhere</li> </ul>

The followings are unrelated to negative changes, though need to be concerned for implementation of watershed management.

- Improvement of relationship between local forest offices and local people

There were conflicts about penalty rules against shifting cultivation between local people's understanding and local forest office's actions. They discouraged local people to reforest in villages.

- Relationship with church

Church's activities and watershed management plans may bring conflicts; therefore, coordination between them is crucial. It is important to have mutual understanding with regard to components of activities.

7) Visiting Advanced Villages : (Training &Visits)

a. Project Activities

Individuals from the target villages who had potential to become core farmers were taken on visits to advanced villages. The purpose of these visits was for those individuals to converse with advanced farmers so that they could reflect on their own farming methods, study land-use possibilities, and motivate themselves to solve their problems by themselves. Also, videos taken during the visit to the advanced villages were shown in the demonstration project's 6 villages to give the participating farmers an opportunity to transfer their newly gained knowledge to the community members who had not participated in the tour. The purpose was to disseminate the knowledge to a wider audience.

b. Result of the Activities and Problems Encountered

a) Results of the Activities

Los Dajaos: Day visit, ASADA (Los Dajaos Agricultural Association)

29 of the participants came from the northern two villages of Los Corralitos and El Convento.

Ocoa: Day visit, ADESJO (Asociación para el Desarrollo de San José Ocoa, Inc.)

Total 40 participants were supposed to participate from each of the 4 villages in the southern region. However, due to heavy rains in Los Frios, which has an altitude of almost 1400m, the truck carrying the participants could not leave the village. The final number of participants in the visit to the advanced villages was 30 from 3 villages.

## T&V for Core Farmer Training: Forestry School, Plan Sierra, Los Dajao

A five-day, four-night visit was made to advanced villages for the purpose of giving a broader understanding and leadership awareness to individuals selected as potential core farmers. 5 people from each of the 6 villages participated in the visit.

The greatest result of this visit to the advanced villages was the opportunity for the representatives of the 6 villages to participate and share together their experiences on the trip. During this longer training session, the core farmers had the first opportunity to share their common problems and as well as their hopes with each other.

### b) Problems Encountered

#### Time Period and Participants

Several of the individuals who were being raised up as core farmers could not participate in the longer training session including the visit to Plan Sierra because they could not leave their farm work. Comments were heard that they would have been able to participate in this activity if it had taken place in February and March.

#### Participation by Women

Direct and indirect efforts were made so that as many women as possible could participate in the training. However, in the case of families with small children, the mothers could not leave their families for 5 days due to their children's needs. As a consequence, a total of only six women participated, and two villages had no women participants. How to increase women's participation in the process is still an unresolved question.



c. Lessons Learned from the Activities and their Application to the Master Plan

On-site visits to advanced villages were very worthwhile and should definitely be incorporated into the Master Plan. In the future when projects are held in other villages, this demonstration project's 6 villages should be designated and utilized as advanced villages among the surrounding villages. Another important issue will be how to coordinate between the day visits to advanced villages, and the longer visits to advanced villages for empowering core farmers.

a) Timing the Activities

From the fact that farmers became more actively involved in the demonstration project after having visited advanced villages, it would seem reasonable that holding the advanced village visits at a relatively earlier stage would contribute to activity development and continuation.

b) Selecting Participants to Advanced Village Visits

Basically, it is best to allow the villages to select their own participants. However, if there are certain individuals whom we want to have their participations, then the village leader should be asked to nominate those individuals.

c) Identifying Advanced Villages

It can be a burden for advanced villages to have to receive many of our visits. Therefore, it will be necessary to identify which villages can be utilized, and to increase the number of identified villages. Although the 6 villages where the demonstration projects had been conducted cannot be compared with those advanced cites, full consideration needs to be given toward their utilization.

#### d) Creating Videos as an Audiovisual Aid

It became clear during the evaluation workshop for the demonstration projects that making a video of the advanced villages, and then showing it during the explanation of those sites was a very effective means of information transfer. An important project would be to request the Secretariat of state for Agriculture and the Secretariat of State for Environment and Natural Resources to help in taking and editing a video on the experiences the farmers in advanced villages (such as Los Dajao or Ocoa) had in successfully adopting new farming methods. The video would be very useful for future target villages.

### **6.3 Evaluation of the Demonstration Projects**

Evaluation of the demonstration projects mainly aims to quantify qualitative changes in the consciousness-raising of people; during the short project, outcomes are difficult to judge.

#### **6.3.1 Objective of the Evaluation**

The demonstration projects in the study, which were prepared and executed in about a six (6) months period, aim at feeding back the outcome of the projects to the watershed management plan for the upper area of Sabana Yegua Dam. Therefore the evaluation discusses “Relevance”, “Impact” and “Sustainability” etc., based on the result of the projects.

#### **6.3.2 Evaluation Design**

##### (1) Evaluation Schedule

The evaluation survey was carried out from the end of November 2001 to the beginning of December 2001 in order to feed back results to the plan just before the project ends.

## (2) Evaluation Methods

This evaluation was carried out following the Project Cycle Management (PCM) method in accordance with the Project Design Matrix (PDM) through field visits, interviews and discussions with the personnel involved in the project based on “Five Basic Evaluation Components<sup>5</sup>”: Relevance, Effectiveness, Efficiency, Impact, and Sustainability.

However the evaluation of forest fire measures in the demonstration projects was based on Relevance, Effectiveness, and Efficiency because these measures aimed at utilizing pumps and materials, and making fire-extinguishing activities the principal objective of the demonstration.

The evaluation mentioned above was basically conducted with local NGOs, counterparts and Study Team. The NCOs, which know the situation of target villages well, will evaluate from a technical viewpoint, which the counterparts and the Study Team will evaluate from a general viewpoint.

## (3) Items of the Evaluation

Relevance, Effectiveness and Efficiency of the projects were evaluated based on the outcome of the projects, and Impact, Sustainability were evaluated based on the possibility of the projects.

## (4) Preparation of PDMs for Evaluation

The PDMs for evaluation were prepared before the beginning of the evaluation survey based on the PDMs prepared at the early stage of the projects through report analyses, interviews and discussions. Measures in the projects were arranged into four types: reforestation measures, agroforestry measures, soil conservation measures and environmental education measures, and four PDMs were made. The purpose of the demonstration projects and output are presented in Table 6-25.

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<sup>5</sup> Five Basic Evaluation Components: 1) Relevance, 2) Effectiveness, 3) Efficiency, 4) Impact, and 5) Sustainability, were introduced items which should be evaluated in DAC meeting 1991.

Table 6-25 Project Purpose and Output

Measures	Demonstration Project Purpose	Expected Output
Forest fire measures	The consciousness of villagers for fire prevention and extinguishing fires is improved.	<ul style="list-style-type: none"> <li>• The present situation of fire prevention zones, monitoring systems, access means and water sources for extinguishing fires were investigated.</li> <li>• Guidance about fire control was examined.</li> <li>• The fire fighting system of the forest management station and the formation of a volunteer fire-fighting unit were examined.</li> <li>• Demonstration for improvement and extension of pump operation technology was performed for local people and a member of a fire-fighting unit.</li> </ul>
Reforestation measures	Village volunteers plant trees.	<ul style="list-style-type: none"> <li>• Acquisition of seedlings became possible.</li> <li>• Reforestation was performed on land of villagers and landowners.</li> <li>• Project participants understood methods of raising of seedlings / planting (technology side).</li> <li>• Project participants understood importance of the forest.</li> </ul>
Agroforestry measures	Village volunteers positively introduce agroforestry in a village.	<ul style="list-style-type: none"> <li>• Project participants obtained basic knowledge about agroforestry through training and agroforestry plots.</li> <li>• Agroforestry plots (nursery, alley cropping) were established.</li> <li>• Villagers accepted a farmer's extension system.</li> </ul>
Soil conservation measures	The villagers who participated in the construction understand the effectiveness of soil conservation facilities.	<ul style="list-style-type: none"> <li>• A technological seminar to villagers was carried out.</li> <li>• Check dams and live barriers were built as erosion control facilities.</li> <li>• A visible effect of soil conservation by the facilities appeared.</li> </ul>
Environmental education	Environmental education through reforestation was accepted in a target village.	<ul style="list-style-type: none"> <li>• Elementary school and junior high school students participating in reforestation developed school forest.</li> <li>• Junior and high school students work as reforestation volunteers in an extracurricular lesson.</li> <li>• Students talk with their families about the environmental importance that they learned at school.</li> </ul>

(5) Survey Items and Data Collection Methods

Components, survey items, and data collection methods are shown in Table 6-26.

Table 6-26 Main Survey Items and Survey Methods

Components	Main Survey Items	Survey Methods
Relevance	<ul style="list-style-type: none"> <li>• Are the demonstration purposes and project purposes in accordance with farmers needs?</li> <li>• What is the farmers' level of satisfaction for the demonstration projects?</li> </ul>	<ul style="list-style-type: none"> <li>• Documents</li> <li>• Interviews</li> <li>• Reports</li> <li>• Evaluation workshop</li> <li>• NGO evaluation report</li> </ul>
Effectiveness	<ul style="list-style-type: none"> <li>• How is the purpose of the demonstration projects achieved?</li> <li>• What is the reason in cases of no good results?</li> </ul>	<ul style="list-style-type: none"> <li>• Interviews</li> <li>• Observations</li> <li>• Reports</li> <li>• Evaluation workshop</li> <li>• NGO evaluation report</li> </ul>
Efficiency	<ul style="list-style-type: none"> <li>• Can a farmer operate projects adequately?</li> <li>• How much of the expected outputs are realized?</li> </ul>	<ul style="list-style-type: none"> <li>• Interviews</li> <li>• Observations</li> <li>• Reports</li> <li>• Evaluation workshop</li> <li>• NGO evaluation report</li> </ul>
Impact	<ul style="list-style-type: none"> <li>• What kind of impact do villagers recognize?</li> <li>• What are the unexpected impacts (plus, minus)?</li> </ul>	<ul style="list-style-type: none"> <li>• Interviews</li> <li>• Evaluation workshop</li> </ul>
Sustainability	<ul style="list-style-type: none"> <li>• What is the degree of participation of farmers?</li> <li>• What is the organizational sustainability?</li> <li>• What is the material and technical sustainability?</li> </ul>	<ul style="list-style-type: none"> <li>• Interviews</li> <li>• Observations</li> <li>• Evaluation workshop</li> <li>• NGO evaluation report</li> </ul>

(6) Scoring of Evaluation Results

The scoring of the evaluation results assessed the degree of achievement based on the survey items listed in Table 6-26 and following the criteria listed in Table 6-27. But the impacts are not scored because they do not concretely appear such a short period.

Table 6-27 Evaluation Criteria

Components	Criteria				
	5	4	3	2	1
Relevance	Very High	High	Moderate	Slightly low	Very low
Effectiveness	Very High	High	Moderate	Slightly low	Very low
Efficiency	Very High	High	Moderate	Slightly low	Very low
Impact	-	-	-	-	-
Sustainability	Very High	High	Moderate	Slightly low	Very low

### 6.3.3 Evaluation Results

#### (1) Outline of Evaluation Results of Forest Fire Measures

The forest fire measures were evaluated from the three evaluation components shown below, namely Relevance, Effectiveness and Efficiency.

##### 1) Relevance

Most villagers have engaged in basic fire extinguishing activities in a forest fire and understand the importance. But, as for actual participation in forest fire measures, most activity is by forest management station staff, with little participation by villagers.

##### 2) Effectiveness

In the Constanza area, twenty (20) volunteers with an age range varying between 17 and 60 years have registered to volunteer in the fire-fighting unit. However, in the other 2 areas there is no such registration, and activities for the establishment of a volunteer fire-fighting unit have not started.

##### 3) Efficiency

Forest Fire workshops for were held in three areas; Sun Jan, Constanza and Padre Las Casas, and 23, 37 and 26 people participated, respectively. Through these workshops, participant's consciousness of: a) promotion of fire prevention measures; b) considerations on shifting cultivation; c) measures for spread of a fire prevention method; d) fire extinguishing activity system; e) early detection system / information system for forest fires, was improved.

In addition, a technical demonstration on pump operation was held 14 times, and a total of 517 people participated. During training including basic pump operation, at the beginning it took participants necessarily six or seven minutes to complete a demonstration exercise, but only about 2 minutes at the end. With such considerations in mind, it can be said that the operational

technology transferred smoothly, and a certain results of a technological nature were obtained.

## (2) Outline of Evaluation Results of the Demonstration Project

### 1) General Results Obtained

General results obtained by the demonstration project are as follows.

- It was confirmed that village leaders are ready to begin organizational activities in their villages through the practices of planning, implantation and evaluation.
- In the evaluation workshop held at the end of the study, the capacity of leaders seemed to have improved, as they were very eager to not only engage in watershed management activities but also in village development activities in all villages.
- Most villagers in the 6 villages expected financial support from the Study Team at the beginning of the study. A lot of them canceled participation after understanding that a project was based on "self-help effort", which limited participation to solely that of the leaders.
- There was some participation by the youth in the 6 villages. In interviews, they showed interest in daily economic activities, whether or not such activities produced benefits.
- In Las Lagunas, friction between residents of high land areas and those of low areas occurred due to the location of the village nursery and the location of a workshop.
- There is a gap between the watershed conservation as proposed in this study and the actual needs of people .

## 2) Evaluation of the Demonstration Projects

The evaluation score of the demonstration projects in each village is summarized in Table 6-28. The villages with the highest evaluation score considering all components are Los Corralitos and Las Lagunas with 3.8. Among components of the projects, agroforestry marked the lowest score with 3.1, and environmental education marked the highest score with 4.3. Among the evaluation items, sustainability shows a lower value than others, meaning that village people only succeeded in parts of the demonstrations. Therefore, it is necessary to appropriately support each component when the watershed management plan is implemented.

### a. Evaluation of Reforestation Project

#### Relevance

Public oriented reforestation activities are consistent with government policy. Although government reforestation policy adopts an approach giving incentives to farmer, the Study Team tried to adopt an approach not providing incentive. It was found that there is a gap between the purpose of this study and the realistic needs of people. In order to close the gap, Convite (or volunteer planting) methods could be used to address public needs by introducing fruit seedling in planting. The Convite method will be adopted in a small scale in the surrounding community.

#### Effectiveness

The possibility of a small scale planting based on Convite (joint force or mutual cooperation) proposed by the public as a new trial was verified for implementation. Difficulties associated with planting space and timely sowing were observed.

#### Efficiency

The reforestation project was effectively implemented through the promotion of the Convite system. The negotiation with the landowners



in the villages and the preparation of Convite activities were in general performed effectively. But, in some villages, most villagers expected a daily allowance for planting, and thus the achievement was much less than expected. In addition, frequent forest fires caused public motivation to fade.

### Sustainability

It can be said that there is sustainability in small scale Convite or volunteer planting by villagers. The Convite system would involve a group of around 5-15 people per activity. Most villagers agreed to maintain plants with their family after planting and they understand that maintenance is different from planting. The activity of village nurseries, through a cycle involving planning, implementation and planting by Convite, brings good results in the sense that people recognize the common importance for implementation and put high value on their performance. Sustainability of village nurseries looks considerably high. People generally understand seedling and planting techniques and confirmed that seeds and seedlings are not hard to get from outside. There are a few technical and physical related obstacles.

Though only on a small scale this study, it is understood that securing a planting site is can be difficult. Although the importance and merit of planting are recognized, planting by Convite may be limited to areas around communities. Thus, it is essential to give clear incentives to landowners such as certification of cutting rights and measures to expand planting.

Table 6-28 Result of Evaluation Scores of the Demonstration Project

Items		Los Corralito	El Convent	La Guama	Los Frios	Las Lagunas	El Record	Average
Total		<b>3.8</b>	<b>3.7</b>	<b>3.3</b>	<b>3.5</b>	<b>3.8</b>	<b>3.3</b>	<b>3.6</b>
Reforestation	Average	<b>4.0</b>	<b>3.5</b>	<b>3.4</b>	<b>3.7</b>	<b>3.8</b>	<b>3.4</b>	<b>3.6</b>
	Relevance	3.9	3.6	3.6	3.9	3.9	3.7	<b>3.8</b>
	Effectiveness	4.3	3.6	3.0	3.8	4.0	3.4	<b>3.7</b>
	Efficiency	4.1	3.5	3.6	3.7	3.8	3.4	<b>3.7</b>
	Sustainability	3.5	3.3	3.2	3.5	3.6	3.2	<b>3.4</b>
Agroforestry	Average	<b>3.3</b>	<b>3.0</b>	<b>2.6</b>	<b>3.2</b>	<b>3.4</b>	<b>3.2</b>	<b>3.1</b>
	Relevance	3.6	3.6	2.6	3.5	3.6	3.7	<b>3.4</b>
	Effectiveness	2.8	2.6	2.1	2.8	3.1	2.7	<b>2.7</b>
	Efficiency	3.4	2.9	2.6	3.2	3.2	3.3	<b>3.1</b>
	Sustainability	3.3	3.0	3.0	3.4	3.5	3.1	<b>3.2</b>
Environmental Education	Average	<b>4.2</b>	<b>4.3</b>	-	-	<b>4.3</b>	-	<b>4.3</b>
	Relevance	4.2	4.2	-	-	4.3	-	<b>4.2</b>
	Effectiveness	4.3	4.5	-	-	4.3	-	<b>4.4</b>
	Efficiency	4.3	4.2	-	-	4.1	-	<b>4.2</b>
	Sustainability	4.0	4.2	-	-	4.3	-	<b>4.2</b>
Soil Conservation	Average	-	<b>3.9</b>	-	-	-	-	<b>3.9</b>
	Relevance	-	3.7	-	-	-	-	<b>3.7</b>
	Effectiveness	-	4.1	-	-	-	-	<b>4.1</b>
	Efficiency	-	4.3	-	-	-	-	<b>4.3</b>
	Sustainability	-	3.3	-	-	-	-	<b>3.3</b>

Note : For details see Appendixes.

## b. Evaluation of Agroforestry

### Relevance

Promotion of agroforestry is consistent with government policy. As for the objectives of this agroforestry demonstration project, the target level seems to be too high due to the short-term implementation period. However, it is certain that curiosity for new agriculture, including agroforestry, rose among most of the villagers.

### Effectiveness

There were no villagers who executed alley cropping during the limited study period. A lot of villagers equated agroforestry practices with fruit tree growing, and more people than expected tried to plant fruit trees.

The introduction of agroforestry brings change to the current agricultural system adopted by villagers. Therefore, it is essential for long-term ongoing activities to focus on increasing understanding of sustainable land use and establishment of an agroforestry system suited for the area

### Efficiency

The study tour to an advanced area produced greater than expected effects and greatly raised the motivation of villagers. For people who could not participate in the training, audiovisual equipment was utilized effectively in an explanation with a video. It was found that this equipment was very useful for people who could not read.

The model farm for agroforestry was positioned at the extension center for villagers. Through the course of implementation, security of the site and difficulties in organizational activities were found.

### Sustainability

Around 7 farmers in each village were selected as candidate core-farmers at the beginning of the agroforestry activities. Two or three progressing farmers were identified in each village at the middle stage, and 5-7 motivated farmers were confirmed at the final stage. A surge of initiatives by villagers was found even in the short term. It may be said that the sustainability of agroforestry, though not always high presently, is expected to improve with the establishment of live fences and fruit tree planting.

c. Evaluation of Environmental Education

Relevance

Environmental education is considered to be important in school, and the environmental education projects through volunteer planting, can be said to be highly relevant from both the standpoint of forest conservation and education.

Effectiveness

Difficulty securing land for implementation of school forestry projects was experienced in 3 villages, but the planned objectives were achieved, and the promotion of school forests was verified. Cooperation of landowners in villages is necessary.

Efficiency

The project was implemented effectively through the positive cooperation of schools and villagers; however, there was difficulty in securing land.

Sustainability

The schools cooperated for both the school forest and the student volunteer planting projects. Students enjoyed planting trees. Furthermore, teachers requested students to maintain school forests after planting on a shift basis, and sufficient educational effect and material for study was expected from the activities. Thus, school forests are expected to fully spread to other schools.

d. Evaluation of Soil Conservation Facilities

Relevance

Simple live barriers have been established in a project implemented in El Convento. The soil conservation facilities considered in this project are consistent with public needs, and the public has great interest in soil conservation. Non-live barriers have also proven to be sufficiently effective in demonstrations.

Effectiveness

Villagers could confirm effects of soil erosion control even though the study period was short. Thus, it can be judged that most villagers have

been able to fully recognize the ease of construction of facilities and the project effects. It was found however, that non-live barriers were difficult to introduce owing to the obstacles they could pose to daily agricultural practices.

#### Effectiveness

The materials used were procured locally and there were no technical problems concerning construction. In this way the facilities were constructed effectively. But the transportation of stones for the construction proved to be difficult.

#### Sustainability

The likelihood that erosion control facilities will be included in agricultural practices is high, but in farmer's organizations there is anxiety regarding large-scale construction. Villagers can procure materials and cope technically. Attention to the development of non-live barriers is low, and it is necessary that this be focused on in the future. Attention to installation of live barriers as an agricultural practice is also an important topic for the future.

### 3) Impact

Direct impact cannot be expected through this project due to the short project period. In addition, it is difficult to establish a clear relation between cause and effect based on this demonstration project. Accordingly, the impact of the demonstration project was examined by studying the public's cognizance of impact and unexpected impact (plus and minus).

#### a. Impact Recognized by People

This data was gathered according to environmental, organizational and income points of views in an evaluation workshop held at the end of the study.

Table 6-29 Impact of the Demonstration Project Recognized by People

Environment	Organization	Income
<ul style="list-style-type: none"> <li>• Recognition of importance of the forest rose among people.</li> <li>• Planting enriches water resources in the future.</li> <li>• Nursery, planting and soil conservation activity lead to decrease of shifting cultivation.</li> <li>• Environment is improved by application of an organic fertilizer (bocashi, earthworm).</li> <li>• Seedling production in village nurseries helps planting activities in future.</li> </ul>	<ul style="list-style-type: none"> <li>• Village meetings became more frequent than before.</li> <li>• Participants in village meetings increased and became active.</li> <li>• The motivation to self-help effort rose remarkably following the study tours to advanced areas.</li> <li>• The community clinic and community center could be attracted by the improvement of solidarity power of a village.</li> <li>• A village is revitalized, and the people who deserted their villages come back.</li> </ul>	<ul style="list-style-type: none"> <li>• The new knowledge produces profits in future.</li> <li>• An income increase is expected by sales of wood and fruit trees in the future.</li> <li>• Planting with felling leads to an income increase in future.</li> <li>• Sale of seedlings is expected.</li> <li>• Sale of bocashi is expected.</li> <li>• Introduction of soil conservation facilities increases production, and profit increase can be expected.</li> <li>• Organic coffee can be produced through organic manure application, and income increase is expected</li> </ul>

b. Unexpected Impact

This data was gathered through the discussion with NGOs, with local understanding, after the evaluation workshop.

Table 6-30 Unexpected Impact of the Demonstration Project

Plus	Minus
<ul style="list-style-type: none"> <li>• It can be said that the planting of about 10,000 trees by forest management station, army and villagers in Los Corralitos is related to an ideal volunteer based planting.</li> <li>• Village people of Los Corralitos and El Convent went to NGOs for advice in order to follow up on a project after the JICA team left.</li> <li>• Meetings and activities concerning village development are increased in all villages.</li> <li>• Three people participated in a village meeting at El Record for planning related to 3 villages neighboring El Record.</li> </ul>	<ul style="list-style-type: none"> <li>• Some friction has occurred between the people of upper and lower areas over location of village nursery and a workshop in Las Lagunas.</li> <li>• Ten village leaders were selected to promote the demonstration project, but they were envied by the persons who were not selected (these persons expected daily allowance). This problem was solved later.</li> <li>• Some people not participating in projects became more indifferent.</li> <li>• It was found in some villages that project participants belonged to a specific political party.</li> </ul>

#### 4) Considerations for Project Implementation

The following notices should be considered to smoothly carry out the village projects in future.

Although planting activity by Convite gained some results, it is necessary to issue certification of planting with felling rights and to raise public initiative through the distribution of seedlings. Cooperation with the National Reforestation Program, by public participation in planting activities and securing profits for planting groups villages, should be considered.

Although the participants in the agroforestry project were confined to a few persons in the initial stage of the project, public awareness of agroforestry was improved through distribution of fruit seedlings, visits to advanced areas, production of bocashi and training in grafting. Considering these results, with ongoing activity and support from other organizations to secure sustainability, agroforestry projects will be widely executed.

It is easy for a farmer to adopt soil conservation measures in agricultural practice. In particular, live barriers are appropriate from viewpoints of initial cost, maintenance and utilization. As it can be expected that farmers will execute soil conservation measures in the future, these measures will extend to other areas through practical use of existing plots and demonstrations in these areas.

A public group manages village nurseries, which are the main activity of the projects. In the case of the establishment of a new village nursery, water resources will be very important, and the number of participants and the number of seedlings to be produced should be taken into consideration. It is necessary to discuss with the public the distribution of seedlings, the production of fruit seedlings and seedling use by the National Reforestation Program and the National Fruit Program.

Monitoring and evaluation workshops are useful to increase understanding, to discuss what people can do, and to determine what support is necessary when the projects are implemented. It is important that the projects are implemented step-by-step.

## **CHAPTER 7 WATERSHED MANAGEMENT PLAN**



## **CHAPTER 7 WATERSHED MANAGEMENT PLAN**

### **7.1 Basic Concept**

The purpose of formulating the Watershed Management Plan (Master Plan) is to restore the headwater conservation function of local forests by means of achieving an improved livelihood for local residents, soil conservation and appropriate forest management, etc.

In areas such as the Study Area which faces mounting problems, including poverty, irrational land use and forest fires, it is difficult to achieve tangible results without the appropriate implementation of various projects which are proposed under a properly formulated watershed management plan.

Given the above-mentioned characteristics of the Study Area, the Master Plan for Watershed Management inevitably has many components. Needless to say, the components of any master plan are related to one another. The Watershed Management Plan for the Study Area, therefore, incorporates all of the components required to achieve its ultimate objective of restoring the watershed conservation function of the area by solving such current problems as irrational land use and forest fires, etc.

The contents of the envisaged Master Plan and the relationship between different components are illustrated in Fig. 7-1. While the general flow of the Master Plan and the mutual connection of its components are explained next together with the basic concept of each component, it must be stated that there is no difference in the importance of each component.

#### **7.1.1 General Flow of Watershed Management Plan and Relationship between Components**

Simply stated, the methodology for the formulation of the Watershed Management Plan firstly involves understanding of the current problems, followed by the establishment of the targets (goals) of the Watershed Management Plan and examination of the necessary measures to achieve the targets while solving the current problems.

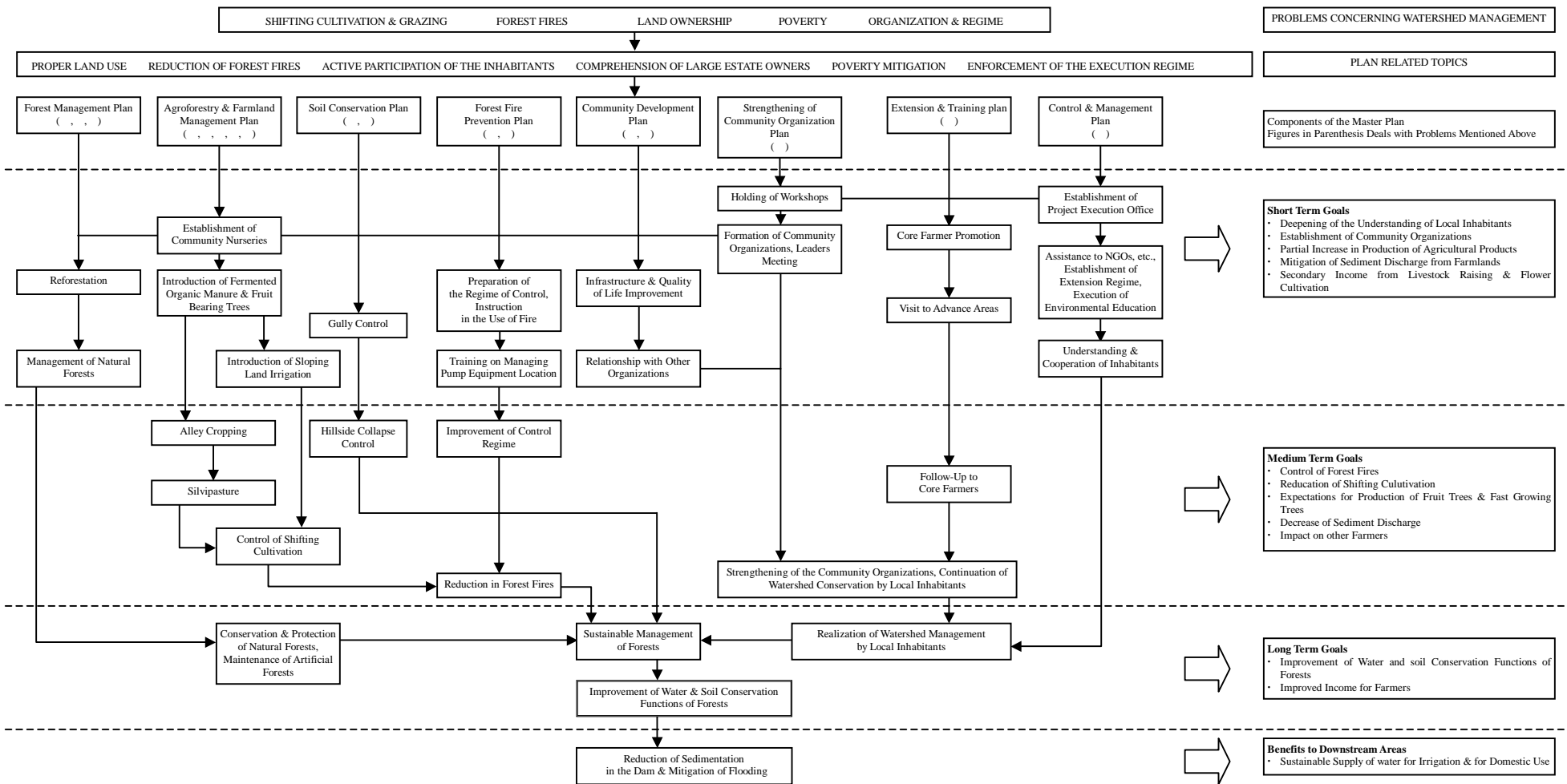


Fig. 7-1 General Concept of the Watershed Management Plan

Although the relationship between the components as solutions can be easily understood based on Fig. 7-1 if the problems, tasks and ultimate target for the Study Area are accurately understood, this relationship is further explained below to assist its understanding by readers of this report.

Firstly, there are five problems to be solved, ranging from ① proper land use to ⑤ poverty mitigation. These are followed by the eight components of the Master Plan, i.e. measures to solve the problems, ranging from forest management to control and management.

Proper land use and the formulation of a forest management plan based on a land use plan are essential to expand the forest area while preserving the existing forest resources. The transition from the current extensive shifting cultivation to a farming practice which does not involve burning through the planning of agroforestry and the management of farmland is essential to improve the present situation of the destruction and loss of forest resources due to various causes. Such transition is related to a community development plan from the viewpoint of increased agricultural productivity and can reduce the frequency of forest fires due to alleviation of the pressing need for burning to produce farmland for shifting cultivation. The preparation of a forest fire prevention project which is unified with the National Forest Fire Prevention Programme of the Under-Secretariat for Forest Resources is essential from the opposite viewpoint to forest management if the reality of frequent forest fires is to be properly dealt with.

In the meantime, the formulation of a soil conservation plan is essential to improve the current situation where no effective measures are in place to stop the degradation of farmland due to the expansion of small gullies with the passing of time.

Given the fact that the participation of local residents is a precondition for the Master Plan, all of the plans are related to one another through such participation. For example, the forest management plan and the agroforestry/farmland management plan are inter-related in terms of the production/procurement of seedlings, the maintenance of village nurseries and the sale/purchase of seedlings from the viewpoint of promoting reforestation.

Meanwhile, the community development plan represents the most important medium and long-term socioeconomic tasks under the Master Plan. Irrigated farming on sloping land, which is a component of the community development plan, is strongly related to the agroforestry/farmland management plan from the viewpoint of inducing farming at fixed plots. The realisation of such farming can, therefore, greatly contribute to the reduction of shifting cultivation. The problem of poverty lies behind many of the problems in the Study

Area and improvement of the livelihood of local residents in the community development plan is a major target for and the key to the success of the Master Plan.

While the extension and training plan directly aims at reinforcing community organizations through the establishment of core farming households, it relates to the agroforestry/farmland management plan and other plans because of the involvement of the extension and training of various techniques in the plan implementation process.

As the active involvement of local residents cannot be expected in the early implementation stage of the Master Plan, the administration is required to take the initiative under the control and management plan to induce the voluntary participation of local residents. When various plans are implemented in the same area, the participants are the same farmers. Because of this, the plan to reinforce community organizations and the extension and training plan designed to promote participation are in turn related to all of the other plans.

### **7.1.2 Priority Ranking of Components**

The establishment and continuance of a close relationship between the administration and local residents at the initial stage is essential for the successful implementation of various projects based on the relevant components of the Master Plan and the eventual achievement of sustainable forest management based on the results of these projects.

For the realisation of watershed management, it is necessary for the administration to collaborate with local residents while local residents require the presentation of measures and policies to improve their livelihood in the near future in order to actively commit themselves to various projects. As the individual involvement of local residents in various projects is highly inefficient, efforts must be made to organize them. For this purpose, a project implementation office should be established under the control and management plan so that this office can organize workshops in villages subject to project implementation to identify local needs and to establish community organizations.

The establishment of such organizations should be followed by the fostering of core farmers who actively participate in various project-related activities and who have leadership qualities and a relatively high level of awareness.

The next steps are the establishment of village nurseries and the production of seedlings as the basis for various plans before proceeding to reforestation and agroforestry. In the meantime, the project implementation office must consider collaboration with NGOs, the establishment

of an extension system, the drafting of a social infrastructure plan and the drafting of a rural livelihood improvement plan.

Some villages may face such pressing problems as forest fires and soil conservation and the priority order of these projects must be determined for each village for their prompt implementation.

### 7.1.3 Basic Ideas for Each Component

Item	Basic Ideas
Land Use	<ul style="list-style-type: none"> <li>• The land use in the Study Area shows that almost half of the total area is covered by forests and that the remaining half consists of farmland, grazing land and (treeless) grassland, etc. Shifting cultivation and grazing take place on grassland and are highly responsible for the watershed degradation as they are responsible for not only forest fires but also for sediment discharge to the lower reaches.</li> <li>• The intentions expressed by farmers in the revolving workshops held under the community project and other findings clearly indicate that the total conversion of shifting cultivation sites to forests and agroforestry sites will be virtually impossible. Most large landowners possessing grazing land are uninterested in reforestation and their interest instead lies with the planting of trees and other activities which are financially advantageous for them.</li> <li>• Land use classification, the basic categories of which are natural forest conservation, creation of artificial forests, introduction of agroforestry, improvement of farming practices and silvo-pasture, is conducted for degraded forests and those sites which the current land use and land use potential are not compatible so that the desirable land use can be realised.</li> <li>• For this classification exercise, the reality of land ownership and lifestyle as well as the behavioural patterns of local residents must be taken into consideration. It is particularly important to secure their understanding of the need for such classification through honest discussions with them and with the assistance of the local community. If necessary, incentives for large landowners should be considered.</li> <li>• One basic policy of the Secretariat of State for Environment and Natural Resources calls for the resettlement of farmers currently dwelling inside national parks to a buffer zone designated by the said Secretariat of State and this policy deserves attention. However, people currently dwelling inside national parks maintain their lives through farming in such parks and proper dialogue between the administration and these people is essential so that any resettlement from a national park area is conducted with their full consent.</li> </ul>

Item	Basic Ideas
Forest Management	<ul style="list-style-type: none"> <li>• The Study Area is located in the upper reaches of the Sabana Yegua Dam and is considered to be an important area for the conservation of this dam. It is also designated a conservation area with emphasis on headwater conservation and soil conservation in the National Reforestation Plan. Local residents are highly aware of the importance of the headwater conservation function of forests.</li> <li>• Under the community project, an attempt was made to promote reforestation by local residents through a community network with the achievement of some positive results. However, the findings of the reforestation workshops show that many farmers consider planting work to be an employment opportunity. This suggests that the wages they earn under the National Reforestation Plan constitute a major incentive for their participation.</li> <li>• In the case of existing natural forests, the target forest type should be determined so that forest management aimed at improving the headwater conservation function is planned. Meanwhile, reforestation in line with forest improvement based on the government policy is planned. Here, it is important to distinguish areas where the voluntary participation of local residents can be secured from areas where such participation cannot be anticipated. The selection of planting species with beneficial effects for local residents and the creation of village nurseries are also required.</li> <li>• Forest roads are necessary for such purposes as reforestation, natural forest management and forest fire prevention. However, the construction of forest roads in areas with steep topography, such as the Study Area, could lead to the occurrence of landslides, making it necessary to pay proper attention to the environment, including the introduction of sufficient soil conservation measures.</li> <li>• The forest management described here demands cooperation between local residents and local forestry officers. In addition, the use of village nurseries and collaboration with the National Reforestation Plan must be considered. A programme designed to allow farmers to obtain land ownership as an incentive for farmers should be prepared to facilitate their participation in the reforestation project and also to complete the processes of planting, tending and the certification of planting without fail. In this case, the income gap between the subject farmers and other aspects must be taken into careful consideration.</li> <li>• Conscious efforts should be made to secure a deeper understanding on the part of schools and to obtain new plots for the school forest scheme which has been introduced as part of the education on the environment in view of the creation of new school forests.</li> </ul>
Agroforestry and Farmland Management	<ul style="list-style-type: none"> <li>• Local agroforestry in the Study Area consists of the cultivation of coffee in broad-leaved forests, the creation of hedges on steep slopes and home gardens. Apart from the cultivation of coffee, the scale of other forms of agroforestry is small and cannot be said to be widespread.</li> <li>• The purposes of introducing agroforestry are (i) to decrease shifting cultivation which is a major cause of forest degradation and (ii) to improve soil conservation measures for farmland and agricultural production.</li> <li>• The results of the community project suggest that local residents prefer the planting of fruit trees. Accordingly, the proper placing of fruit trees and crops forms the basis for the agroforestry/farmland management plan. In addition, other possibilities are to be presented to local residents, including farming using organic fertiliser originating from animal excrement and irrigated farming using vinyl pipes as part of the forest fire prevention/control measures.</li> <li>• For the promotion of agroforestry, it is important to foster core farmers in each village/community so that they can play a leading role in the extension of agroforestry to the people of not only their own villages but also nearby villages with the use of small demonstration plots.</li> </ul>

Item	Basic Ideas
Soil Conservation	<ul style="list-style-type: none"> <li>• There are many devastated sites in the Study Area, including gully erosion sites, landslide sites and bank erosion sites. Among these, gully erosion sites which are closely related to the daily lives of local residents are hardly dealt with except for a few sites.</li> <li>• The results of the community project suggest the importance of using inexpensive materials which are locally available and of introducing simple methods to implement measures to control small-scale landslides and gullies.</li> <li>• For the highly costly restoration of large-scale landslide sites, the most realistic measure is believed to be the protection of these sites from the spread of fire from shifting cultivation sites and trampling by livestock with a view to encouraging the restoration of vegetation.</li> <li>• The implementation of the said erosion control measures should be directed at protecting such vital community infrastructures as farmlands, houses, roads, etc. Also it is important to organize local residents to effectively carry out erosion control works.</li> </ul>
Forest Fire Prevention & Control	<ul style="list-style-type: none"> <li>• It is reported that some 50% of the forest fires in year 2000 were those that spread to forests from shifting cultivation sites. Such forest fires not only destroy a forest but also impede its natural regeneration and therefore negatively effect its sustainable management.</li> <li>• As part of the forest fire prevention and control project, fire extinguishing training for local forest officials on the use of water pumps, workshops in villages and the formation of volunteer fire corps were conducted with some success to prevent and control forest fires in the Study Area.</li> <li>• As forest fires occur every year, regular training and the implementation of prevention measures are necessary. Given the importance of shifting cultivation as the livelihood of local residents, it is impossible to immediately stop shifting cultivation. It is, therefore, important to establish a fire prevention and extinguishing system which incorporates both local residents and forest management offices/forest stations. This system should feature the strengthening of the volunteer fire corps in each village, the provision of appropriate guidance on shifting cultivation and the early detection of forest fires from monitoring towers (fire look-outs), etc.</li> <li>• To achieve such objectives, a plan is to be formulated for not only a fire prevention and extinguishing system but also for the deployment of simple fire equipment/tools for initial fire-fighting activities and vehicles to transport personnel to the scene of a fire.</li> </ul>
Community Development & Strengthening of Community Organizations	<ul style="list-style-type: none"> <li>• The Study Area is considered to be the poorest area in the Dominican Republic. Although local residents have some interest in forests and reforestation, their first priority is to secure food rather than to participate in reforestation activities.</li> <li>• The menu for livelihood improvement which emerged from the community project includes the raising of pigs, goats and sheep, the cultivation of flowers and medicinal herbs, folk crafts and bamboo works, etc. The selection of appropriate activities is preferable, taking the local characteristics and needs of residents, etc. into consideration.</li> <li>• Many villages lack essential social infrastructure components, such as electricity supply, water supply, roads and/or bridges. The development of these is highly ranked among the needs of local residents. Moreover, an increase of their income is of major concern for local residents.</li> <li>• It is believed that community groups formed to implement watershed conservation and village development, etc. can significantly contribute to community development by applying the problem-solving ability nurtured in the process of organization to negotiations with external bodies and reforestation activities, etc.</li> </ul>

Item	Basic Ideas
Extension and Training	<ul style="list-style-type: none"> <li>• The results of the community project suggest the importance of identifying core farmers which can play a leading role in watershed conservation and community development through extension activities with other farmers.</li> <li>• The study visits to advanced areas raised the awareness of the participants of the importance of self-help efforts and group activities. Similar study visits are planned as a component of the extension and training plan under the Master Plan.</li> <li>• As the Study Area is an area with a high illiteracy rate in the Dominican Republic, it should prove to be more effective to use audio-visual equipment to record activities in advanced areas and in their own villages to show them to local residents rather than the distribution of pamphlets.</li> <li>• As a result of the implementation of the demonstration project in six villages, project bases have been established in Constanza, Padre Las Casas and Bohachio. The smooth implementation of various projects under the Master Plan is expected with these bases acting as focal points.</li> </ul>
Implementation of Master Plan	<ul style="list-style-type: none"> <li>• The formulation of the implementation plan for the Master Plan (which is formulated under the Study) by the Department of Planning of the Forest Planning and Policy Administration is desirable in collaboration with the Department of Watershed Management, Department of Reforestation and Management and Department of Natural Forest Management of the Reforestation Management Administration and the Department of Forest Fire Prevention and Control of the Fire Protection Administration with the assistance of forest management offices in local areas.</li> <li>• Given the fact that the Study Area falls under the jurisdiction of several forest management offices, a new body responsible for the implementation of various projects should be established together with an advisory council designed to coordinate the opinions of watershed management-related government bodies, local public bodies and other organizations.</li> <li>• The establishment of a new body responsible for project implementation cannot guarantee close linkage with local residents because of the current shortage of manpower and equipment of the Under-Secretariat for Forest Resources. Accordingly, NGOs and private organizations will be actively used for the implementation of projects.</li> <li>• To control shifting cultivation which is a major cause of watershed devastation, to promote adequate land use and to conserve/restore forests, it is necessary to secure the active participation of local residents in the Master Plan. For this reason, the participation of local residents is upheld as the major principle for the implementation of the Master Plan.</li> </ul>

## 7.2 Land Use Plan

The purposes of the land use plan are to ensure the most beneficial use of resources and to ensure environmental conservation for years to come. This plan must, therefore, be harmonious with the comprehensive examination of not only the potential productivity of the land but also the plan's function of conserving the natural environment, the socioeconomic aspects, purposes and extension effects of the planned activities, etc.

### 7.2.1 Classification of Land Use Potential

#### (1) Classification of Land Use Potential in Study Area

Based on the criteria used to classify land use potential in the Dominican Republic, new criteria have been developed by combining the soil conditions and gradient of the land to classify the land use potential in the Study Area. The underlying concept for this



classification and the method to prepare a land use potential map are explained in the Appendix. The criteria for the land use potential categories in the Study Area are shown in Table 7-1.

Table 7-1 Classification Criteria for Land Use Potential

Category	Criteria
II	Cultivable plot which is also suitable for irrigation; distributed on flat land, gently undulating land or hill with minor restrictive factors for land use; high productivity is possible with appropriate intensive management
III	Cultivable plot which is also suitable for irrigation but land use is limited to highly profitable crops; restrictive factors include low fertility, large quantity of gravel, excessive drainage, shallow soil and salinity; medium productivity is possible with intensive management
IV	Cultivation is restricted but perennial crops and pasturing grass can be grown; improvement measures are necessary to alleviate strong restrictive factors; these measures include soil improvement, fertiliser application, improved drainage and soil erosion control; the productivity is medium to low
VI	Unsuitable for cultivation except for perennial and mountain crops; suitable for forest or pasture use; strong restrictive factors include steep topography; large quantity of gravel; shallow soil and proneness to erosion; medium intensive conservation measures are required for the cultivation of perennial crops and grazing grass; rational measures are required for the development of forestry
VII	Unsuitable for cultivation and only suitable for forest use; strong restrictive factors include steep gradient, large quantity of gravel and rocks and extremely shallow soil
VIII	Unsuitable for either cultivation or forestry development; these plots include coastal land and inland wetland which are unsuitable for agriculture due to poor drainage or high level of salinity, very steep hillsides and steep land along rivers

Using these criteria for land use potential classification, the land use potential in the Study Area was categorised and the results are shown in Table 7-2.

Table 7-2 Area by Land Use Potential Category

(Unit: ha)						
Actual Use Classification	Forest P, L, S	Shrub Land Za	Grazing Land H	Grassland Zm	Farmland Ta	Total
II	27	0	52	119	1,551	1,749
III	461	3	43	242	473	1,222
IV	3,463	358	397	2,076	2,461	8,755
VI	64,573	4,176	1,956	35,743	5,252	111,700
VII	13,934	1,066	104	9,295	362	24,761
VIII	5,073	698	28	4,249	256	10,304
Total	87,531	6,301	2,580	51,724	10,355	158,461

Although the Study Area covers an area of 166,614 ha, the total area for land use potential classification is 158,491 ha because of the omission of (i) coffee plantations

where no special problems demanding watershed management measures exist and (ii) water bodies and village housing areas which are not subject to watershed management.

The category with the largest area is Category VI with 111,700 ha, followed by Category VII with 24,761 ha, Category VIII with 10,304 ha, Category IV with 8,755 ha, Category II with 1,749 ha and Category III with 1,222 ha.

## (2) Inappropriate Land Use

The introduction of some measures is necessary from the viewpoint of watershed management for those areas where the present land use is inappropriate because of conflict between the present land use and the desirable land use. Areas of such inappropriate land use in the Study Area are those listed in Table 7-3.

Table 7-3 Areas of Inappropriate Land Use

Potential Land Use Category	Present Land Use	Area (ha)	Reasons for Classification as Areas of Inappropriate Use
III	Farmland	473	Despite being the category requiring soil conservation measures, the land is used for farming without such measures
IV	Grassland	2,076	Despite being the category requiring some restrictions on cultivation, shifting cultivation is taking place without soil erosion prevention measures
	Farmland	2,461	Despite being the category with restrictions on cultivation, irrigated agriculture is taking place without soil erosion prevention measures
VI	Grazing Land	1,956	Despite being the category requiring conservation measures, grazing is taking place without such measures
	Grassland	35,743	Despite being the category requiring conservation measures, shifting cultivation is taking place
	Farmland	5,252	Despite being the category requiring conservation measures, irrigated agriculture is taking place
VII	Grazing Land	104	Despite being the category suitable only for forest use, grazing is taking place
	Grassland	9,295	Despite being the category suitable only for forest use, shifting cultivation is taking place
	Farmland	362	Despite being the category suitable only for forest use, irrigated agriculture is taking place
VIII	Shrub Land	698	Despite being the category to be preserved as forest, the forest quality has significantly deteriorated
	Grazing Land	28	Despite being the category to be preserved as forest, grazing is taking place
	Grassland	4,249	Despite being the category to be preserved as forest, shifting cultivation is taking place
	Farmland	256	Despite being the category to be preserved as forest, irrigated agriculture is taking place

## 7.2.2 Desirable Land Use

### (1) Land Use Classification Matrix

The matrix shown in Table 7-4 has been created to indicate the adequate land use in order to improve the existing inappropriate land use in the Study Area and to preserve/improve the water and soil conservation function of the watershed.

In this matrix, the potential land use is shown along the vertical axis while the present land use is shown along the horizontal axis. In addition, the desirable land management categories are shown for each potential land use category, including the areas of inappropriate land use mentioned earlier.

For the introduction of desirable land management categories in this matrix, agricultural production based on agroforestry, etc. is taken into consideration in view of the livelihood of local residents for areas where the use as forest is desirable from the viewpoint of land use potential. For the actual application of this matrix, adequate land management measures must be introduced, taking the intentions of local residents into proper consideration. Moreover, as for as the National Park is concerned, it should be protected as forest.

Table 7-4 Land Use Category Matrix

Present Use Category	Forest	Shrub Land	Grazing Land	Grassland	Farmland
II	Forest-1 (Forest-3)	Forest-1 (Forest-3)	Grazing-1 (Forest-3)	Agriculture-1 (Forest-3)	Agriculture-1 (Forest-3)
III	Forest-1 (Forest-3)	Forest-1 (Forest-3)	Grazing-1 (Forest-3)	Agriculture-2 (Forest-3)	Agriculture-2 (Forest-3)
IV	Forest-1 (Forest-3)	Forest-1 (Forest-3)	Grazing-2 (Forest-3)	Agriculture-2 (Forest-3)	Agriculture-2 (Forest-3)
VI	Forest-2 (Forest-3)	Forest-2 (Forest-3)	Grazing-2 (Forest-3)	Agriculture-2 (Forest-3)	Agriculture-2 (Forest-3)
VII	Forest-2 (Forest-3)	Forest-2 (Forest-3)	Forest-2 (Forest-3)	Forest-2 (Forest-3)	Forest-2 (Forest-3)
VIII	Forest-3 (Forest-3)	Forest-3 (Forest-3)	Forest-3 (Forest-3)	Forest-3 (Forest-3)	Forest-3 (Forest-3)

\* The land management categories in brackets should be adopted within the boundaries of a national park.

## (2) Contents of Conservation Measures

Table 7-5 describes the management categories shown in the matrix. The more detailed management practices under each category are described in 7.3 onwards.

Table 7-5 Description of Management Categories

Management Category	Description
Forest-1	Given the gentle topography and high land productivity, artificial forest management primarily aimed at producing wood is conducted with due attention being paid to the headwater conservation and soil conservation functions
Forest-2	Given the steep topography and low land productivity, natural forest management aimed at performing the headwater conservation and soil conservation functions is conducted
Forest-3	Given the extremely harsh natural conditions, including the National Park and extremely steep topography, forest management as protected forest where no active cutting or other activities take place is conducted
Grazing-1	As grazing produces few problems from the viewpoint of soil conservation, the land is continually used for grazing purposes
Grazing-2	Silvo-pasture using trees is introduced to prevent soil erosion due to grazing
Agriculture-1	Active agricultural production is conducted with improved farming practices as hardly any land use restrictions exist
Agriculture-2	Agroforestry incorporating soil conservation measures, including simple vegetation terracing work, depending on the topography and other land use conditions is conducted

### 7.2.3 Area by Land Use Category

#### (1) Area by Land Use Category

The area by land use category in the Study Area is shown in Table 7-6 using the matrix described earlier.

The preservation and management of forests and the creation of artificial forests are predominant inside national parks for the purpose of conservation. Agroforestry and silvo-pasture are planned to support the lives of local residents outside national parks even though the sites should be managed as forests.

Table 7-6 Area by Land Use Category in Study Area

Zone Category		Inside National Parks		Outside National Parks		Total		Remarks
		Area (ha)	Area Ratio (%)	Area (ha)	Area Ratio (%)	Area (ha)	Area Ratio (%)	
Forest	Forest-1			2,575	2.9	2,575	1.6	
	Forest-2			42,208	48.3	42,208	26.7	
	Forest-3	71,032	100	5,799	6.6	76,831	48.4	
	Sub-Total	71,032		50,582		121,614		
Grazing Land	Grazing-1			95	0.1	95	0.1	
	Grazing-2			2,353	2.7	2,353	1.4	
	Sub-Total			2,448		2,448		
Farmland	Agriculture-1			1,670	1.9	1,670	1.1	
	Agriculture-2			32,759	37.5	32,759	20.7	
	Sub-Total			34,429		34,429		
Total		71,032	100.0	87,459	100.0	158,491	100.0	

(2) Changes of Land Use After Plan

Table 7-7 shows the prospective changes of land use after the formulation of the land use plan based on the study results on the present land use and desirable land use.

Table 7-7 Changes of Land Use by Land Use Category before and after Formulation of Land Use Plan

Category	Before the Plan	After the Plan							Total
		Forest-1	Forest-2	Forest-3	Grazing-1	Grazing-2	Agriculture-1	Agriculture-2	
Forest	87,531	2,252	34,556	50,723					87,531
Shrub Land	6,301	323	2,951	3,027					6,301
Intensive Grazing Land	2,580		104	28	95	2,353			2,580
Grassland (Treeless)	51,724		4,399	21,404			119	25,802	51,724
Farmland	10,355		198	1,649			1,551	6,957	10,355
Total	158,491	2,575	42,208	76,831	95	2,353	1,670	32,759	158,491

Unit : (ha)

Although the total area of forest remains unchanged, 6,301 ha of shrub land are entirely changed to forest. 2,580 ha of intensive grazing land before the plan are changed to 132 ha of forest and 2,353 ha of silvo-pasture with 95 ha remaining unchanged. 51,724 ha of

grassland (treeless) are changed to 25,803 ha of forest, 119 ha of farmland with improved farming practices and 25,802 ha of agroforestry after the plan. In the case of farmland, 10,355 ha before the plan are changed to 1,847 ha of forests, 1,551 ha of farmland with improved farming practices and 6,957 ha of agroforestry.

As such, the plan envisages a forest increase of 34,083 ha and improved farming practices and improved land use by means of silvo-pasture and agroforestry for 36,782 ha of land.

### **7.3 Forest Management Plan**

#### **7.3.1 Direction of Forest Management Plan**

(1) Preservation of Existing Forests

Forests in the Study Area account for some 52% (87,531 ha) of the entire area, consisting of some 29% (48,473 ha) inside national parks and some 23% (39,085 ha) outside national parks. From the viewpoint of securing the headwater conservation and soil conservation functions, the preservation of their present state with adequate management is, in principle, adopted as the aim of forest management.

(2) Reforestation at Suitable Forest Sites

In the case of existing grazing land, grassland and farmland which is unsuitable for cultivation and where shifting cultivation, grazing or other activities are taking place, the conversion of their present form of land use to forest will basically be attempted. Reforestation will be conducted with the understanding of landowners and/or land users with a view to increasing the forest area so that the water and soil conservation function can be maintained or enhanced throughout the watershed.

(3) Implementation of Operation Suitable for Site Conditions

The adequate maintenance and management of forests are essential to achieve a high level of the water and soil conservation function and, therefore, operation suitable for the soil type, ground inclination and elevation, etc. will be conducted. The site conditions will also be taken into consideration for the creation of new forests by means of planting. This will include the selection of suitable species.

#### (4) Forest Management with Due Care for the Environment

Given the rich indigenous flora on Hispaniola Island, the large-scale introduction of exotic species requires careful consideration. Some exotic species may well be introduced, however, at those places with a strong need for early greening by local residents on the grounds that the introduction of exotic species of which the characteristics have been studied worldwide may be necessary to achieve early and reliable reforestation results.

### **7.3.2 Classification of Forest Management**

#### (1) Basic Ideas of Classification

Three land use categories, i.e. Forest-1, Forest-2 and Forest-3, which involve the preservation and management of land in the form of forest under the land use plan are used here as the basic forest management categories. In addition, concrete management types have been established for each forest management category based on the land productivity, present land use and present forest type, etc. from the viewpoint of the preservation/enhancement of the water and soil conservation function and of wood production. These categories and types are shown in Table 7-8.

Two national parks, i.e. the José del Carmen Ramírez National Park and the Valle Nuevo National Park, are located in the Study Area. Although the management of forests inside these national parks should follow the guidelines given by the national park management plan, these forests are included in the present Master Plan from the viewpoint of watershed conservation for the entire Study Area.

Table 7-8 Forest Management Categories

Category		Forest Type	Management Type	Criteria
Forest-1		Production Forest	Artificial Forest with Clear Cutting	Given the high land productivity and the virtual absence of problems associated with water and soil conservation, the management of artificial forests to mainly produce wood through the cycle of clear cutting and planting is selected for this forest category. This Forest operation will be conducted outside the national park.
Forest-2	-1	Conservation Forest	Natural Forest with Selective Cutting I	Given the need for forest management with due attention paid to the maintenance of the water and soil conservation function because of the steep inclination and other site conditions, the management of natural forests is opted for. Healthy forests will be preserved through regeneration by selective cutting. This Forest operation will be conducted outside the national park.
	-2		Natural Forest with Selective Cutting II	While the site conditions are the same as Natural Forest with Selective Cutting I, artificial forests are created through planting to replace the existing land use which is not forest. The management of these artificial forests will gradually change to natural forest management as in the case of I above. This Forest operation will be conducted outside the national park.
Forest-3	-1	Protection Forest	Natural Forest with Prohibited Cutting I	As the severe natural conditions, including steep inclination, demand protection in the form of a national park, etc., cutting is prohibited for this type of natural forest. No special management activities are conducted. This operation will be conducted within the national park and in areas where site condition is severe.
	-2		Natural Forest with Prohibited Cutting II	While the site conditions are the same as Natural Forest with Prohibited Cutting I, artificial forests are created through planting to replace the existing land use which is not forest or where natural regeneration is very difficult due to the occurrence of frequent forest fires. The management of these artificial forests will gradually change to natural forest management as in the case of I above. This operation will be conducted within the national park and in areas where site condition is severe.

Note : In the Watershed Mngement Plan Maps reforestation after clear felling of natural forest is expressed as Forest 1-1, and reforestation in other land use categories is shown as Forest 1-2.

(2) Area by Management Type

The area by management type is shown in Table 7-9.

Table 7-9 Area by Management Type

Category		Forest Type	Management Type	Inside National Parks	Outside National Parks	Total
Forest-1		Production Forest	Artificial Forest with Clear Cutting	0	2,575 (new planting 323)	2,575
Forest-2	-1	Conservation Forest	Natural Forest with Selective Cutting I	0	34,556	34,556
	-2		Natural Forest with Selective Cutting II	0	7,652	7,652
Forest-3	-1	Protection Forest	Natural Forest with Prohibited Cutting I	48,471	2,252	50,723
	-2		Natural Forest with Prohibited Cutting II	22,561	3,547	26,108

Unit : (ha)



### **7.3.3 Forest Management Types**

#### **(1) Management of Artificial Forests with Clear Cutting**

##### **1) Cutting Method**

The cutting method is clear cutting. While the cutting area is determined by the technical standards for forest management set forth by the Under-Secretariat for Forest Resources, it is desirable for the area to be minimised from the viewpoint of preserving the water and soil conservation function. No cutting is conducted along rivers or streams to create protected tree belts.

##### **2) Regeneration Method**

Regeneration is conducted by artificial planting using the species and method described below.

###### **a. Planting Species**

Table 7-10 shows the feasible growth range in terms of the elevation for the planting species of which the introduction is considered under the National Reforestation Plan and by the Under-Secretariat for Forest Resources and this range is used as the selection criteria for the planting species. Should reforestation be promoted with the participation of local residents, the prospects of future use and other aspects must be taken into consideration in the selection process.

Table 7-10 Growth Range of Candidate and Feasible Species for Planting under National Reforestation Plan

	Tree Species	Elevation (m)						
		0	500	1000	1500	2000	2500	3000
National Reforestation Plan	1 Pinus caribaea	→						
	2 Pinus occidentalis	→						
	3 Cordia alliodorata	→						
	4 Swietenia mahogani	→						
	5 Grevillea robusta	→						
	6 Cedrea odorata	→						
	7 Inga Vera	→						
	8 Juniperus glacialior	→						
	9 Colubrina arborescens	→						
	10 Simarouba glauca	→						
	11 Calophyllum calaba	→						
	12 Catalpa longissima	→						
Other Tree Species	13 Casuarina equisetifolia	→						
	14 Gmelina arborea	→						
	15 Guazuma ulmifolia	→						
	16 Leucaena leucocephala	→						
	17 Gliricidia sepium	→						
	18 Pithecellobium saman	→						
	19 Erythrina poepligiana	→						
	20 Acacia angustissima	→						
	21 Spondias mombim	→						
	22 Prunus Occidentalis	→						
	23 Juglans jamaicensis	→						

b. Planting Method

Planting is basically conducted in accordance with the technical standards for forest management set forth by the Under-Secretariat for Forest Resources. The planting distance is determined based on the site conditions as such various combinations as 2.5 m x 3 m, 2.5 m x 2.5 m and 3 m x 3 m, etc. are feasible. The rainy season which lasts from May to October is the preferable time for planting. However, as it overlaps with the busy farming season, careful preparations are required to secure a sufficient workforce. The planting method employed by the community project firstly involves the transportation of planting stock from a nursery to near the planting area by truck, followed by manual or animal transportation to the actual planting area. The seedlings are then distributed to the planting plots where planting holes are dug. Prior to digging these planting holes, the grass around the holes is cleared to prevent any

obstruction to the growth of the planted seedlings. The standard size of these holes is a radius of some 25 cm and a depth of some 25 m.

< Important Points for Planting >

- Forests cannot be expected to develop if planting is conducted at sites with shallow top soil and/or extremely dry conditions. Natural regeneration is relied upon at these sites for the time being so that reforestation efforts can commence at sites with good tree growth prospects.
- Planting on dry slopes must ensure a sufficient water retaining capacity and air permeability of the ground.
- At grazing land, riparian forests are preserved or newly created. Group planting is believed to be more effective to ensure the survival of the planted trees than the scattered planting of single trees. In this manner, stands in the form of grouped trees are created.
- At steeply sloping sites, such earth retaining work as log work or wicker work, etc., is introduced prior to planting to ensure sufficient scope for root extension and water retention. In this way, travelling water and sediment are trapped to improve the soil conditions.
- At pine forests with a high elevation, a water repelling, rather solid surface layer is formed where litter is strongly bonded by hypha. If possible, mild agitation of the top soil layer is desirable.

3) Tending Method

a. Weeding

Weeding should be continually conducted for approximately the first three years until the planted trees outgrow the height of the undergrowth. If necessary, cultivation weeding using a hoe and other tools should be conducted to clear plants around the planted trees.

b. Pruning

In principle, pruning is not conducted but may be conducted to ensure the healthy growth of the trees. When the production of high quality wood is particularly required, pruning is conducted taking the dimensions of the wood to

be produced and the DBH of the planted trees into consideration. Careful attention is required in the case of intensive pruning when the trees are still young as the tree growth could be damaged.

c. Improvement Cutting

Species which are not the target species which invade the reforestation sites after planting and which disrupt the growth of the planted trees are cleared. However, if invading trees other than the target species are useful species, reasonable efforts should be made to leave them as long as their presence is not harmful to the growth of the planted trees.

d. Thinning

Thinning is conducted when competition between trees commences following the closure of the crown of the planted trees. The timing of thinning is determined in consideration of the sale of the thinned wood.

(2) Management of Natural Forests with Selective Cutting I

1) Cutting Method

The cutting method is selective cutting. Group selecting cutting is employed for pine forests while single tree selective cutting is employed for broad-leaved forests and dry forests to ensure their regeneration. As the bearing year differs from one species to another, the bearing situation should be taken into consideration to determine the year for selective cutting.

2) Regeneration Method

The regeneration method is natural regeneration. In the case of pine forests and broad-leaved forests, as seeding regeneration is the norm, forest bed treatment may be necessary to facilitate the germination of the seeds. Dry forests are regenerated by sprouting.

3) Tending Method

Tending is basically not required for natural forest management. However, when the regeneration and growth of the succeeding trees are insufficient, it is necessary to conduct such tending work as tilling of the forest bed, planting of seedlings, cutting of saplings and improvement cutting. In any case, adequate tending may be required

at appropriate times by observing the regeneration and growth of the succeeding trees.

(3) Management of Natural Forests with Selective Cutting II

1) Cutting Method

The cutting method is the same as the method used for the management of natural forests with selective cutting I.

2) Regeneration Method

The regeneration method is the same as the method used for the management of natural forests with selective cutting I.

3) Tending Method

The tending method is the same as the method used for the management of natural forests with selective cutting I.

4) Inducement from Artificial Forests to Natural Forests

For the swift creation of forests at the target sites, artificial forests are firstly created. However, the number of trees to be planted at the initial stage is less than that for the management of artificial forests with clear cutting as the creation of mixed forests is aimed at. In addition, useful species other than the planted species are left uncut at the time of weeding and improvement cutting.

(4) Management of Natural Forests with Prohibited Cutting I

1) Cutting Method

In principle, cutting is prohibited.

2) Regeneration Method

The regeneration method is natural regeneration.

3) Others

No operation takes place except in special cases, including the removal of trees damaged by disease or pests. The same operations will be conducted within the national park.

(5) Management of Natural Forest with Prohibited Cutting II

1) Cutting Method

In principle, cutting is prohibited.

2) Regeneration Method

The regeneration method is natural regeneration.

3) Others

No operation takes place except in special cases, including the removal of trees damaged by disease or pests. At sites like grazing land of which the present land use is not forest but where artificial planting is feasible, artificial planting is conducted with a view to eventually guiding an artificial forest to become a natural forest. At other sites where artificial planting is impossible due to the harsh natural conditions, their use for grazing is terminated to leave the sites for natural transition. Moreover, basically the forest operation within the national park will be natural regeneration. However, in sites where severe damage had occurred due to forest fires and in areas where natural regeneration is difficult to conduct, reforestation will be conducted for quick forest rehabilitation. After forest rehabilitation management of natural forest with prohibited cutting I will be carried out.

(6) Forest Roads

Forest roads are essential for not only reforestation and forest management but also for the prevention and extinguishing of forest fires and the transportation of forest as well as agricultural products.

The ground of the Study Area is very fragile and the frequent occurrence of hurricanes means that there are many landslide sites in the upper reaches. As part of the forest management plan, the construction of forest roads is planned to provide access to the planting sites. The forest road density will be 10 m per ha based on the relevant standard set forth by the Under-Secretariat for Forest Resources and the planned total length of forest roads is 650 km.

It is necessary to note the following points when forest roads are constructed.

- ① From the topographical point of view, the preferred route is along a ridge and the construction of forest roads on steep hillsides should be avoided as much as possible.

- ② An existing village road should be used to provide the starting point for a new forest road which then stretches to the planned planting site.
- ③ The forest road width should be sufficient for use by small trucks and the road should be as flat as possible.
- ④ Cross-drain work and side ditches should be introduced in appropriate places in view of the rainfall intensity at the time of a hurricane, etc.
- ⑤ The cooperation of local residents who will use the roads should be sought in view of forest road maintenance.

### **7.3.4 Supply of Seedlings**

#### **(1) Supply of Seeds and Seedlings**

In regard to the supply of seeds, the Seed Bank situated at the Department of Seed Production of the Reforestation Management Administration of the Under-Secretariat for Forest Resources is responsible for the supply and management of seeds in the Dominican Republic. The nursery at each forest management office also collects seeds from the surrounding area and, therefore, no problems are anticipated in regard to the supply of seeds once a proper quality control system is in place.

#### **(2) Use of Nurseries**

##### **1) Existing Public Nurseries**

As mentioned earlier, there are several public nurseries in the Study Area, including those belonging to the Constanza Forest Station and the San Juan Forest Management Office and the nursery created under the Quisqueya Verde Plan. The supply of seedlings for the planned planting sites by these existing nurseries is, therefore, possible. Moreover, the facilities at these nurseries can also be used.

##### **2) Village Nurseries**

At present, the small nurseries created under the community project have an average of three nursing beds and each bed can produce an average of some 1,000 seedlings/year, totalling 3,000 seedlings. If some beds are used twice a year, up to 4,000 seedlings/year can be produced by these nurseries. If it is possible to procure seedlings under the National Reforestation Plan, etc. together with the availability of new nursery sites, the seedling demand under the forest management plan can be sufficiently met. One problem in regard to village nurseries is water management. However, any problem in this aspect can be solved by the construction of simple

water supply facilities. The equipment and materials required by village nurseries are cheesecloth for the nursing beds, stakes, wire for protection, a water tank and water pipes.

### 7.3.5 Participation of Local Residents

The anticipated mechanism for the participation of local residents in the forest management plan is shown in Fig. 7-2.

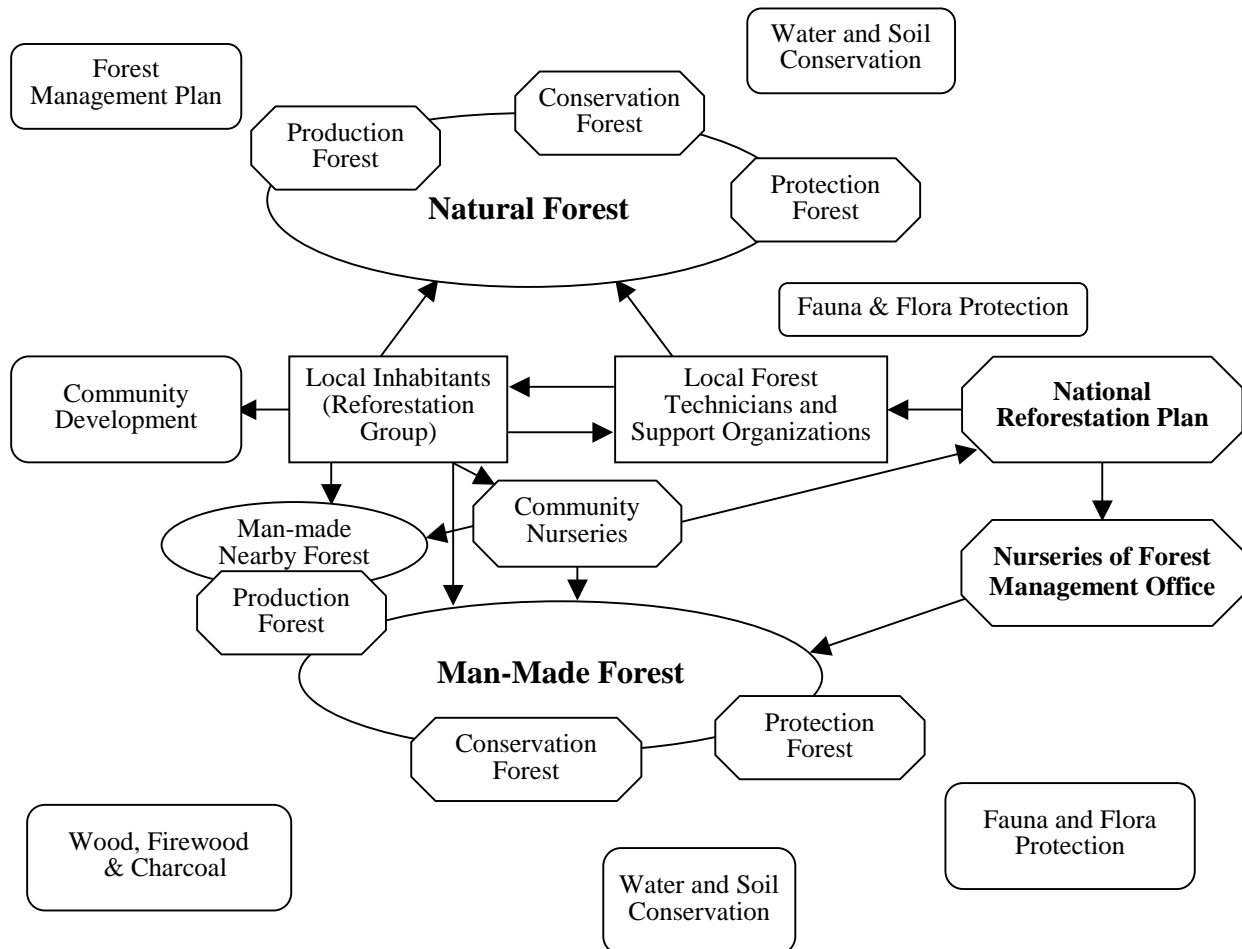


Fig. 7-2 Mechanism for Participation of Local Residents in Forest Management Plan

#### (1) Management of Natural Forests

The subject natural forests are those located around villages or on public land. The types of work to be conducted by farmers include weeding, pruning and the removal of dead trees. Because of the huge area involved, a new group for forest management should be created within the existing planting group so that the members of the new group can



manage natural forests as well as patrolling forests to detect forest fires. The management cost may be covered by communal funds, the forest fund of the government and/or the budget for forest fire control.

(2) Planting in Nearby Areas

Reforestation around a village means that the farmers themselves plant and manage the trees on their own land. The seedlings will be supplied by forest stations and village nurseries. At the start of planting, applications are made to the competent forest station for a planting certificate and a cutting permit to acquire ownership of the planted trees. The vicarious execution of the administrative work and technical guidance on planting work by local forestry officers and the supply of high quality seedlings, etc. should act as incentives for farmers planning to conduct this type of planting.

(3) Large-Scale Reforestation

Large-scale reforestation is conducted in remote areas where public land and land belonging to large landowners is situated.

The National Reforestation Plan currently being implemented by the Under-Secretariat for Forest Resources is contributing to the promotion of local employment through the payment of wages to participating local residents. In order to actively promote the reforestation of land belonging to large landowners, dialogue with large landowners should be attempted with the cooperation of planting groups. The reforestation of land owned by large landowners near the headwater area is directly linked to the lives of local residents. The priority participation of the members of planting groups in the National Reforestation Plan appears necessary for the promotion of reforestation and some of the earned wages is used to pay the forest management cost and the village development cost.

(4) Production of Seedlings

Village nurseries will be used as key bases for the supply of seedlings for the reforestation sites. Up to the present, the production of seedlings at village nurseries has focused on forestry species. In the future, the seedlings of fruit trees will also be produced in response to the strong request by local residents. The management of these nurseries will be left to women and the production range will be widened to include vegetables and flowering plants in addition to seedlings to obtain wood. Use of the income for nursery repair and village development is important in view of the possible need to supply seedlings for the National Reforestation Plan.

## (5) Land Ownership

The sale of seedlings by village nurseries, the employment of local residents through linkage with the National Reforestation Plan and the awarding of land ownership should act as incentives for local residents to participate in planting activities.

The latest village survey found that while the need for land ownership among villagers was not particularly high except for villages around national parks, many farmers express interest in borrowing from an agricultural bank and in securing future land inheritance through the acquisition of land ownership. Meanwhile, some farmers were found to be reluctant to acquire land ownership because of the huge cost arising from the large distance to farmland.

Based on these findings, the land ownership programme will only be implemented in the subject areas for reforestation to promote planting in these areas.

For the planning of this programme, extensive discussions in each community to establish communal consent are essential as the programme will not benefit local residents living outside the planting areas despite the better incentives for farmers in the planting areas. Moreover, the planning and implementation of the programme should be quickly conducted under the leadership of the Under-Secretariat for Forest Resources in view of the smooth progress of the procedure to acquire land ownership.

## **7.4 Agroforestry and Farm Management Plan**

### **7.4.1 Target Farmers**

#### (1) Agriculture

Agroforestry activity is targeted toward farmers who are practicing sloping land irrigation farming and farmers practicing traditional agriculture. However, in the case of traditional agriculture it would be impossible to work with all the farmers in the watershed area who practice traditional agriculture. Therefore, in this Master Plan the traditional farmers are divided into two groups based on their land accessibility: those with lands close to the village and those with distant lands. As a result, the target farmers fall within the following three groups:

- ① Farmers practicing sloping land irrigation farming
- ② Farmers practicing traditional farming on lands in or close to the village.
- ③ Farmers practicing traditional farming on lands distant from the village.

Since nearly all the farmers who practice sloping land irrigation invest their capital in PVC pipes, their agricultural lands need to be close to the village, or if distant, easily accessible. This is so that they can pay close attentions to their investment. From a geographical perspective, farmers who continue traditional farming methods on lands within or close to the village should be able to change their farming methods to more labor intensive methods. Farmers doing traditional agriculture on distant lands, however, due to the time restriction from commuting to their lands, find it difficult to practice intensive farming or permanent land-use agriculture. For this reason, it would be difficult for them to abandon basic shifting cultivation methods.

The above classification of farmers into three groups was made for convenience in agroforestry application and does not mean that the farmers in each group, apart from their classifying criteria, all share the same characteristics. It should be remembered that the farmers in each group show differences in the types of crops they grow, their interest in agroforestry, their financial resources, their land area, labor force, etc.

The aim of agroforestry is to empower core farmers, and then to "disseminate from farmers to farmers" through the help of these core farmers. Therefore, core farmers would ideally be raised up from among the farmers in groups 1 and 2 described above. The farmers in group 3, on the other hand, would be the recipients of the extension, gradually receiving the results achieved by the core farmers. It will probably be difficult for the farmers in group 3 with distant lands to abandon shifting cultivation in a short time period; it may also be difficult for them to develop alternative agricultural methods. However, by helping the farmers to gradually introduce fruit trees into their lands, their concern for the trees that they planted and awareness of the consequences of shifting cultivation may lead them to change their farming practices. The fact is that shifting cultivation is rarely observed in areas of coffee production. The most realistic approach for introducing agroforestry to farmers in group 3 would be to encourage them to stop shifting cultivation in exchange for helping them to establish their own fruit orchards.

The important points in empowering core farmers with agroforestry are as follows:

- ① A certain length of time is necessary to empower core farmers.
- ② Core farmers should be selected from within the process of applying agroforestry.
- ③ Precise criteria on the selection of core farmers are not needed, but the selection should be left to the villages.
- ④ Core farmers should not be given special obligations or privileges.

## (2) Cattle Pasturing

For cattle farmers, agroforestry should be introduced in the form of silvopasture to offer them many benefits. However, silvopasture can be labor intensive making it difficult to encourage mid- and large-scale cattle farmers not living in the local villages to adopt this method. This Plan's target group is farmers who reside in the local village and have a dual operation of agriculture as well as small-scale cattle raising (less than 10 cattle).

### **7.4.2 Agroforestry Applications**

#### (1) Application of Agroforestry to Agriculture

The agroforestry measures described below should not be carried out independently, but in a comprehensive manner with the communities' understanding and cooperation. When farmers start to apply agroforestry methods to their farm they may feel insecure about the results of the new production methods and therefore should not be expected to convert all their farmland to the new methods at once. Rather, they should gradually apply the new methods to their farming on a scale that they feel comfortable with.

In addition, the agroforestry methods should be applied in stages as explained in detail in the following section. In applying agroforestry, it is important that the first priority be to continuously communicate with the farmers, and then to set easily achievable goals, and to proceed step by step to accomplish each goal based upon the farmers' understanding and consent.

##### 1) Create Interest in Forest Trees by making Village Nurseries

Village nurseries stimulate villagers' interest in forest trees, create an opportunity for participants to experience the importance of community organizations, and help to identify and empower core farmers.

##### 2) Introduce Fruit Trees

A vital aspect of introducing agroforestry to farmers with difficulty in understanding the concept of agroforestry is to begin by designing the farmers' land-use plan with emphasis on fruit trees as the main agroforestry component. Farmers who practice shifting cultivation will not quickly abandon their traditional agricultural practice that has been beneficial for them. Therefore, those farmers should be advised to plant fruit trees along creeks or near riverbanks, and they should be repeatedly encouraged to leave vegetation along the rivers and at the lower end of their shifting cultivation plots.

PRODEFERUD, an organization of the Secretariat of State for Agriculture specializing in fruit trees, and the Secretariat of State for Natural Resources and Environment have an agreement to distribute free fruit trees to farmers. The Project could use this source to distribute fruit trees to farmers as a way to increase their interest in fruit production. Furthermore, fruit tree seeds could be obtained from PRODEFERUD and planted in the village nurseries. In this manner, the villagers could raise their own fruit tree seedlings and stimulate interest in growing fruit trees.

### 3) Nursery Management and Workshops

The knowledge of trees is indispensable in the introduction of agroforestry. By gaining experience in managing nurseries the farmers can deepen their understanding of trees and develop their awareness of the importance of growing trees. It is important to note that one of the main objectives for establishing village nurseries is to strengthen the leadership ability and sense of responsibility of the participants directly involved in nursery management. This is because nursery maintenance is a dynamic process for participants and such a dynamic process can be expected to bring a sense of responsibility to the core members.

### 4) Introduce Organic Fertilizer from Earthworms

It is important to utilize earthworms to make organic fertilizer from organic matter that is currently being lost from the farming system and to incorporate the matter back into the system. This process is also expected to create awareness among farmers of the utility of existing but unused resources. At the same time, feeding *Leucaena* or *Canabaria* leaves to earthworms to produce organic fertilizer would allow a compound use of the trees.

### 5) Introduce Home Gardens

The home garden is an agroforestry technique that can be utilized for testing a variety of production systems. Positive results obtained in the home garden can be gradually transferred to other farms. The gardens can be combined with fruit trees to increase farmers' income.

### 6) Create Forests for Producing Charcoal or Firewood

The farmers' lands include many areas that are not suitable for farming. Those areas could be planted with *Gricidia* (*Gricidia cepium*) or *Leucaena* to produce wood for charcoal or firewood.

7) Fruit Tree Quality Control by Grafting

Grafting can make fruit trees begin bearing earlier, improve fruit quality, and increase their market value. This will increase farmers' interest in fruit trees, and stimulate nursery activities.

8) Apply Organic Fertilizer on Fruit Trees

The amount of organic fertilizer that earthworms can produce is limited, making it unrealistic for large-scale agricultural use. However, sufficient quantities can be obtained to spread at the base of the fruit trees to maintain and increase their productivity.

9) Introduce Stabled Animals

By using stables, farmers can be made aware of the usefulness of the unused manure resource. Promoting the use of stables can also stimulate the creation of forests for fodder.

10) Introduce Bocashi Fertilizer (Northern region)

It is recommended that fertilizer should be produced to use in sustainable agricultural practices on permanent farmland. (For the fabrication of Bocashi, see Agroforestry Manual)

11) Introduce Hedgerows and Vegetation Terrace Work

Vegetation terrace work should be introduced utilizing elephant grass (*Panicum elephantipes*), Vetiver (*Vetiveria zizanoides*), and Leucaena to increase farmers' awareness regarding the importance of soil conservation.

12) Stabilize Farmers' Income through Crop Diversification

It is important to actively introduce a variety of fruit tree species to diversify production items. Renovation of coffee farms should be done in cooperation with CODOCAFE. As stated above in Home Gardens, farmers are recommended to begin experimental cultivation of other crops based on the results obtained in the home gardens.

13) Introduce Organic Repellants and Repelling Plants

Introducing organic repellants and repelling plants to increase the use of plants can also be one of the main activities of agroforestry. In the Constanza, La Vega, and

Padre Las Casas regions, it is easy to collect rice hulls and convert them into charcoal. Pyrolygneous acid can be made from the smoke emitted in this process and used for pest and disease control. Technical assistance for producing pyrolygneous acid from rice hulls can be obtained from the pilot Bocashi fertilizer plant that is located in Constanza and built by individual JICA experts.

#### 14) Alley Cropping Demonstration Site

Alley cropping conserves the soil and makes nutrient circulation between the trees and soil possible. The practice of alley cropping could foment farmers' understanding of agroforestry and the use of trees in agriculture.

#### 15) Establish Farmers' Independence and Comprehensive Farm Management

It is essential that the farmers obtain skills not only in agroforestry, but also in a variety of farming technologies. Experiencing the comprehensive processes would give them the independence and ability to change their farming system on their own.

The reality is that the profits from agricultural crops and forest products produced by agroforestry are mainly pocketed by middlemen, leaving only a small amount for farmers. Several measures are feasible to change the situation to increase the income of farmers with the assistance of the Project Implementation Office (which is described later) as introduced by the Coffee Producers' Cooperative at Los Cacaos in the Ocoa Watershed. These measures are (i) strengthening of farmers' organizations, (ii) creation of a direct link with the central market in Santo Domingo and (iii) provision of market information by the Under-Secretariat of State for Forest Resources.

#### (2) Sloping land Irrigation Agriculture

The main purpose of sloping land irrigation agriculture is to increase production, but at the same time it can bring the additional benefit of the settlement of agricultural plots. As described in "3-5 Executing Projects", ADESJO's achievement is seen in the installation of sloping land irrigation PVC pipes, which brought a significant reduction in shifting cultivation in their target communities and contributed to the conservation of natural forests.

Sloping land irrigation agriculture is done by creating a small dam at a river's headwater, conducting the water to farmers' agricultural lands, and then watering their agricultural products using sprinklers. In order to implement this type of agriculture some of communities have to establish pipelines that extend for several kilometers, depending on

the location of their lands, requiring a substantial investment. Thus, it is essential to have the support of the Secretariat of State for Agriculture and aid agencies. In this master plan, their support should be introduced step by step in accordance with the investment in social infrastructures.

### (3) Agroforestry with Pasture: Silvopasture

#### 1) Production of Fodder Trees

The production of fodder trees such as Morera (*morus spp*), Leucaena, and Canabaria can serve as the first step toward changing the cattle raising method from pasturing to stabled cattle farming. It should be noted that the introduction of this method would also create an awareness of the utility of trees in cattle farming.

#### 2) Introduction of Alley Silvopasture

Alley silvopasture is one method of silvopasture practice. This method can be introduced with the compound use of Morera, Leucaena and Canabaria. A mixed plantation of fodder trees, such as Leucaena, with improved grasses can foment an awareness of tree usage among cattle owners who usually think that trees are an obstacle to cattle raising.

#### 3) Hedgerow Use

Gricidia can easily be made into hedgerows and can also be used as posts for barbed wire fences. These hedgerows and fence posts can at the same time function as a source for producing charcoal and firewood. Regarding the use of hedgerows, large-scale cattle farmers have several hundred hectares of pastureland whose boundaries are often unclear; as such they seldom use wire fences on these extensive pastures and may have less need for posts or hedgerows. The small-scale cattle farmers, on the other hand, have limited pastures in or nearby the villages and they are faced with the need to enclose their pastureland with fences. Occasionally cattle farmers use the hedgerow as a fence, but more often they use stakes as fence posts. It is also noted that fodder trees can be planted and used as posts or as hedgerows.

#### 4) Extension of Stabled Cattle Farming

Pasturing cattle requires extensive land. It would be better for the small-scale cattle farmers to incorporate semi-stabled cattle raising methods and use fodder trees as one of the food sources for their cattle. At present, stables are rarely used, and cattle raising is based on pasturing. A field rotation system is used to rotate the



herd from one field to the next. It is unlikely that mid- and large-size cattle farmers with large herds could convert to using stables for beef production. However, it is feasible for small-scale cattle farmers, or farmers who practice both agriculture and cattle raising to combine stables and pasturing as a semi-stabled operation. This would also permit the use of manure to produce organic fertilizer because the semi-stabled operation makes it easier to collect manure.

#### 5) Create Grazing Forests

This is a difficult silvopasture method, but it can be used by small cattle farmers with interest in forest planting. Quick growing tree species are recommended for planting. When the trees reach a height of more than 2m, the forest can be used for pasturing because the tree height will hinder the cattle from browsing on the trees. Since the land can't be used for pasturing until the trees are 2m in height, it is important that the cattle farmers have other pastures available. Also, the forested land needs to be enclosed in a fence to protect the trees until they have grown to 2m in height.

#### 6) Actively Develop Silvopasture

Silvopasture should not be applied in isolation, but should be actively developed as part of comprehensive agroforestry plans.

### **7.4.3 Process for Applying Agroforestry**

Promoting agroforestry practices among farmers means that farmers will change their farming methods to new more labor intensive methods. Practically speaking, farmers will have to adapt themselves to new tasks they have never done before, such as producing and planting fruit tree or forest tree seedlings. Furthermore, farmers will not just manage crops, but will need to manage diversified lands with plural uses. This type of change in land use methods will also bring changes in production patterns.

The number of farmers in a village who want to undertake these changes and apply new technology are few. The process for disseminating agroforestry can be expected to be complicated, some farmers who show interest initially might later quit, and other farmers may suddenly take interest. Therefore, in order for agroforestry extension to be successful, the extension side must be in constant communication with the farmers building a relationship of trust between both sides, together they should agree upon easily achievable goals and gradually proceed to accomplish those goals.

For farmers to enter the unknown territory of agroforestry, the cooperation of their friends, the exchange of information while carrying out tasks, and the communal management of the nursery are all very important. In the case of fruit tree production, in order for farmers to benefit from scale in marketing many farmers should produce the same product at the same time. Therefore, although the decision to apply agroforestry on his/her land is the individual decision of each farmer, the farmers should not each go their separate ways. Agroforestry extension should be seen as part of village development, and should be undertaken by organizing the villagers so that they can work for their own development.

The goals and stages indicated below can be used as a reference and should not be thought of as absolute standards. The conditions in each village differ and the processes for applying agroforestry will vary accordingly. It is best to be flexible and to value the villagers' determination, interest, and decision.

Table 7-11 Process for Applying Agroforestry

Section	Stage	Item
Agroforestry Application Plan	Stage 1	Establish a nursery
	Stage 2	Plant fruit trees
	Stage 3	1. Nursery management and workshop 2. Create organic fertilizer from earthworms
	Stage 4	1. Improve fruit trees by grafting 2. Apply organic fertilizer to fruit trees 3. Establish stables for animals 4. Apply Bocashi fertilizer (Northern region) 5. Create hedgerows and vegetation terrace works
	Stage 5	1. Stabilize income through crop diversification 2. Promote and motivate farmers in fruit tree growing 3. Expand organic fertilizer production 4. Foment awareness on importance of soil conservation 5. Apply organic repellants and repelling plants
	Stage 6	1. Actively develop home gardens 2. Promote use of organic fertilizer in agriculture 3. Install alley cropping 4. Search for and expand use of organic and plant repellants
	Stage 7	Establish self-help initiatives and comprehensive farm management system
Sloping Land Irrigation Promotion Plan	Stage 1	Raise farmers' concern for improving farm management
	Stage 2	Establish community organization
	Stage 3	Consensus process
	Stage 4	Plan preparation
	Stage 5	Carry out activities
	Stage 6	Improve farm management
	Stage 7	Establish self-help initiatives and comprehensive farm management system
Silvopasture Application Plan	Stage 1	Establish a nursery
	Stage 2	Plant fodder trees
	Stage 3	1. Create alley pastures 2. Create hedgerows
	Stage 4	Build stables for cattle
	Stage 5	1. Increase the production of organic fertilizer 2. Create alley pasture on slopeland
	Stage 6	Actively develop silvopasture
	Stage 7	Establish self-help initiatives and comprehensive farm management system

Note : Refer to Agroforestry Manual for detailed explanation of each stage.

## (1) Agroforestry Application Plan

The agroforestry application plan does not contemplate only technology extension, but also includes motivating farmers and introducing processes for gradually changing their production systems. Each stage of the process does not begin and end in technology extension. It requires a long-term process of changing the consciousness of the farmers as they proceed to the next stage. Agroforestry extension is a comprehensive activity, not the extension of a single subject, and must be carried out in conjunction with other components such as nurseries, organic fertilizers, and improving farm management.

### 1) Short-term Goal (3 years from initiation): Stage 1 to stage 4

Seminars, T&V and seminar follow-up are held to train core farmers; agroforestry and organic fertilizer use are thoroughly promoted.

### 2) Mid-term Goal (from year 2 to year 7): Stage 4 to stage 6

Core farmers are formed in each village; through their efforts, the same agroforestry practices as those used by the core farmers are developed on other farmlands in and around the villages; the extension effect of the core farmers begins to be seen.

### 3) Long-term Goal (from year 5 to year 10): Stage 6 to stage 7

Centering on the core farmers, farmers' groups are formed which practice a variety of agroforestry methods; agroforestry is practiced around the villages; shifting cultivation practices gradually diminish.

## (2) Sloping Land Irrigation Promotion Plan

This plan is based on the above "Agroforestry Application Plan". It can be carried out only in those villages that have a water source and where the community and landholders are in agreement with the Plan. During the stages of "community organization", "consensus process", "plan preparation" and "carrying out activities", ADESJO should be contacted. The Plan should be carried out while receiving the advice of ADESJO and using their many years of experience as a reference.

In the stage of "carrying out activities" the farmers will naturally have to supply the labor force. In such case, many farmers will work with the Plan out of obligation, but the time they spend working on their own farms will be sacrificed. Therefore, the stage for "carrying out activities" should include a request to Food for Work for their cooperation. It is important that the family finances of the participating farmers do not weaken during the year of executing activities.

- 1) Short-term Goal (3 years from initiation): Stage 1 to stage 4

The community side and the watershed management side come to an agreement and new sloping land irrigation farming is undertaken; the participating farmers prepare their own plan.

- 2) Mid-term Goal (year 3 to year 7): Stage 4 to stage 6

Activities are carried out; agroforestry develops; farm management improves

- 3) Long-term Goal (year 5 to year 10): Stage 6 to stage 7

Shifting cultivation practices are almost entirely abandoned in the watershed.

### (3) Silvopasture Application Plan

The target population of the Silvopasture Application Plan is farmers who reside in the villages with dual operations in small-scale cattle farming (about 10 cows) and agricultural production. Thus, the Silvopasture Application Plan should not be executed independently. The Agroforestry Application Plan should be the base for working with the dual operation farmers who raise cattle, and the Silvopasture Application Plan should be applied in conjunction with the direction of that Plan.

- 1) Short-term Goal (3 years from initiation): Stage 1 to stage 4

Seminars, T&V and seminar follow-up are held to train core farmers; silvopasture and organic fertilizer use are thoroughly promoted.

- 2) Mid-term Goal (year 2 to year 7): Stage 4 to stage 6

Core farmers are formed in each village; through their efforts, the same silvopasture practices as those used by the core farmers are developed on other farmlands in and around the villages; the extension effect of the core farmers begins to be seen.

- 3) Long-term Goal (year 5 to year 10): Stage 6 to stage 7

Centering on the core farmers, farmers' groups are formed which practice a variety of silvopasture forms; silvopasture is practiced around the villages; shifting cultivation practices gradually diminish.

7.5 Soil Conservation Plan

7.5.1 Soil Conservation Targets

- Simple and economical structures, such as check dams, using logs and stones and wicker works are planned together with the use of materials which can easily be obtained locally.
- The range of work to be planned includes (i) the planting of grasses and shrubs which can be used to improve the conditions of eroding areas and to serve local residents and (ii) the natural regeneration of trees.
- As shown in Fig. 7-3, various types of soil erosion and mass movement are taking place in the Study Area. Of these, the subjects of the soil conservation (erosion control) measures are small-scale gullies and small-scale landslides which can be controlled with the participation of local residents. In the case of large-scale soil erosion, forest protection and reforestation are proposed.

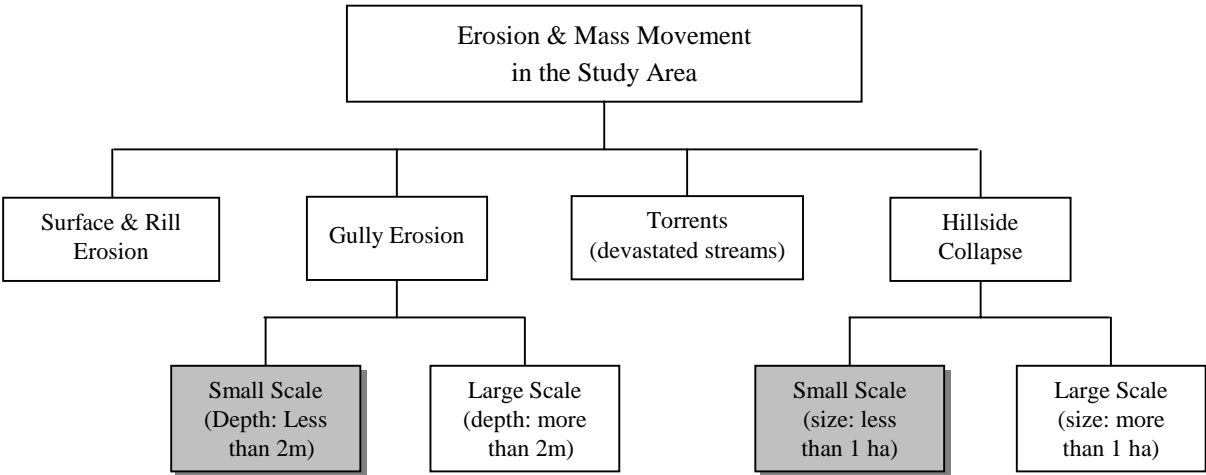


Fig. 7-3 Soil Erosion and Mass Movement in the Study Area

The most important subject of protection in this plan is Sabana Yegua Dam. In regard to various types of erosion and mass movement, priority is given to protecting those which are closely linked to the lives of local residents, such as farmland, houses, footpaths and communal grazing land. When such public facilities as roads, bridges and schools are the subjects of protection, collaboration with the related government organizations will be sought to control erosion and mass movement.

## 7.5.2 Control Measures

### (1) Gully Erosion Control

#### 1) Basic Ideas

It is necessary to follow the following principles to introduce effective measures to control gully erosion in areas with a high rainfall level such as the Study Area.

- ① Construction of a diversion channel to divert the surface water from the gully head to a natural stable river; this channel should be covered with stones or vegetation to prevent erosion inside the channel.
  - ② Planting in the catchment area where a gully has appeared to reduce and control the amount of surface erosion.
  - ③ Stabilisation of a gully through a combination of vegetative and civil engineering measures.
  - ④ Construction of log check dams above a gully; while these log check dams are temporary structures lasting for only 3 – 4 years under the weather conditions in the Study Area, they are inexpensive and easy to construct and maintain by local residents. This type of check dam reduces the natural gradient of a gully, decreases the velocity and erosive force of the water flow and prevents bank erosion.
  - ⑤ Introduction of a masonry check dam at the lower end of a gully.
  - ⑥ All of these structures are accompanied by a vegetative measure, i.e. planting, after their completion. These structures protect plant seeds and cuttings, etc. from being washed away by means of preserving the soil and water inside a gully. The selection of plants will be left to local residents.
- #### 2) Model Plan for Small-Scale Gullies (Depth: Less than 1 m)

The subject gully is that located near Pinal Bonito (in the upper reaches of Grande del Medio River).

- ① This gully is 0.7 m deep, 1.5 m wide and 55 m long with a catchment area of some 2 ha and is taking place on excessively grazed grassland with a gradient of 20°. Excessive grazing is the main cause of the surface erosion. The subjects for direct protection are grassland and the road below the gully.

- ② A some 0.3 m deep, 0.4 m wide and 100 m long diversion channel is constructed at the gully head to change the path of the surface flow and the internal walls of this channel are lined by plants and stones.
- ③ Inside the gully, a 2.5 m long and 0.8 m tall masonry check dam is constructed at the gully mouth. Masonry and log check dams are constructed at approximately 5 m intervals up to the gully head. The effective height of these dams is less than 1 m with 0.5 m deep foundations. The wing depth is 0.5 m for a masonry dam and 0.3 m for a log dam. The diameter of the logs to be used is 10 – 12 cm.
- ④ Following the completion of the check dams, seeds and cuttings are grown between and around these dams inside the gully at a distance of 0.25 m x 0.25 m.
- ⑤ Given the length and average width of the gully, some 640 cuttings are required to cover an area of 0.004 ha. This gully control measure is outlined in Table 7-12 while the small-scale gully control model is illustrated in Fig. 7-4.

Table 7-12 Planning of Small-Scale Gully Control Model

Location	Planting		Diversion Channel (m)	No. of Check Dams	
	Area (ha)	No. of Cuttings		Log	Masonry
Near Pinal Bonito (in upper reaches of Grande del Medio River)	0.004	640	100	6	5



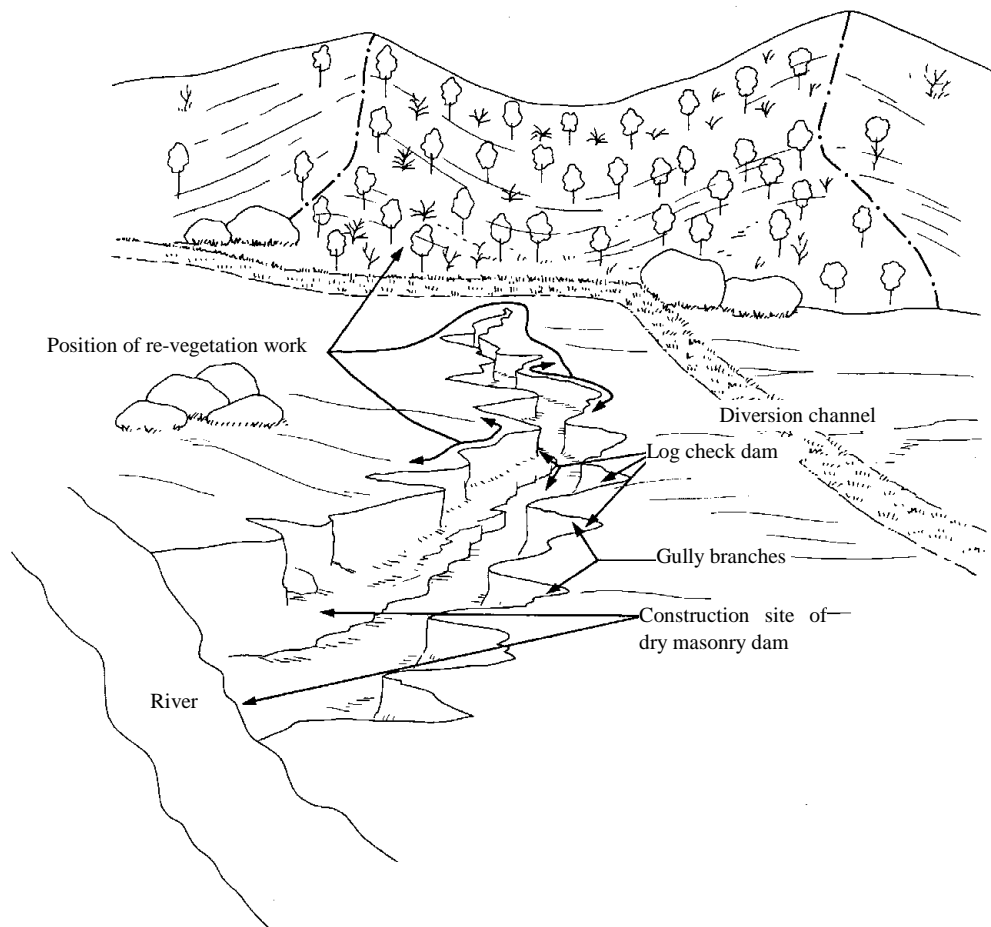


Fig. 7-4 Gully Erosion Control Model Using Vegetative and Civil Engineering Measures

3) Rehabilitation of Small-Scale Gullies

For the present plan, the introduction of small-scale gully control works should be considered for 30 such gullies in the Study Area using the measure outlined in Table 7-12 as the model.

4) Rehabilitation of Large-Scale Gullies (Depth: 1 m or more)

Areas in which large-scale gullies with a depth of 1 m or more are developing in a large number are the area between Padre Las Casas and Bohechio in the lower reaches of Grande del Medio River and the Ocoa River basin in the lower reaches of Las Cuevas River. In both areas, the principal causes are (i) the degradation of dry forests which have lost their undergrowth due to excessive grazing and where disorderly cutting is taking place to produce charcoal wood, (ii) inappropriate drainage facilities for roads running through forests and (iii) the deep and unconsolidated soil and concave topography. As many gullies are deeper than 10 m,

major civil engineering work involving the construction of structures using concrete or gabions is required for their complete control. Here, the following mitigation measures are proposed as they can be employed with the participation of local residents.

- ① Educational activities are conducted for local people who are engaged in grazing inside forests and/or charcoal production to improve their awareness of the process of forest degradation and the emergence of large-scale gullies leading to sediment disasters.
- ② After the above process is understood by local residents, grazing and cutting for charcoal wood are gradually prohibited in areas with advanced gullies to protect such areas.
- ③ Education is provided for local residents on methods of using forests which do not cause gullies or degraded land. In the case of roads eroded by gullies, the road office should regularly maintain the roadside drainage facilities.

## (2) Landslide Control

### 1) Basic Ideas

- ① To prepare effective landslide control measures, the causes, depth, existence of facilities for direct protection and their costs are studied and verified.
- ② In the case of a small-scale landslide of which the direct cause is concentrated surface flow from the top of a slope, simple civil engineering measures are applied to divert the surface flow in order to stabilise the mass movement. To prevent secondary erosion at the landslide site, a vegetative measure which is of benefit to local residents is also implemented.
- ③ If the major cause is a downpour caused by a hurricane, fragile geology/soil or groundwater, such mitigation measures as the natural regeneration of vegetation and forest protection are proposed to prevent the further expansion of the landslide.

### 2) Model Plan for Small-Scale Landslides (Area: Less than 1 ha)

#### a. Landslide Site at El Recodo (Upper Reaches of Las Cuevas River)

- ① This landslide was originally caused by Hurricane George and damaged some 2 ha of farmland at the piedmont as well as a neighbouring

needle-leaved forest and a small irrigation channel. The main factors were the downpour due to the hurricane and the steep gradient (38°). In places which have since been stabilised, the natural regeneration of pine (*Pinus occidentalis*) and local low shrubs is observed. Some trees have already reached 1.2 m in height. The subjects for direct protection are 2 ha of farmland, the small irrigation channel and pine forest.

- ② The construction of a diversion channel is unnecessary as there is no risk of surface erosion from the upper part.
- ③ Those places which are relatively stable and where the natural regeneration of the vegetation has taken place are protected from burning, grazing and/or cutting.
- ④ Wicker works using 8 – 12 cm diameter logs are created to stabilise areas of surface erosion and/or rill erosion (secondary erosion) in order to assist the natural regeneration of the vegetation with useful plants for local residents planned between the lines of wicker works. The selection of plants is left to local residents.
- ⑤ Log wicker works are created at some 5 m intervals along the contour lines. The ground height of these wicker works is approximately 0.5 – 0.6 m and the wing length on each side is 0.5 m. As this landslide site is some 80 m long and 40 m wide, some 16 rows of wicker works are required. The small-scale landslide control model is outlined in Table 7-13. This control model is illustrated in Fig. 7-5.

Table 7-13 Planning of Small-Scale Landslide Control Model

Location	Control Measures			Remarks
	Log Wicker Works	Planting (ha)	Protection of Natural Regeneration (ha)	
El Recodo (upper reaches of Las Cuevas River)	16 rows (approx. 656 m)	0.12	0.2	Natural regeneration is taking place over an area of 0.2 ha.

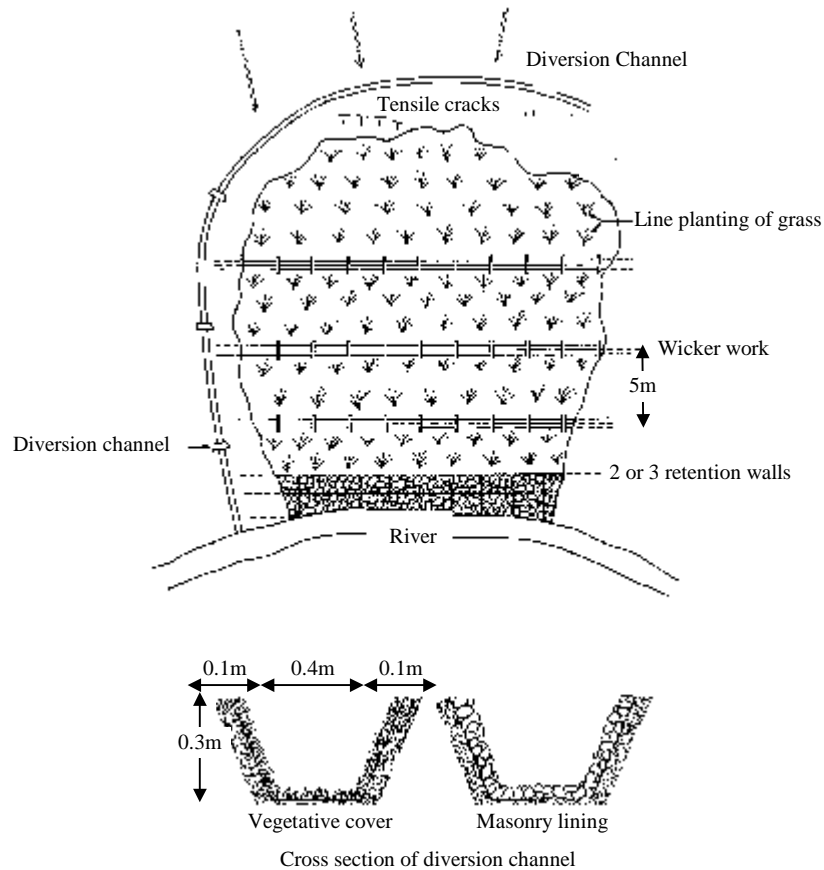


Fig. 7-5 Small-Scale Landslide Control Model

### 3) Rehabilitation of Small-Scale Landslide Sites

For the present plan, the introduction of small-scale landslide control work should be considered for 561 such sites in the Study Area using the measures outlined in Table 7-13 as the model.

### 4) Rehabilitation of Large-Scale Landslide Sites

① Most of the 151 large-scale landslide sites in the Study Area recorded by the field survey or aerial photograph interpretation have occurred in places with a steep slope ( $35^\circ$  or steeper) and/or fragile geology following the downpour by Hurricane George. At some sites, while secondary erosion caused by rainfall during the rainy season is observed, the natural regeneration of the vegetation can be seen at most sites after the passing of some three years since Hurricane George. The landslide mitigation measures for these sites are described below.

② Sites where the natural regeneration of the vegetation is taking place are protected from burning and grazing.

- ③ The cutting of neighbouring natural and artificial forests (within 2 km of a former landslide site) are prohibited to protect them from burning and grazing.

### (3) Devastated Torrent Control

#### 1) Basic Ideas

A torrent is characterised by a steep gradient. The occurrence of several landslides in the upper reaches leads to the deposition of unstable sediment on the riverbed and harsh bank erosion takes place along the channel. Effective measures include landslide control in the upper reaches and the construction of a check dam using concrete or a gabion across the channel. The model plan considered here includes (i) forest protection along the channel and in the upper reaches and (ii) the creation of riparian forests.

#### 2) Model Control Measures

With the cooperation of local residents, forests along both banks are protected from burning, grazing and cutting. If there is no forest, riparian forests are created after obtaining the consent of local residents. The width of these riparian forests and the planting species are left to local residents to decide.

### **7.5.3 Form of Participation for Local Residents**

For the implementation of effective water and soil conservation measures, the participation of local residents is essential for the planning, implementation and management of an erosion control project (incorporating simple civil engineering and vegetative measures).

#### (1) Participation of Small Landowners

- 1) As the land belonging to most small landowners living in the Study Area is located on steep slopes, the top soil is washed away downstream due to severe erosion caused by heavy rain due to a hurricane or during the rainy season. The resulting loss of the soil fertility leads to a poorer harvest every year. While some small landowners are well aware of this problem, most of them own less than one ha of land. Their lives are simply self-sustaining and they do not possess the necessary capital or skills to conduct water and soil conservation activities on their land. As it is difficult for them to be engaged in such activities under their current living conditions, it is necessary to form water and soil conservation groups to create the opportunity for them to participate in such activities. Assuming that such a group has 12 members who mutually participate in vegetative retaining work and gully

prevention work, etc. on each other's farmland once a month, the implementation of water and soil conservation activities will become possible at 12 farming sites a year with the participation of all 12 members.

- 2) As not many local residents in the Study Area have previous experience of participation in group activities, government extension workers and NGOs should play an important role in the organization of local residents.

## (2) Participation of Large Landowners

Some large landowners are absentee landowners while others are uninterested in water and soil conservation activities. Others are aware of the seriousness of soil erosion. There is a case of one large landowner in El Convent using his own money to construct vegetative retaining works and a reservoir by hiring a water and soil conservation expert. Here lies the possibility for small landowners to learn water and soil conservation techniques and to participate in water and soil conservation activities through the collaboration of large landowners interested in such activities and groups formed by small landowners. Needless to say, government extension workers and NGOs must play a bridging role between the above two groups of landowners.

For the planning of an erosion control project, careful attention must be paid to the points listed below to motivate the participation of local residents in erosion control activities as well as protection and management activities.

- 1) Planting of plants and trees which can be used as animal feed or in the daily lives of local residents as a water and soil conservation measure
- 2) Planting of trees of which the branches and leaves can be used as animal feed or fuelwood
- 3) Supply of seedlings, cuttings and seeds by village nurseries created in the course of the Study

## (3) Necessity for Extension Activities

The creation of several demonstration plots for soil erosion prevention/control in the Study Area is believed to be necessary so that local residents and landowners can learn the methods to construct simple civil engineering and vegetative erosion control facilities while participating in the relevant project. These plots are truly important from the viewpoint of extension activities. Once landowners actually see the practical effects of

these facilities in terms of soil erosion prevention, the possibility of their participation in water and soil conservation activities will grow considerably stronger.

## **7.6 Forest Fire Prevention and Extinguishing Plan**

Forest fires are one of the most difficult problems for the implementation of a forest protection plan. What are required to prevent forest fires are (i) the establishment of a forest fire extinguishing system based on laws to create a reliable forest fire prevention and extinguishing system, (ii) the control of the occurrence of fires through preventive activities in normal times and (iii) the systematic implementation of early detection and reporting, a swift response and fire extinguishing activities when a forest fire occurs.

### **7.6.1 Strengthening of Fire Prevention and Extinguishing System at Under-Secretariat for Forest Resources**

#### **(1) Development of Forest Fire-Related Laws and Regulations**

The establishment of a reliable forest fire prevention and extinguishing system firstly requires the development of the relevant laws. It is, therefore, necessary to insert basic provisions stipulating forest fire control measures in the Forest Law which is currently being enacted.

The basic provisions should cover such matters as the purpose of forest fire prevention, central government offices and local public bodies involved in forest fire prevention and extinguishing activities, obligations of the public, designation of the administration organization responsible for forest fire business, establishment and organizational structure of the forest fire protection headquarters and fire stations to deal with forest fire business, deployment of personnel in charge of dealing with forest fire business and obligations of personnel dealing with forest fire business.

It is also necessary to enact government ordinances, instructions, rules and regulations, etc. to enforce the law together with a system under which the provisions of the law can be enforced in stages in a concrete manner.

#### **(2) Development of Effective System for Fire Company Activities**

Well-organized fire prevention and extinguishing activities are essential to control forest fires. Such well-organized activities must firstly be realised through the fire prevention and extinguishing skills of individual fire-fighters by means of education and practical training, followed by the establishment of a system which is made up of highly skilled

individuals and which is capable of implementing the said activities in an effective manner. The importance of well-organized activities to fight fires means that companies composed of forest fire-fighters should be created and trained as groups capable of acting independently or in collaboration with other companies.

Fire-fighting units should be ranked as platoons, companies and battalions, etc. in accordance with their manpower strength in view of the effectiveness of deploying an appropriate unit depending on the actual scale of a fire. In addition to forest fire-fighters, other staff members of the Under-Secretariat for Forest Resources should be considered to be support personnel in the case of the spread of a forest fire.

## **7.6.2 Establishment of Support System by Government Organizations**

### **(1) Establishment of Collaborative System Involving Government Organizations**

Although there is already a collaborative system between the forest management bureaus and other government organizations, improvement of the system is necessary because of the present inadequacy of implementing such collaboration in an organized manner.

#### **1) Use of the Military and Others**

The military is a national organization with a high level of mobility and consideration should be given to its playing a supporting role in the national collaborative system to fight forest fires. The Army and the Air Force in particular have experience of being mobilised to fight forest fires and have shown their willingness to assist forest fire extinguishing activities. As the collaboration of the Army and the Air Force appears to be essential to minimise the damage caused by forest fires, the preparation of a mobilisation plan for the Army and the Air Force to fight forest fires as soon as possible is essential in order to put such a collaborative system in place.

When a forest fire spreads over a huge area, the collaboration of other national organizations in addition to the military is essential. In this context, the preparation of a mobilisation plan involving all relevant national organizations is also necessary. This plan should be considered to incorporate the collaborative system involving various government organizations for PR activities on fire prevention in addition to collaboration for fire extinguishing activities.



## 2) Establishment of Support System for Municipal Fire Services

The Law Concerning Fire Service Headquarters (Law No. 2527 concerning the establishment of fire stations; enforced on 2<sup>nd</sup> June, 1912) stipulates that each municipality has the obligation to establish a fire station. In the case of relatively large cities, a fire service headquarters is also established along with fire stations. According to the interview survey results, Santo Domingo, the capital, Santiago, San Juan, Constanza and Cercado, etc. have their own fire service headquarters and fire stations. Among these, the fire service headquarters in Santo Domingo and Santiago in particular are relatively large and have experience of dispatching fire companies to fight forest fires. These headquarters have indicated that they could dispatch fire companies to assist forest fire extinguishing activities in the future if the conditions are right. It is, therefore, necessary to conclude an outside response agreement with the municipal fire services in these large cities to establish such a support system.

Meanwhile, the municipal fire services in small cities are limited in terms of both vehicles and manpower and they lack the extra capacity to respond to forest fires. Accordingly, these fire services do not respond to forest fires in their own area of jurisdiction except for those forest fires which occur in mountain foot areas.

Apart from the manpower and other limitations, the fire trucks deployed by municipal fire services are more than 30 years old and are well beyond their expected life, except for those in Santo Domingo, and it is practically impossible to dispatch these old fire trucks to the scene of a forest fire. Because of this limitation, a support system involving small municipal fire services should only be contemplated after improvement of their trucks and manpower strength. At the same time, the area of jurisdiction of each of these fire services should be clearly set forth by law.

In regard to the forest fire response system in the area of jurisdiction of a municipal fire service headquarters, the Forest Law does not appear to have a provision for such area. However, the results of the interview survey with chief officers and others at the headquarters in Santo Domingo, Cercado and municipalities in the Study Area indicate that the area of jurisdiction of a fire service headquarters overlaps with the entire administrative area of the municipality, including forest areas. Consequently, it is probably safe to assume that each municipal fire service headquarters is responsible for dealing with forest fires in the area of its jurisdiction. Nevertheless, it appears to be impossible for most of these headquarters to respond to forest fires because of the reasons described earlier. This situation means that improvement of

the fire trucks owned by the fire services in those municipalities where modernisation of the fire trucks is long overdue will strengthen the response system of municipal fire services to forest fires and will considerably reduce the damage caused by forest fires.

### **7.6.3 Fire Prevention and Extinguishing System**

#### **(1) Prevention System**

The causes of forest fires in the Study Area have already been described in 4.5.1-(2). Many forest fires are caused by human carelessness in the course of the slash and burn method of agriculture or on the part of forest users and arson. As the number of forest fires caused by an act of God, such as lightning or other natural phenomena, is limited, it is believed that many forest fires can be prevented by education.

In particular, it is believed that education for people entering mountain forests and for local residents will substantially reduce the number of forest fires as well as the damage caused by forest fires and, therefore, the establishment of a fire prevention publicity system is necessary.

#### **1) Publicity Using Information Boards**

Publicity is an important element of forest fire prevention. In particular, field publicity using information boards can be expected to be highly effective to raise awareness of the need for fire prevention.

Many of the people participating in the workshop or responding to the interview survey expressed a need for information boards and education, suggesting that such needs are shared by both forest management bureaus and local residents. Following these opinions, a survey was conducted on information boards and other outdoor publicity facilities in the Study Area and its surrounding area. This survey found that information boards calling for fire prevention are practically non-existent in villages, at the entry points of roads, including forest roads, into forests or along these roads and at camping and other sites where people gather.

Given this situation, information boards to educate people entering mountain forests on the importance of forest fire prevention should be systematically introduced through the joint efforts of forest management bureaus and local residents as a forest fire prevention measure. Suitable places for such boards include areas of frequent

forest fires and entry points to national parks in addition to the places mentioned earlier.

## 2) Publicity Through Mass Media

A forest fire prevention campaign using such mass media as television and newspapers is very effective to promote wide area forest fire prevention. However, this constitutes a nationwide educational activity for forest fire prevention which must be systematically implemented every year under the leadership of the Under-Secretariat for Forest Resources.

## 3) Establishment of Forest Fire Prevention System Through Introduction of Fire Prevention Week

A priority campaign should be implemented for the prevention of forest fires. One important measure is the introduction and promotion of a forest fire prevention week prior to the arrival of the forest fire season. It is essential to establish a system to promote the nationwide commitment to forest fire prevention activities before the arrival of the forest fire season and other activities.

## 4) Forest Patrol System

Forest patrols to prevent fires is also effective for the prevention of forest fires. Although forest patrols are primarily the responsibility of forest patrol teams, the participation of members of the volunteer fire corps and local residents is essential because of the positive effects of such participation.

Local residents can be expected to play the following roles in assisting fire prevention.

- ① Advice on the handling of fire at the time of burning farmland
- ② Forest patrolling during the dry season with a high fire hazard
- ③ Education for the general public

## (2) Detection and Reporting System

The response to the outbreak of a forest fire consists of a series of activities: ① detection and confirmation, ② reporting (including reporting to and a request for response by the fire service and volunteer fire corps, etc.), ③ response by fire-fighters (fire-fighters of the forest management bureau, local residents, volunteer fire corps members and the military, etc.) and ④ fire extinguishing activities.

The early detection of a forest fire is mainly conducted by local residents, a forest patrol team or monitoring by a monitoring tower. A pair of binoculars is an essential tool for the detection and confirmation of a forest fire.

Radio communication equipment is essential for the quick reporting of a forest fire after its detection. In reality, reporting is made on foot or using a donkey in addition to the use of radio communication equipment. As reporting by means other than radio communication equipment takes a long time, they are ineffective for the mitigation of fire damage.

The survey on the deployment and use of radio communication equipment found that there are nine base stations with such equipment at five forest offices and four monitoring stations. Of the nine monitoring towers and monitoring stations, five do not have radio communication equipment. The provision of more radio communication equipment is, therefore, necessary to strengthen the reporting system.

One efficient fire detection method is the use of a remote controlled TV monitoring system. (This system is already in use in Japan as a replacement for the fire look-out system.) As this system ensures effective monitoring as well as reporting, resulting in improvement of the working conditions for fire personnel, its future introduction should be considered to improve monitoring and reporting.

The reporting of a forest fire among local residents is done by word of mouth and the lengthy time required means a delay in the response by local residents to a forest fire. In preparation for a forest fire and other local emergencies, the preparation of a calling out plan, supplemented by the provision of a loudspeaker, siren, fire-bell and wind sleeve, etc., is necessary. With such a plan in place, it is essential to establish a systematic reporting and communication system to call upon fire volunteers as well as to publicise the outbreak of a fire to local residents. The development of a communication network with the military and municipal fire services, the response of which is likely to be requested to fight forest fires, is also necessary. This arrangement should include a procedure to communicate requests for such a response.

#### **7.6.4 Participation of Local Residents in Fire Prevention and Extinguishing Activities**

##### **(1) Formation and Activities of Volunteer Fire Corps**

Except for those posted at monitoring stations, most forest fire-fighters are deployed in urban areas and also have other duties. This means that they require some time to confirm the outbreak of a fire and to prepare to respond or to reach the fire scene. As a result, there is a strong likelihood that the start of fire extinguishing activities may be late. Because of this, there is always a risk of a forest fire widely spreading. Meanwhile, people living inside or near a forest are generally quick to detect, confirm and respond to a forest fire and often arrive at the fire scene before the forest fire company. It is, therefore, essential to utilise local manpower to mitigate the damage caused by forest fires.

The survey results show that almost all local residents have experience of fire extinguishing activities and show a strong willingness to participate in fire extinguishing activities as volunteers, indicating a rising mood among local residents to form a volunteer fire corps.

To exploit this situation, volunteer fire corps should be formed to ensure efficient activities in terms of both fire prevention and fire-fighting and to promote forest fire prevention measures.

The survey conducted in the Study Area on the formation of experimental volunteer fire corps set a target of recruiting 20 volunteers each in San Juan, Padre Las Casas and Constanza. As of August, 2001, this target has already been reached in Constanza. For the formation and continuous functioning of volunteer fire corps, special consideration must be given to not over-burdening those members who work during normal times so that their volunteer work can co-exist with farming or other types of livelihood. Prior to the formation of volunteer fire corps, the relevant laws and regulations must be in place to address such matters as the deployment of equipment and tools for volunteer fire corps (and its members), renting of personal protective gear, payment of an allowance for actual fire extinguishing work and establishment of a compensation system for accidents in the line of duty, etc. to clarify the status, etc. of volunteers. The preparation of suitable financial treatment corresponding to the degree of contribution by volunteers is also important.

As the first step of the desirable process to organize volunteer fire corps, five villages will be selected for each of the three forest management stations in the Study Area to form 15 volunteer fire corps in five years. Thereafter, 5 – 6 model areas will be selected each year from among 159 villages (districts) nationwide to organize volunteer fire corps in some 30 areas in five years. The persons responsible in these model areas will play a leadership role in the organization of volunteer fire corps in the remaining areas.

What is important in this organizational process is the creation of an atmosphere for volunteer participation by checking various obstructive conditions to participation through the exchange of opinions in a workshop, etc. so that the conditions to make participation possible are identified and created. Although it is obvious that the young men's association will form the active core of the volunteer fire corps, the participation of village elders and officials should be considered to make the fire corps an independent organization based on the consent of all villagers. The women's association should also play certain roles. The introduction of a young men's section and a women's section as subordinate bodies of the volunteer fire corps is also possible.

Needless to say, while a volunteer fire corps should be formed as an organization to conduct fire fighting before the authorities arrive at the fire scene based on their own initiative, its basic ideas and purposes must follow the relevant government policies. For this purpose, the chief of each forest management station must assist such organization and provide guidance and advice when it is needed. The said chief should also be responsible for providing appropriate education and training for volunteers.

Meanwhile, the members of a volunteer fire corps are expected to be involved in the following fire prevention activities in addition to fire extinguishing activities.

- ① Education and publicity vis-à-vis local residents (educational activities at local meetings, guidance on the handling for fire at the time of burning and display of information boards)
- ② Participation in various training sessions
- ③ Forest patrols and other activities on a rota basis

## (2) Collaboration Between Forest Fire Companies and Volunteer Fire Corps

Local residents already have a custom of reporting forest fires and immediately commencing fire extinguishing activities when a forest fire breaks out. The preparation and strict enforcement of a manual based on this custom is, therefore, possible when a volunteer fire corps is formed. Under such an arrangement, a volunteer fire corps can

instantly commence initial fire-fighting activities following the outbreak of a fire, report the fire to a forest fire company and continue its activities under the command of the latter following the arrival of the latter at the fire scene. Good collaboration between the forest fire company and volunteer fire corps, including the implementation of duties under the command of forest fire-fighters when volunteers are engaged in daily preventive activities based on a rota schedule prepared by the forest management station, should prove highly effective to prevent and to fight forest fires.

### (3) Guidance on Shifting Cultivation

Forest fires are the principal cause of the destruction of forests and the spread of fire from burning for shifting cultivation is a major source of forest fires. Under these circumstances, proper guidance on the handling of fire at the time of burning for shifting cultivation or other reasons is an effective way of reducing the number of forest fires.

In the Study Area, while strong guidance based on the permit system is already provided for shifting cultivation, forest fires caused by burning for shifting cultivation still persistently occur, indicating the need for further tightening of the system and guidance. Guidance should be provided on the following concrete matters.

- ① When burning is planned, a permit should be obtained in advance in accordance with the law.
- ② The important points for burning should be thoroughly explained.
- ③ There should be a notification system for burning for purposes other than shifting cultivation which causes rising flares which could be mistaken for a fire.
- ④ Firebreaks should be created prior to burning.
- ⑤ Burning should be witnessed by a fire-fighter or a staff member of the forest management bureau.
- ⑥ The proper timing and duration of burning and the presence of a monitor should be secured.

## **7.6.5 Development of Foundations for Forest Fire Extinguishing Activities**

In parallel with the development of a forest fire prevention, monitoring and extinguishing system, it is necessary to develop the foundations for fire prevention and extinguishing activities. Matters which are deemed to be relevant in this context are described next.

## (1) Construction of Monitoring Stations

Monitoring stations are important facilities to monitor forests and to detect forest fires. When a forest fire occurred on 7<sup>th</sup> March, 2001 near Mt. Bajon Blanco, lasting for one week and destroying some 1,000 ha of forest, monitoring stations (towers) played an important role in mitigating the fire damage through its early detection and reporting and subsequent reporting of the spread of the fire. This incident illustrates the importance of introducing more monitoring stations (towers).

These stations are also used as resting places as well as overnight accommodation for forest patrols. Moreover, they are important for fire prevention work and as bases for reporting detected forest fires and other communication purposes. There is only one monitoring station (tower) run by four monitors in the Study Area at Bajon Blanco.

The number of monitoring stations (towers) required in the Study Area is believed to be four, assuming that they are located at an equal distance and that the effective radius for fire detection and confirmation is 10 km. As one station is already operating with another in place at La Pena, at least two new monitoring stations should be constructed.

## (2) Water Supply for Water Tanks

Water is an essential element for forest fire extinguishing activities. Water supply in the Study Area can be made from dams, rivers, water tanks, taps for irrigation water and fountains, etc. In regard to public water supply sources, there are two public water tanks for irrigation purposes (storage capacity of 100 tons and 200 tons of water) in the Valle Nuevo National Park with a sufficient storage capacity. As it has been confirmed by those responsible for the management of these tanks that they can be used for fire-fighting at the time of an emergency, it is planned to use the water tanks as fire water supply sources.

However, these tanks alone are insufficient as public water supply sources for fire-fighting and it is necessary to secure other water tank for fire extinguishing use. The survey in the Study Area found privately-owned water tanks, taps for irrigation water, irrigation reservoirs, streams and fountains in various places. As it is quite possible to use these water sources for fire extinguishing activities, the transfer of techniques regarding the effective use of these water sources is necessary.

The owners of private water tanks have indicated their willingness to cooperate with fire extinguishing activities and discussions should be held with these owners on how to use their water tanks for fire extinguishing activities.



### (3) Heliports

As already stated in 7.6.2-(1), the construction of heliports is essential in view of collaboration with the military in order to utilise their mobility to fight forest fires (for the transportation of personnel and equipment and also for actual fire extinguishing activities). In the northwestern area and part of the southern area to which access is difficult because of the absence of forest roads, fire companies struggle to reach the scene of a fire. The construction of a heliport in these areas is, therefore, a priority. Land of 50 m by 50 m in size must be secured for the construction of a heliport and the heliport surface may be grass, earth, concrete or asphalt depending on the ground conditions.

### (4) Firebreaks

The introduction of firebreaks is an effective way of preventing the spread of a forest fire. Firebreaks can be composed of trees, roads, rivers and earth mounds, etc. and the creation of appropriate firebreaks for the specific local topography by appropriate means, including weeding along roads and rivers and the well-planned locationing of farmland inside a forest, is desirable.

## **7.6.6 Provision of Equipment and Tools**

The provision of some monitoring and fire extinguishing equipment and tools is highly desirable to ensure the effective functioning of forest fire control measures.

### (1) Required Quantities

#### 1) Improvement of Equipment and Tools at Forest Management Offices and Volunteer Fire Corps

The equipment and tools to be deployed at forest management offices and volunteer fire corps are outlined below.

The equipment and tools for forest management offices consist of those for monitoring purposes and those for fire extinguishing purposes. The former include patrolling vehicles, patrolling motorcycles, radio transmitters and binoculars, etc. while the latter include transport vehicles, fire equipment, portable pumps, fire hunters, such manual tools as fire beaters, such personal gear as outfits and boots and helicopter buckets.

These equipment and tools should be deployed at each forest management office and the required quantities differ from one office to another depending on the size of the area under jurisdiction, the mobilisable manpower and the number of monitoring stations, etc. Based on their use in the demonstration project during the first and second field survey periods, the establishment of one fire station for each forest management office is assumed, resulting in a total of three fire stations in the Study Area. Table 7-14 shows the required quantities of fire equipment and tools, primarily focusing on those already provided by the Government of Japan.

Table 7-14 Required Quantities of Equipment and Tools

No.	Type of Equipment, etc.	Name of Equipment, etc.	Qty Required	Qty Required at Each Office	Qty Already in Place in Dominican Republic	Qty Provided by Japan	Qty Required for the Project
			A	B=A/3	C	D	E=A-(C+D)
1	For Prevention and Monitoring Activities	Patrolling Vehicle (4WD): duplicate with No. 5	3	1			3
2		Patrolling Motorcycle	3	1			3
3		Radio Transmitter (mobile)	17	5	3	9	5
4		Binoculars	9	3		4	5
5	For Fire Extinguishing Activities	Transport Vehicle (for personnel and equipment)	6	2	3	0	3
6		Portable Pump Set	12 sets	4		5	7
7		Fire Hunter	150 sets	50		60	90
8		Fire Beater and Other Tools	150 sets	50	132	18	0
9		Collapsible Water Tank	15	5		15	0
10		Dust Protective Mask	60	20		60	0
11		Dust Protective Goggles	60	20		60	0
12		Protective Clothing	150 sets	50			150
13		Helicopter Bucket	10				10

Note : The details of helicopter buckets are described later as they will be deployed by the military rather than by the forest management stations.

Calculation of the personnel and equipment deployment is based on the standard deployment per forest management office, i.e. fire station.

Forest fire-fighters : 50

One platoon consists of approximately five persons.

Three platoons make up a company.

Three companies make up a battalion.

A battalion is organized for each fire station.

Volunteer fire corps : 100

One team consists of approximately five volunteers.

Five teams make up one unit.

Four units make up one corps.

A volunteer fire corps is organized for each village.

In regard to vehicles to transport personnel and equipment, etc. if the vehicles provided by the Government of Japan during the first field survey period are to be used for forest fire control, their number is deducted from the required quantity. Five radio transmitter units will be deployed at each forest management office and one transmitter will be deployed at each of the two monitoring stations which currently lack a radio transmitter.

Table 7-15 Number of Required Fire Personnel Corresponding to Quantity of Equipment to be Deployed

No.	Type of Equipment, etc.	Name of Equipment	Qty Required	Qty Required at Each Office	Total Qty Deployed		No. of Personnel per Unit	Required No. of Fire Personnel		
					Fire Service	VFC		Fire Service	VFC	Total
					A	B=A/3		C	D	E
1	For Fire Prevention and Monitoring Activities	Patrolling Vehicle (4WD); duplicate with No. 5	3	1	3		1	3		3
2		Patrolling Motorcycle	3	1	3		1	3		3
3		Radio Transmitter (mobile)	17	5	15		1	15		15
4		Binoculars	9	3	9					
5	For Fire Extinguishing Activities	Transport Vehicle (for personnel and equipment)	6	2	6		1	6		6
6		Portable Pump Set	12 sets	4	9	3	4	36	12	48
7		Fire Hunters	150 sets	50	45	105	1	45	105	150
8		Fire Beater and Other Tools	150 sets	50	30	120	1	30	120	150
9		Collapsible Water Tank	15	5		15	3		45	45
10		Dust Protective Mask	60	20	40	20				
11		Dust Protective Goggles	60	20	40	20				
12		Protective Clothing	150 sets	50	150					
13		Helicopter Bucket	10							10
14		Others	Reserve Personnel to Carry Messages, etc.						12	18
Total								150	300	460

Notes

1. The quantity required at each station includes equipment, etc. for the volunteer fire corps.
2. Radio transmitters are provided for senior commanders of the forest fire service.
3. Protective clothing is not included in the calculation as it is provided for all forest fire-fighters.
4. Binoculars are not included in the calculation as they are used for multiple purposes.
5. Dust protective masks and goggles are not included in the calculation as they are used according to need.

## 2) Deployment of Helicopter Buckets

As the aerial sprinkling of water by a helicopter is highly efficient to extinguish a forest fire, the provision of buckets to be used by Army and Air Force helicopters is necessary. In the interview survey conducted with the Army and Air Force during the first and second field surveys, both the Army and the Air Force stated that while they cannot currently dispatch helicopters for fire extinguishing activities due to the lack of helicopter buckets, they are willing to assist such activities once buckets are deployed. The involvement of the Army and the Air Force in forest fire extinguishing activities can, therefore, be materialised fairly soon by establishing a proper procedure.

10 buckets are required to match the number of helicopters possessed by these forces, i.e. seven for the Air Force and three for the Army. Dams in the Study Area and its surrounding area can easily be used to supply water for the helicopter buckets.

## (2) Deployment Plan

The equipment and tools referred to in (1) above will be provided and deployed in the first year of the Project at the San Juan, Constanza and Padre Las Casas Forest Management Offices in addition to those already deployed.

## (3) Use of Provided Equipment

It has been confirmed that the equipment, etc. provided by the Government of Japan during the first and second field surveys has been very effectively used at the places of deployment, utilising the skills learned through training, and has also been maintained to a good standard for immediate use at each forest management office because of the transfer of maintenance skills along with its deployment. This situation suggests that the equipment and tools to be newly provided and deployed will mitigate the damage caused by forest fires.

## **7.6.7 Improvement of Fire Extinguishing Skills**

### (1) Continuous Meetings to Demonstrate Fire Pump Operating Skills

During the first field survey period, a preliminary exercise was held approximately three times in each of three areas of the Study Area. Subsequently, the first meeting to demonstrate fire pump operating skills was held with the participation of those who had participated in the said exercise. From a technical point of view, this meeting was very

successful and was highly appraised by the participants and guests alike. This kind of meeting should, therefore, be continuously held to further improve skills, to promote the participation of new volunteers, to educate local residents on forest fire prevention in their areas and to enhance the awareness of related organizations, including the Under-Secretariat for Forest Resources. The likely outcome of such meetings is described below.

- Frequency : Every year
- Venue : Although it is possible to have a different venue every year, it appears more appropriate for the time being to hold the meeting at the same venue each year for the convenience of management and guests.
- Participants : Staff members of forest management offices and volunteers of volunteer fire corps (including the general public)
- Operating method : Operation of portable pump and fire hunters by a group of nine people, including a commander
- Guests : Representatives of the Under-Secretariat for Forest Resources, the military, municipal fire services, volunteer organizations and schools, general public and others

## (2) Continual Training

Training on various operational skills is essential for the learning and improvement of the skills required to operate fire equipment and tools and also for effective collaboration between forest fire-fighters as well as volunteers. A training programme should, therefore, be prepared to ensure continual training.

Various types of training should be repeatedly conducted every four months in a year. There should be three different types of training, i.e. (i) individual training for forest fire-fighters and volunteers of volunteer fire corps, (ii) joint training for both and (iii) integrated training incorporating staff members of the forest management offices and local residents.

The desirable training frequency for individuals is approximately one time a month for forest fire-fighters and approximately every three months for volunteers. Joint training should be held approximately every six months while integrated training should be held approximately once a year.

In addition to the above training, skill training based on manuals should be held at the time of the recruitment of new forest fire-fighters or new volunteers.

### (3) Preparation of Manuals

For the universal implementation of forest fire control measures, the preparation of appropriate manuals is essential. The types of manuals which are immediately required are listed below and these manuals should prove useful to ensure effective fire prevention and fire extinguishing activities after the transfer of skills. In fact, manuals have already been prepared based on similar manuals used mainly in Japan taking the present conditions of the Study Area into consideration. While these manuals focus on basic activities, they should be expanded and revised with the future improvement of the skills and situation of forest fire-fighting in the Dominican Republic.

- ① Portable fire pump operation manual
- ② Forest monitoring manual
- ③ Manual to organize meetings to demonstrate fire pump operation skills

## **7.7 Rural Development Plan**

### **7.7.1 Basic Concept on Rural Development Plan**

Poverty alleviation is recognized as the highest need for communities in the Study Area whose poverty level is in the lowest in the whole country. It is believed that one of the major reasons for degradation of forest in the area can be attributed to poverty. In this context, to alleviate poverty, both the direct manner of improvement of the social infrastructure and the indirect manner of provisions for opportunities to grow income should be included as “Rural Development Plan” in the watershed management plan. The significance of the plan is summarized by the following three points:

- ① Poverty is expected to be alleviated through Income growth derived from the plan as well as improvement of the social infrastructure.
- ② The plan empowers vulnerable population including women
- ③ The plan contributes to the smooth operation of other components of watershed management plan as Entry Point Activities<sup>6</sup>

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<sup>6</sup> When making the first access to a village, donors/persons in charge of a project bring some incentives to

The Rural Development Plan is composed of a livelihood improvement plan and a social infrastructure improvement plan, both of which proceed with other plans including reforestation and agroforestry in a tight relationship.

### **7.7.2 Livelihood Improvement Plan**

#### **(1) Local people's Consciousness about Livelihood Improvement**

The village workshops held in January and February, 2001 showed extremely high expectation to improve livelihood among villages. However, in spite of their strong desire to increase income, most of them have less detailed images about measures to raise income. Images they had are quite limited – only to raising animals such as goats, sheep, pigs, cattle and chickens, which they have been traditionally bred. Majority of villages in the area have no tradition of making woodwork and bamboo works. In addition, the flower business is concentrated only in some parts of Constanza area. In short, alternatives in their mind to improve livelihood are very limited.

#### **(2) Appropriate Measures to Improve Livelihood in the Study Area**

The plan introduces the "Basket system", in which local people themselves can choose components from presented options, taking into consideration their own necessities and capacity to operate. The reason for introducing this system is derived from the experiences in the demonstration project, which revealed varying conditions of existing infrastructures, village locations, farming conditions, etc. Such differences convinced that a fixed set menu of options is inappropriate for the Study Area. The contents of the basket are shown below, all of which are proposed on the basis of experiences in the demonstration project and successful examples of other projects.

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attract village people to a project aside from project components themselves. Incentives, in many cases, relate to rural development along with income growth, and improvement of living conditions. In addition, it is expected to alleviate attrition between local people and government staff, who is often regarded as just a visitor for legal inspection.



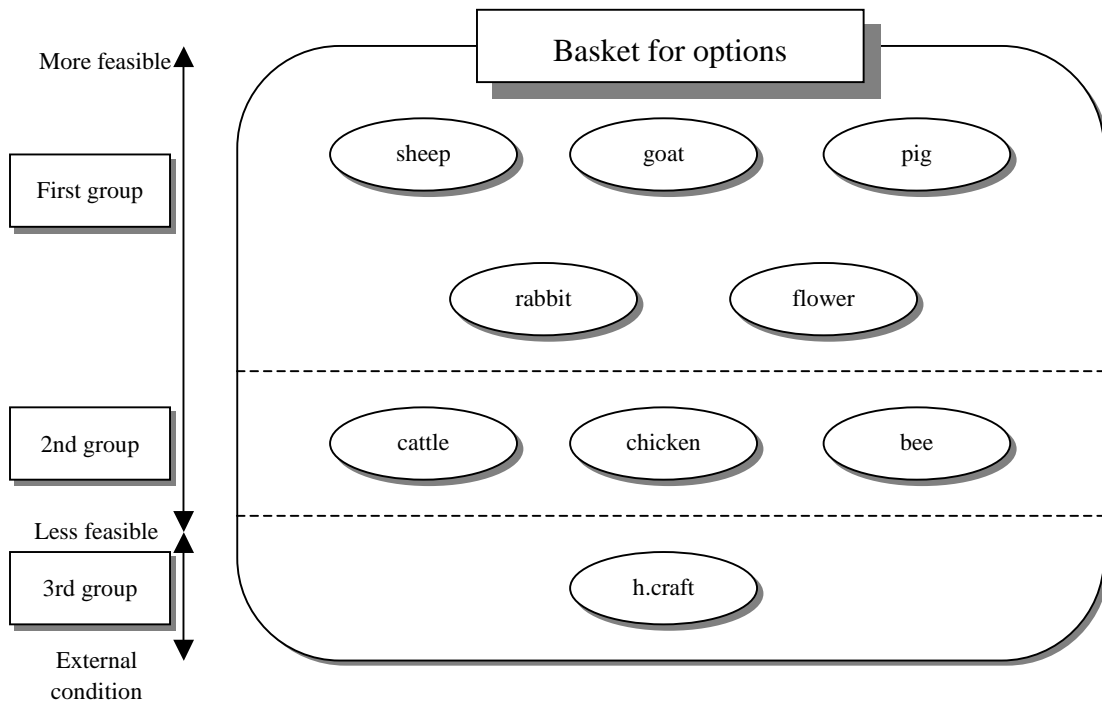


Fig. 7-6 Basket of Options for Income Improvement

Table 7-16 summarizes each component including targeted population, advantage, problems, and targeted areas.

Table 7-16 Components of the "Basket"

		Targeted population	Advantage	Problem	Targeted area
The first group	Sheep	Individual or community group  (basically for community group)	Have experiences to raise them High marketability Enable to align with activities of Agroforestry	Damage to crops Difference of market price by species (market price varies inversely proportional to risk of disease) Be attacked frequently by dogs	Padre Las Casas area (semi-dry area)
	Goat	Individual or community group  (basically for community group)	Have experiences to raise them High marketability Enable to align with activities of Agroforestry	Damage to crops Difference of market price by species (market price varies inversely proportional to risk of disease) Be attacked frequently by dogs	Padre Las Casas area (semi-dry area)
	Pig	Individual or community group  (basically for community group)	Relatively easier, and less damage to crops High marketability	Prevention of disease and management of feed High cost on feed Influence on environment of surroundings (odor)	All
	Rabbit	Individual	Short cycle, and easy management Easy to gain opportunities to visit and learn neighboring projects, whose rabbit component runs well	Low profit Need assistance to find and secure market route Some regions have no customs to eat. Smaller possibilities of domestic consumption than other animals such as chicken	All
	Flower	Individual or community group	Middle-high marketability Use hand-in knowledge accumulated by activities of village nursery, possible to expand to flower cultivation in family basis	Need technical assistance Need to satisfy conditions: climate and road	Constanza

		Targeted population	Advantage	Problem	Targeted area
The second group	Cattle	Individual or community group	(in the case of draft cattle) possible to operate cattle rental in some villages (in the case of cattle for meat) high marketability	(in the case of draft cattle) need to coordinate with persons operating business of draft cattle rental Require knowledge of raising High cost Damage to crops Enter national parks	All
	Chicken	Individual or community group	High demand in domestic consumption	Low profit, requires a certain of quantity Damage to crops, and plants at village nursery	All
	Bee	Individual or community group	High profit	High risk of disease Constraint from natural condition	All
The third group	Bamboo work	Individual or community group	Growing market recently Have chances to receive instructions by Taiwan technical cooperation, which may even proceed to Constanza area Technically easier than woodwork	Need space and trainers for instruction. Nearly impossible if there is no assistance from donors such as Taiwan Less availability of Makinoi, a popular specie for bamboo work	Constanza

### (3) Introduction

#### 1) First Group (high feasibility)

##### a. Condition of Introduction

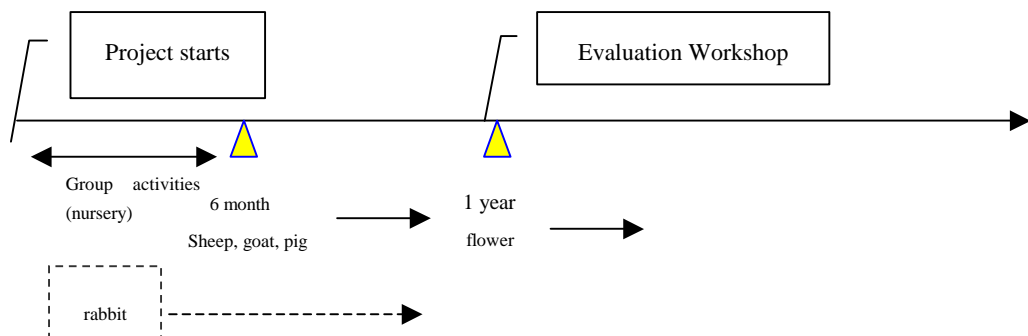
It seems the Padre Las Casas area has smaller risks for raising sheep and goats owing to knowledge accumulated for long time as a traditional custom. However, in order to avert from persistent problems with their raising such as damaging crops, it is crucial to establish and make thorough internal rules on raising them. Therefore, internal rules are a prerequisite for actual introduction. Rules should cover contents regarding palisades, feed, profit sharing and other subjects related to cooperative raising.

Raising pigs also requires internal rules as sheep and goats do. Considering that pigs are vulnerable to disease, internal rules must consider prevention of disease, cost sharing of injections and other subjects such as feeding costs. Flower cultivation proceeds with activities of village nurseries, thus,

coordination with internal rules of village nursery is necessary. In the case of rabbits, which are handled more easily than other animals, to raise on an independent basis can be promoted. Rabbits, therefore, would be introduced when system of technical and information exchange internally is confirmed. The case for rabbits unnecessarily pays attention to rules of profit sharing as required in other animals.

b. Timing of Introduction

The livelihood improvement plan should ideally launched at an early phase of project because of its expected role as an Entry Point Activity. It is, however, important to note that only after a certain level of organizational capacity is assured through village nurseries and other activities should the introduction start because as aforementioned, cooperated raising calls for organizational capacity. Rabbits, however, may be introduced earlier than others. Flower cultivation basically launches from the second year, depending on performance of village nurseries.



c. Important Notice for Implementation

The responsibility of the persons in charge of the project lie in supporting village people to form stronger community groups by establishing various internal rules before introduction. In addition to the principal role, there are three crucial points that must be carefully addressed for implementation.

- ① Need to watch that local people do not to start various optional activities beyond their capacity. It is unnecessary for people to undertake all activities; they should strike a balance between their wishes and capacity with a flexible introduction schedule.
- ② Introduce opportunities to participate in other plans, and also consider another ways to introduce the livelihood improvement plan with some

conditions. Otherwise, it is likely that people will only become interested in activities in the livelihood improvement plan and not activities in the watershed management plan.

- ③ Coordinate sending technicians/instructors to the sites in response to needs.

Promotion of women’s active participation

While the results of Needs Ranking in PRA workshop showed that the belief that women should only engage in household work still persists broadly in the Study Area, not a small number of women have desire to gain job opportunities. Most women in the area, however, yearn for not for a large income but rather a sub-income to supplement their household income. In this sense, small-scale components in the plan meet their needs. For example, flower cultivation in the northern area and animal raising in the southern part are expected to promote more active women’s participation.

- d. Necessary Inputs to Share between Donors and Villages

Inputs from both sides in the plan are shown in Table 7-17.

Table 7-17 Necessary Inputs

	Donor	Village
Sheep, goats, pigs, rabbits	<ul style="list-style-type: none"> <li>• Animals (left)</li> <li>• Technical support</li> <li>• Support for finding market</li> </ul>	<ul style="list-style-type: none"> <li>• Building palisade with their own materials</li> <li>• Necessary materials in a daily basis such as feed</li> <li>• Prevention of disease</li> <li>• Labor force for above matters</li> </ul>
Flowers	<ul style="list-style-type: none"> <li>• Seeds and plants</li> <li>• Pots</li> <li>• Technical support (sending technicians)</li> <li>• Support for finding market</li> </ul>	<ul style="list-style-type: none"> <li>• Maintenance of village nursery</li> <li>• Enlargement of village nursery, or building another one newly, if necessary</li> <li>• Daily maintenance such as watering, plucking up weeds</li> </ul>

- e. Relationship with Other Plans in the Watershed Management Plan

Raising sheep and goats can proceed with a tight relationship with the "Silvo-pasture plan" in the agro-forestry component. In addition, raising sheep, goats and pigs enables improvement of farming practices though use of

animal excreta organic fertilizer. Appropriate timing of introduction should be determined along with observation of performance as part of the agro-forestry component.

Additionally, other external projects present examples in which villages establish internal funds whose capital come from profits generated from raising animals. Although it is true that these examples show ideal goals, more priority was put on using the livelihood improvement plan as a lubricant to smooth operation of other plans, and generate opportunities to empower the population. Finally, there is no doubt that the plan is a main pillar of the master plan because it directly responds to high needs in the villages.

f. Animals to Input

The plan targets thirty one villages for the first five years in accordance with the extension plan, offering ten sheep, ten goats, five pigs, sixty rabbits, and flowers.

2) Second Group (with risk for implementation)

a. Condition of Introduction

Relatively higher risks persist in raising cattle, chickens and bees due to problems as described in the Table 7-12. If their introduction were desired, it would be important for participants to visit other projects to learn how to do. Other projects showing good examples as follows: cattle: a project by CEPROS (Padre Las Casas); chickens: a project by PRODAS (San Juan); bees: a project by ADESJO (Ocoa), etc. Only after studying the experiences of other projects' and when organizational and technical capacity in a village reaches an affordable level, should introduction of them be considered.

3) Third Group (feasibility fluctuates by external conditions)

a. Condition of Introduction

The plan proposes bamboo works as one of components in the livelihood improvement plan. Bamboo works are currently operated outside the Study Area through cooperation of Taiwan, whose assistance covers development of bamboo nurseries and processing of bamboo shoots. According to the project plan of Taiwan, it may extend to Constanza area, however, in this master plan it is categorized in the third group because its realization heavily relies on external

conditions. Bamboo works require ongoing technical instructions and it would be almost impossible to do without external assistance.

### 7.7.3 Social Infrastructure Plan

#### (1) Local Social Infrastructure Needs

Poor conditions of social infrastructure – deteriorated or unpaved roads is an example – bring direct or indirect impact on poverty in the area. The Needs Ranking at the village workshop provided opportunity to reaffirm strong needs among local people.

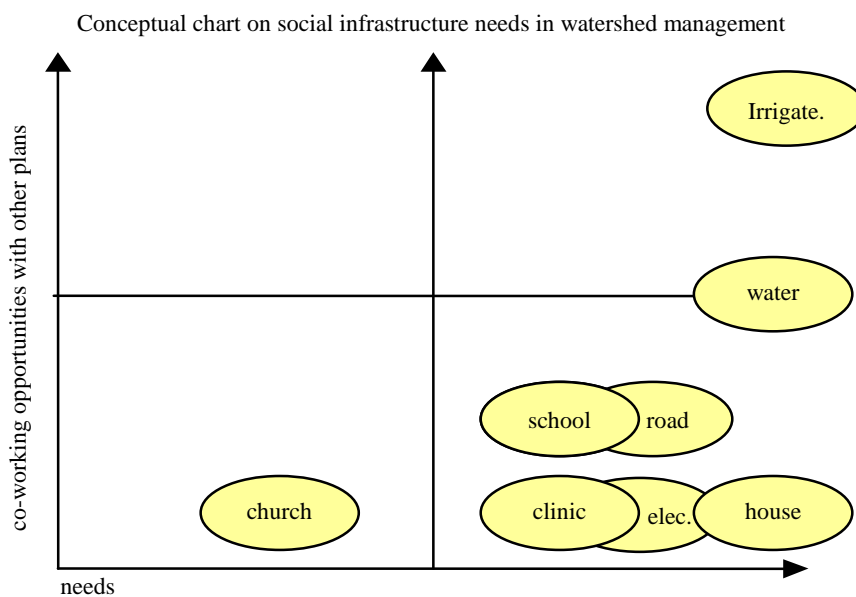


Fig. 7-7 Local Needs on Social Infrastructure

Fig. 7-7 shows relationship of each local need by charting them, whose. The X-axis represents the result of the Needs Ranking, and the Y-axis represents the degree of relevance to other activities in the master plan.

#### (2) Settlement of Priority Component

It is obviously impossible for the plan to respond to all the needs of local people due to budget constraints. The plan should prioritize some activities by judging whether components have can work with other plans. Chart 7-6 suggests that irrigation is the strongest candidate component.

In addition to irrigation, a simple-structured and low-cost machine for making bricks, which the forestry school in Jarabacoa is now promoting, can be considered as another possibility to introduce in the Study Area.

### "Introduction of Irrigation Facilities"

Needs for irrigation facilities in the Study Area now become greater partly due to rehabilitation needs after hurricane George hit the area in 1998. Irrigation facilities not only fulfill local needs but also play a role to alleviate slash and burn farming directly or indirectly. The ADESJO Project in Ocoa is reporting that irrigation facilities introduced with rules banning slash and burn farming lead to natural recovery of forest resources.

"Irrigation facilities" in this plan signifies not large-scale facilities but simple ones as vinyl pipe.

### (3) Introduction

#### 1) Condition of Introduction

Irrigation facilities should be introduced only after performance in other activities such as village nursery meets criteria mentioned below, supposedly two years after the project launches. Requirements for costs, and moreover, increase organizational capacity to maintain projects require appraisal time, even though it is basically a function of "Entry Point Activity". Appraisal is separated into two phases, as shown in Table 7-18.

Table 7-18 Main Items to Appraise

Timing of Appraisal	Items to appraise
The end of the first year	① Organizational capacity reaches a certain level, references would be performance in village nursery (set up rules of maintenance, etc)
Sometime in the second year (depend on situation)	① Confirm technical concerns about catchment place, convey of water, land tenure, permission of land use (overlying pipes on farmland) ② Set up internal rules about facilities use and persons in charge

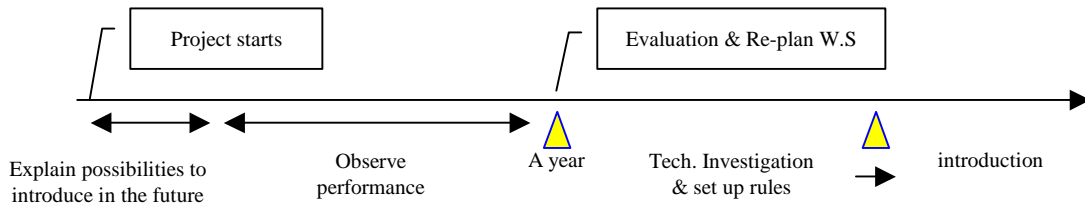
#### 2) Timing of Introduction

Project holds an evaluation workshop that would be driven by local people themselves one year after the project starts. The workshop evaluates performance thus far and re-plans activities for the coming year. To best take advantage of opportunities, local people and persons in charge of the project should discuss timing of introduction.



3) Important Notice for Implementation

Although it is better to put off introduction of irrigation facilities until all criteria is met, an effective strategy to gain early local interest in the project will be to announce that the project will provide irrigation facilities in the future. The announcement, however, must discuss the steps to introduction, which may take longer than the public may imagine. The project must be make fully clear in order to avoid problems in the future.



4) Necessary Input to Share between Donors and Villages

Input from both sides in the plan is described in the Table 7-19.

Table 7-19 Necessary Inputs

	Donor	Village
Irrigation	<ul style="list-style-type: none"> <li>• Vinyl chloride pipe (from catchment area to entrance of village)</li> <li>• Technical support</li> <li>• Support for coordination of land, water use and others</li> </ul>	<ul style="list-style-type: none"> <li>• Vinyl chloride pipe (from a point in village to each farming lot)</li> <li>• Labor force</li> <li>• Coordinate various admission (water use, laying pipes on farmland)</li> </ul>

5) Relationship with other Plans in the Watershed Management plan

It is important to set up internal rules on use of irrigation facilities with mentioning the ban on shifting cultivation that should be a condition to the introduction of facilities. Detailed rules on maintenance should be left to the public's discretion; however, persons in charge of the project should ensure that a maintenance system is in place before introduction and should continuously monitor performance, though in actual practice it may be difficult in many cases due to location. In order to obtain steady results, beneficiaries of irrigation facilities should include farmers engaging in shifting cultivation in remote places even by use of land replotting, which the ADESJO project actually employed in their own projects. Moreover, irrigation facilities may overlap with some activities. For example, beneficiaries of

irrigation owe obligation to plant trees, or contrarily, persons who voluntarily planted trees receive privilege to become beneficiaries of irrigation.

Concerning the selection of beneficiaries---reflecting the demonstration project

The demonstration project revealed that village leaders sometimes felt pressure over the course of the project because they were not sure if they would benefit from their work. It is worthwhile for persons in charge of the project to propose that priority privileges to receive irrigation facilities be granted to such leaders, or persons working hard in village nurseries. These proposals will not likely be well received by the public; therefore only an outside third party can manage such matters.

6) Target Sites

Target sites are 31 villages for the first five years in accordance with the extension plan.

## **7.8 Plan of Strengthening Organizational Capacity of Community group**

### **7.8.1 Importance of Strengthening Organizational Capacity**

Strengthening organizational capacity of village community groups represents a major pillar of the watershed management plan. Since the plan requires cooperative group activities, if a village lacks a community group with sufficient organizational capacity, the watershed management project will stumble.

Strengthening organizational capacity is also important from the viewpoint of rural development. As learned in the study, some villages made petitions on their own to government and NGOs to assist with social infrastructure, and actually obtained some results. With this in mind, it seems suitable to strengthen social infrastructure in villages at the appeal of community groups. This style of approach seems to be more suitable in the case of the Dominican Republic.

### **7.8.2 Basic Concepts for Strengthening Organizational Capacity**

Two basic approaches are taken for strengthening the organizational capacity of community groups.

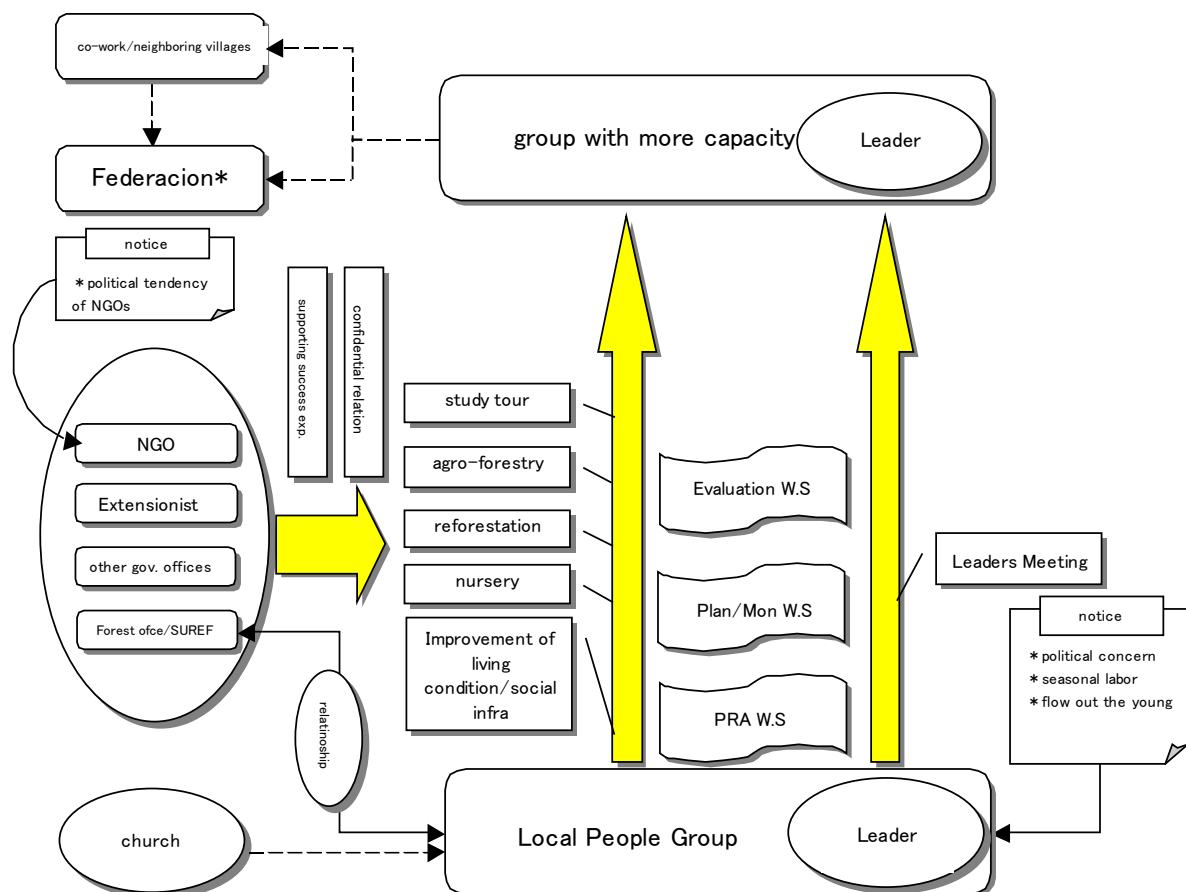
- ① Strengthen capacity of local people overall

- ② Strengthen capacity of leaders in community group (along with , or prior to in order to lead a group)

The plan for strengthening organizational capacity broadly covers all local people through village workshops, and holds leaders' meetings to encourage leaders who will tract the activities of the project.

It is, however, important to consider not only independent activities that contribute to strengthening organizational capacity, but also many other activities such as village nurseries, and the breeding of sheep and goats. The Plan, therefore, proceeds with the basic concept of the importance of cooperating with activities in other plans.

Relationship of each component for strengthening organizational capacity is shown in Fig. 7-8. It includes description of another organization, which is regarded as a developed structured organization, called Federacion.

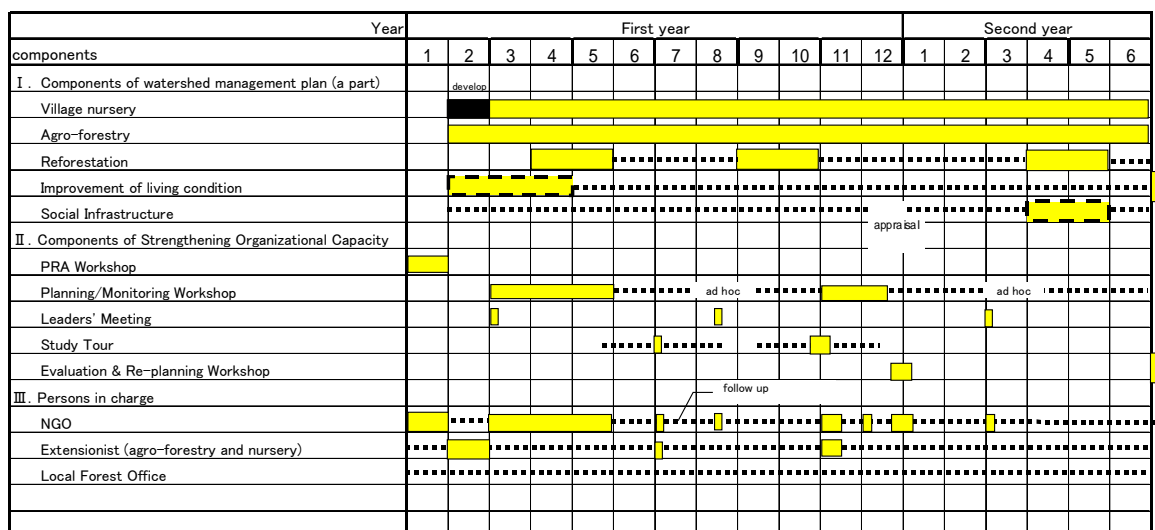


\* Federacion is an organization developed from normal local people group, and now many of them are nearly transferred to half-NGO. They are even able to gain subsidiary from the government.

Fig. 7-8 Conceptual Chart on Strengthening Organizational Capacity of Community Group

### 7.8.3 Components of Plan for Strengthening Organizational Capacity of Community group

The plan proceeds with activities of other plans including various workshops. Fig. 7-9 shows a model schedule of the plan components.



note: The above schedule is a model. The schedule should be flexible.

Fig. 7-9 Schedule of Components

#### (1) PRA (Participatory Rural Appraisal) Styled Workshop

##### 1) Objective

The first contact with a village is established in a workshop introducing PRA tools. A major goal of the workshop is to share local consciousness about the condition of watershed degradation and to create self-awareness as a concerned population.

##### 2) Contents

The PRA workshop comprises the following components:

- Village resource map
- Institutional analysis
- Historical analysis
- Transect walk
- Group discussion (men and women)
- Needs ranking

In the final stage of a workshop, participants select leaders who are expected to lead members and coordinate activities. However, a better tactic for selection is to assign temporary leaders and then determine actual leaders later, so as to avoid selecting leaders in a stressful atmosphere.

As the workshop is the first contact with villages, attention should be given to how people are invited. Schools, churches or other neutral locations free from internal political issues should be chosen as meeting locations. Participants should be unbiased.

(2) Planning and Monitoring Workshop

1) Object

This workshop aims to build local people's capacity for planning, managing and solving problems. In the course of the demonstration project, it was found that actions planned by local people frequently failed goals as scheduled because of problems with time management, role allocations, etc. It is important for the workshop to provide a village with opportunities to understand how they should predict obstacles and courses of action to achieve their goals.

2) Contents

In order to strengthen organizational capacity of community group, workshops on "village nursery" and "reforestation" are held.

Table 7-20 Matrices Utilized in Workshop

Planning workshop	Monitoring workshop
Expectation (for achieving )Obstacles	Achievement
Actions	Obstacles faced
Deadline	Lessons
Persons in charge (two for each)	New actions
	Deadline
	Persons in charge (two for each)

It is more important for a community group to acquire organizational management capability and to share consciousness about the problems in a village than to just to fill in the matrices.

### (3) Leaders' Meeting

#### 1) Objective

The leaders' meeting aims more to build the capacity of village leaders than to offer opportunities 1) to make them aware as leaders, and also 2) to acquire hands-on knowledge of planning and monitoring through workshops.

#### 2) Contents

The leaders' meeting provides opportunities to freely discuss the "role of leaders" and "problems faced by leaders". For the purpose of 2) mentioned above, the leaders of each village will make a report drawing on their experiences in planning workshops in their own villages and then present the report to the other leaders. The presentation expects to evoke brisk discussion and information exchange among leaders.

Leaders' meetings should be held with neighboring villages as this will enable leaders to consider their activities thus far objectively and to utilize acquired knowledge or information in their own villages afterwards.

Women's participation should be regarded as a prerequisite for leaders' meetings. Women are likely to feel distant to a project when topics are skewed to farming activities, as shown in the Demonstration Project. Accordingly, it is important to promote women's participation by selecting topics more directly involving women's activities.

### (4) Study Tour

#### 1) Objective

The study tour has a great positive impact on the consciousness of participants. According to the Demonstration Project, visiting sites where farmers have achieved greater success under natural conditions similar to other participants provides good motivation.

In addition, the study tour demonstrates not only advanced farming techniques but also that activities undertaken by community group with sufficient capacity will lead to fruitful results in agricultural development, and more broadly in rural development.

2) Contents

There are two types of Study Tours.

	Necessary days	Number of participants
1	One day trip	Relatively larger number can participate
2	3-4 days trip (staying at training facility)	Five persons in each village (necessary to select them in a village)

(5) Evaluation & Re-Planning Workshop

1) Objective

Considering the importance of having local people evaluate their own activities, an evaluation workshop should be held one year after a project launches and activities for the next year should be planned. The workshop should be planned with an exciting atmosphere, like that of a festival, in attempt to attract new participants.

2) Contents

Evaluation in the workshop should be composed of the following.

Things done & not yet done

Obstacles

Lessons from obstacles and things not yet done

In addition to , other topics including social infrastructure should also be discussed in the workshop.

**7.8.4 Important Notice for Implementation**

(1) Strengthening Organizational Capacity of Community Groups

1) Important Notice of Internal Concerns in a Village

a. Political Concerns in a Village

In the Study Area, there are some villages with strong internal political interests, and which community groups are divided and back different political parties. Accordingly, persons in charge of a project need to pay attention to the composition of a community group to avoid concentration of a particular group.

The first access to villages is critically important in this sense. As aforementioned (see 7-8-3-(1)), politically neutral organizations such as churches and schools are regard the best entities for making first access.

## 2) Important Notice about Focal Points between Villages and Persons in Charge

### a. Supporting Community Groups towards Success

The basic concept of action by community groups or "Self help", is called "Auto Gestion" in Spanish. It signifies that spontaneous activities of community group are the first step towards the resolution of their needs, and only that simply waiting for external assistance does not solve anything. The concept is immensely significant and practically efficient for villages in the Study Area.

The persons in charge of a project need to offer ongoing support to the actions of community groups' under the concept of "Self help". For example, if a village is unable to acquire fruit plants despite their intensive efforts, the person in charge should introduce an official fruit plants distributor, PRODEFRUD, to a village by utilizing their own unique governmental channels. Successful experiences will create a virtuous circle for further activities; on the other hand if they continue to not be successful they are likely to lose their energy. Thus, external support is quite important.

## 3) Important Notice on External Concerns

### a. Church

Catholicism has a great influence in the Study Area. The churches understanding of projects may positively accelerate activities. Even if special conflict does not occur, it is also important that mediators are available to provide support when activities of parties create conflict.

### b. Coordination of NGO

The Demonstration Project found that relationships between NGOs and local people sometimes deteriorated in some villages mainly due to the NGO's political action inside villages. In this context, it is important to pay attention to the characteristics of NGOs.



c. Improvement of Relationship between Local Forest Offices and Villages

Conflicts between local forest offices and local people were found during the Demonstration Project. It mainly rested with ad hoc attitude of local forest office when levying penalties on slash and burn farming, which most farmers practice as custom. Mutual understanding of this matter is necessary for smooth operation of the project.

(2) Characteristics of Region

According to the result of the Demonstration Project, Constanza, where more day-basis farming labors exist than Padre Las Casas, had a tendency to show less interest in components of the Demonstration Project such as village nurseries and agro-forestry. Looking at these results, introduction of approaches that focus more on improvement of living conditions and income, would be better here than in other areas, especially northern Constanza, and the southern part of Constanza.

### **7.8.5 Implementation**

Reflecting the goal of the plan to "strengthen organizational capacity of community groups", well-balanced coordination with other plans is necessary. At a village level, a triad structure composed of local forest offices, NGO in charge of management of community groups, and technical support specialists, is an ideal structure for implementation of the project.

Because the plan "strengthening organizational capacity of community group" carries out workshops such as PRA, planning and monitoring, and leaders' meetings, as a mandatory requirement, persons in charge of this section need to have sufficient experience in rural development. In this sense, in terms of efficiency and feasibility, NGOs and consultants are considered strong candidates to contribute.

## **7.9 Extension and Training Plan**

### **7.9.1 Extension and Training in Villages**

(1) Basic Attitude in Extension

In order for farmers in the target watershed region to accept sustainable agriculture and free themselves from traditional agriculture, they will need to increase their knowledge of new farming methods. However, the limited activities of the small number of government extension workers have not been able to answer this need. The further one

goes from Padre Las Casas, Bohechio and Constanza, the center of the target area, the more limited the activities of the extension workers become, and sustainable agricultural practices are only isolated exceptions making their horizontal extension a difficult task. Neither is extension among the farmers scattered throughout the entire watershed a simple matter.

Illiteracy among many farmers is also important factor to be considered. Not too much can be expected from their creative interpretations of the written material given to them at the seminars and their trial and error efforts to adapt it to their needs. Instead of relying on print media, core farmers should be set up as the center of extension for each village. The principal strategy of "extension by farmers to farmers" should be practiced centering on these core farmers. The training sessions for empowering core farmers should serve the dual purpose of giving a wide range of new knowledge to village farmers. Moreover, the organization responsible for implementation of the Master Plan should, in cooperation with education authorities, implement adult literacy programs in the target villages.

(2) Target Extension Group and the Expansion Process

The strategy of "extension by farmers to farmers" implies that the core farmers living in the village must speak to other villagers in their own way so that many villagers can absorb the core farmers' thinking and come to share the same awareness as the core farmers regarding the importance of sustainable farming.

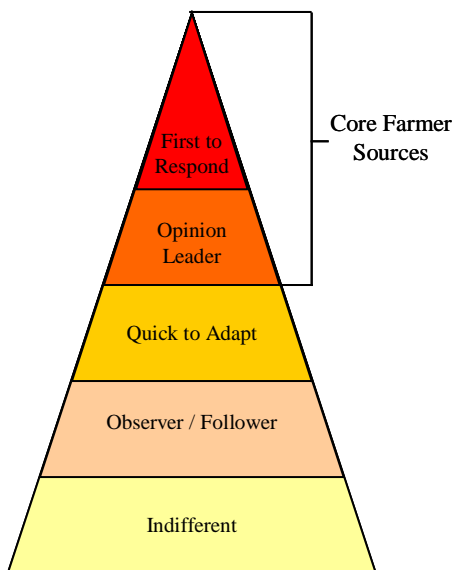


Fig. 7-10 Conceptual Diagram of Farmer's Level of Interest Strata

In each village, people who show interest can be classified according to their individual character, social position in the village, the trust they receive from other villagers, their financial well-being, etc. However, looking at the villagers from an external viewpoint, they can be broadly classified according to their interest level into 5 strata as shown in " Fig. 7-10 Farmer's Level of Interest Strata ".

Among these groups, those interested in new things, the "First to Respond Stratum", and those trusted by other villagers, the "Opinion Leader Stratum" are the two strata from which individuals should be the source to be raised as core farmers of the community. People belonging to the "First to Respond Stratum" can be expected to enthusiastically

participate in the activities from the very beginning, but they are often younger in age or do not hold a position in the village. Therefore, agroforestry extension in the village will not be successful if only the people from the "First to Respond Stratum" are relied upon.

People in the "Opinion Leader Stratum" who are trusted by villagers are more important. Once they become convinced and recognize the benefit of agroforestry, their communication by word of mouth to other villagers will draw in people from the "Quickly Adapting Stratum" and the extension process will begin to expand. However, since opinion leaders are usually middle-aged or elder people and sometimes do not quickly adapt to new ideas, they must be educated together with the "First to Respond Stratum" in a balanced manner.

The "Quickly Adapting Stratum" includes many women. Their ability in information transference by word of mouth is valuable and even indispensable for detailed agroforestry extension.

### (3) Combined Extension Methods: Mixed Media Strategy

The most pressing issue for the Project is "extension", the transfer of information from the Project side to the farmers.

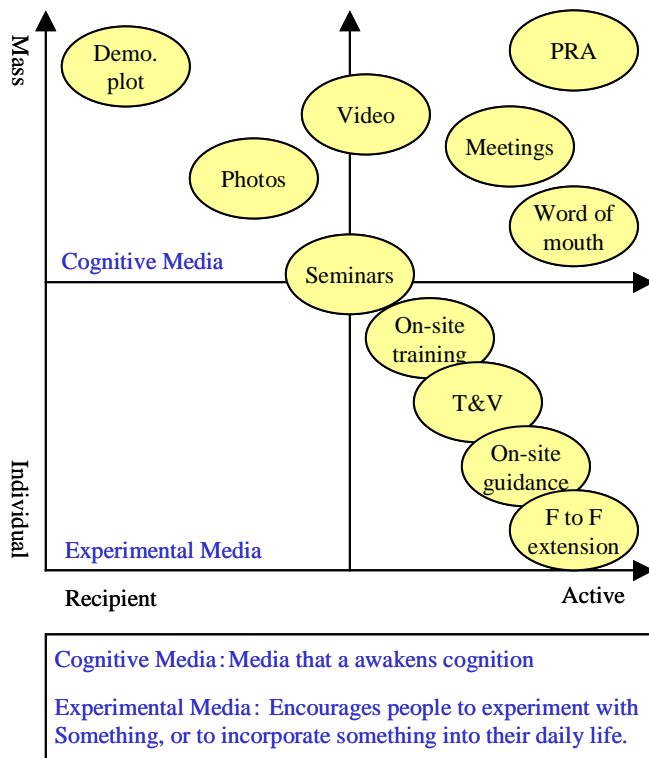


Fig. 7-11 Conceptual Diagram of Combined Extension Methods

the Project side to the farmers. The use of print media for extension, however, is ineffective in target villages that include many illiterate farmers. Therefore, a combination of extension methods, or a "mixed media strategy", must be employed.

Under a combination of extension methods, the Project side first needs to consider how to deliver the information that they want to convey to the farmers. A combination of media is then employed in stages to effectively promote the information through mixed media. These media include from information delivery to the entire community (mass delivery) by showing videos and

photos, to a whole array of individual extension activities (individualized delivery).

"Extension by farmers to farmers" is the principal strategy used for extension in this Master Plan. Here, the primary concern is how to create core farmers in each village by using a combination of extension methods in stages to empower the core farmers. First, the individual's understanding is awakened through the "Cognitive Media" and then in the extension process the "Experiential Media" allow the individual to actually apply his/her newly acquired information.

What is important in this case is the Project side's judgement as to which extension process and which media should be used to motivate the villagers.

#### (4) Media Content and Their Utilization Process

Extension media can be broadly divided into cognitive media and experiential media, with each medium having its own characteristics. These characteristics must be well understood so that proper judgement can be made as to which media should be used and how they should be applied in the above mentioned extension process. Table 7-21 shows the general processes used to approach the villages, with an explanation of media 1 to 21.

Table 7-21 Content and Purpose of Extension Media

Extension Media, Training	Content and Purpose	Time
1. Promote initial workshop	When beginning extension in a new village, promote the first workshop to village leader and others	Before Project initiation
2. Introduce Project	Introduce the Project execution personnel and Project purpose	At Project initiation
3. Show video	Show the video "Autogestion en Los Andes"; emphasize the importance of self-help; introduce basic concept of Project	(Same Day)
4. Converse with core farmers	Converse with core farmers in core villages	(Same Day)
5. Select PRA and contact person	Analyze problems and grasp needs; select contact person in the community	Immediately after beginning Project
6. Nursery training and nursery making	Hold training in nursery work, build nursery	Immediately after doing PRA
7. Training in small-scale planting	Practice and training in how to plant seedlings grown in the village nursery	5 to 6 months
8. Training in fruit tree planting	Obtain fruit trees; practice and training in how to plant fruit trees	5 to 6 months
9. Training in grafting	Practice and training in how to graft fruit trees	Depends on farmers
10. Leaders meeting	Gather the contact person from each village and discuss problems	"
11. Visit Nursery at Developed Site Converse with core farmers	Visit nurseries in nearby developed areas; converse with core farmers who manage nurseries	1 to 2 months after making nursery
12. Workshop on nursery management	After visiting nurseries, villagers discuss how they will manage their village nursery	After visiting nurseries
13. Forest tree planting workshop (Combite promotion)	Hold meeting on how to use Combite method for planting forest trees in village	Depends on farmers
14. Visit developed site (day trip)	Select potential core farmers; visit Ocoa in the south, Los Dajao in the north	6 to 8 months after making nursery
15. Visit developed sites (5 days 4 nights) empower core farmers	Select motivated core farmers; visit Barabacoa Forestry School and Plan Sierra	10 to 11 months after making nursery
16. Show video after visiting developed-sites	Make video during visit to developed sites; hold video presentation to inform other villagers of trip; trip participants should lead the explanation	Immediately after visiting developed sites
17. Workshop on making organic fertilizer	Hold workshop on earthworm use; villages near Constanza can visit Bocashi plant	After visiting developed sites
18. Agroforestry training	Hold various agroforestry training sessions for core farmers	After designating core farmers
19. Farm management training	Hold (Diagnostics, Planning and Designing) training to improve farm management for core farmers	After designating core farmers
20. Evaluation workshop	Hold evaluation workshop every year to check the contents of activities carried out by the Project	1 year after making nursery
21. On-site guidance: follow up (empower core farmers)	At core farmers' lands, give on-site guidance based on the farm management training	After designating core farmers

## 7.9.2 Extension Organization and Extension Process

### (1) Extension Plan

The Extension Plan will be divided into a First Period, Second Period and Third Period consisting of 5 years each for a total of 15 years. The Project will work with about 30 villages in each Period, covering all the villages during the 15 years of the Project, although this will also depend on the Project's normal development.

### (2) Extension Organization

The extension target area is very large, 166,000ha, and the villages scattered across the watershed are not easily accessible. The watershed is divided into a northern region centered on Constanza, and a southern region centered on Padre las Casas. Therefore, the extension system will need two central organizations, one organization for the north, and another for the south.

Area	Village where demonstration project will be conducted (Core Village)	Residence of Extension Worker
Northern Region		
Western Constanza area	Los Corralitos	Constanza
North-South Constanza area	El Convento	Constanza
Southern Region		
Las Cuevas area	El Recodo	Padre Las Casas
Rio Medio area	Las Lagunas	Padre Las Casas
Northern Yaque del Sur area	Los Frios	Los Frios
Southern Yaque del Sur area	La Guama	Arroyo Cano

As indicated below, in order for the extension to be more effective the demonstration project carried out during this study will be continued, and the six target villages of the demonstration project will be designated as "Core Villages" and extension will be carried out centering on those villages. Furthermore, a total of 3 Project extension leaders who will be in charge of the project extension work will be dispatched, one to the north and two to the south, and they will be in charge of 6 extension workers.

### (3) Selecting Extension Target Villages

To select the target villages for extension, the conflictive land-use area of a village is divided by the parameter to give the conflictive land-use ratio for the villages. Villages with a higher ratio will be given priority as extension targets. One extension

area will consist of between 5 and 6 villages. The aim will be to begin extension work in 31 villages within the five years of the Project's First Period.

The target villages for the First Period were selected by taking into account, in addition to a high ratio, the village's location in relation to the Core Villages and the urgency of watershed conservation in the area. Table 7-22 lists the 31 villages selected for the First Period.

The villages for the Second Period will be selected based on the results of the First Period and the response of the surrounding villages.

Table 7-22 Extension Target Villages for the First Period

Area	Target Villages	Conflictive Land-Use Ratio	Comment
<b>Northern Region</b>			
Western Constanza Area 5 villages	Los Corralitos	86.37	
	Arroyo Hondo	81.64	
	Los Almendrales	67.74	
	Los Cayetanos	59.29	
	Arroyo Naranjo	45.41	
North-south Constanza Area 5 villages	El Convento	10.63	El Convento and El 31
	Rio Grande	25.21	
	Pinar Parejo	4.47	Saiberia and Castillo
<b>Southern Region</b>			
Las Cuevas Area 5 villages	El Recodo	46.88	
	Las Cayas	61.39	
	Las Avispas	76.67	
	Las Guamas	83.49	
	Arroyo Corozo	90.03	
Rio Medio Area 5 villages	Las Lagunas	33.78	
	Las Canitas	58.50	
	Los Cedroso Mendoza	92.38	
	Botoncillos	58.38	
	Gajo del Monte	72.85	
Northern Yaque del Sur Area 6 villages	Los Frios	39.23	
	Los Montacitos	43.64	
	El Montazo	24.57	
	Cucarita	25.39	
	Los Guayuyos	58.37	
	El Recodo	61.86	
Southern Yaque del Sur Area 5 villages	La Guama	26.67	
	El Palmar	-	
	El Naranjo	-	
	Buena Vista	44.42	
	La Vereda	21.11	

#### (4) Characteristics of each Area and their Extension Objective

##### 1) Western Constanza Area

The objective of extension in this area is primarily crop diversification and soil conservation. Since several communities have already started to contact INDRHI, Constanza municipality and the Office of the Presidency to install PVC pipeline for their agricultural purposes, advances in village development and the creation of a network among the villages are expected.

##### 2) Northern-southern Constanza Area

This area's incentive for planting forest trees is lowest among the 6 areas. A good approach would be to begin by introducing fruit trees and Bocashi organic fertilizer. Due to the history of forced expulsion from the area, many houses are crudely built. It would be good to introduce a brick-making machine to win people's trust and create a community organization while continuing to speak with them on the importance of watershed conservation. This is an area with an abundant water resource. Therefore, it would be possible to work jointly with PRONATURA, a governmental NGO that supports hydroelectric power generation, to promote a watershed conservation plan that would include both hydroelectric generation and watershed conservation.

##### 3) Las Cuevas Area

Many farmers have lands that are located near a mountain summit or along a mountainside and they go on foot or by horse for long hours to reach their farmlands. This time restriction makes it difficult for them to undertake both tree planting and agricultural work. Cooperation with the "Food for Work" program will be needed to develop forest tree planting activities in this area. Since this has traditionally been a coffee growing area the most realistic approach would be to work jointly with CODOCAFE in renovating the coffee plantations, and at the same time to plant fruit trees to help diversify the farmers' income base. Although people who live in this area have a great need for sloping land irrigation, but there are very few water sources.

##### 4) Rio Medio Area

In Las Lagunas avocado production is increasing. Many core farmers who had a central role in the demonstration project are building their own fruit tree nurseries by their own initiative. It would be important to obtain PRODEFRUD's support in helping farmers to continue this activity. Since there are many cattle farmers in the



village it would also be good to develop silvopasture in this village. Furthermore, the other villages nearby could be approached using the same fruit tree species grown in Las Lagunas.

5) Northern Yaque del Sur

Shifting cultivation agriculture and coffee growing are the primary farming activities. Cooperation with CODOCAFE is needed to promote coffee plantation renovation. In recent years, people's interest in fruit trees has grown. Therefore, farm improvement should be done with fruit trees as the center of focus. Since the area has a high altitude it should be possible to raise fruit species that don't grow in other areas. New fruit varieties, such as apples and strawberries, could be incorporated. The area also has small-scale farmers with dual operations of agriculture and cattle raising. They should be approached for developing silvopasture.

6) Southern Yaque del Sur

Due to the unique topographical characteristics of the area, a trial and error period will most likely be needed for finding the best approach to the villages. However, a PRA could be done to identify villagers' needs, form an extension strategy and then put together effective extension media. In this way, a group of core farmers could be established. La Guama has the main access road to the Carmen Ramirez National Park so it is essential that vigorous nursery activities and tree planting activities, including fruit tree planting, are developed in this village as a demonstration to other village farmers. What will be vital in this approach will be to increase the exchange between La Guama village and the core farmers from other villages so that La Guama's results can be disseminated to the surrounding villages. CODOCAFE or PRODEFERUD can also be a help in increasing coffee seedling and fruit tree production. In this way, a diversified production system should expand throughout the population.

## **7.10 Project Management Plan**

### **7.10.1 Project Implementation System**

(1) Basic Ideas

For the implementation of the Master Plan, proper consideration must be given to the fact that shifting cultivation is the main livelihood of local residents despite it being the

principal cause of forest degradation in the watershed. The Master Plan strongly adopts the concept of community participation and various projects under the Master Plan must be implemented with such participation by giving local residents a major role to play. For this purpose, the formation of a community group for each component of the Master Plan is necessary to encourage voluntary commitment and awareness as leading members in project implementation on the part of local residents.

Apart from the Under-Secretariat for Forest Resources, the INDRHI and other government bodies are involved in watershed management. Various secretariats of state other than the Secretariat of State for Environment and Natural Resources are also related to the Master Plan as in the case of the Secretariat of State for Education which is related to school forests. Accordingly, the efficient implementation of the Master Plan with the coordination of all related government bodies is essential. For this purpose, councils to coordinate the opinions of various administrative bodies should be established at both the central and local levels in view of the proper arrangement of the project contents, project sites and project priority. At the local level, the understanding and cooperation of local public bodies are essential for the smooth implementation of projects. The participation of the municipal, district and village authorities should, therefore, be considered. In regard to local residents, it is necessary to listen to their opinions at the planning stage as the eventual implementers of projects in order to secure the effectiveness of projects in addition to requesting their participation in projects.

The local forest management offices responsible for the watershed in question are the Southwestern Forest Management Office at San Juan de Maguana and the Central Forest Management Office at La Vega. However, the establishment of a new body other than the existing forest management offices to be exclusively responsible for the implementation of the Master Plan is desirable to secure the effective implementation of projects. A project implementation office which is directly accountable to the Under-Secretariat for Forest Resources will, therefore, be newly established to be responsible for the implementation of the Master Plan.

In the Las Cuevas River basin, there are two villages under the jurisdiction of the South-Central Forest Management Office at Santo Domingo but only part of these village areas belongs to the said watershed.

Given the available manpower and equipment, etc. of the Under-Secretariat for Forest Resources and local forest management offices, it is deemed to be difficult to closely liaise with local residents who actually implement the projects even if a project

implementation office is newly created. The reality of community project implementation under the Study and of the implementation systems of similar watershed management projects currently in progress in other areas suggests that the use of NGOs with local links and private consultants, etc. to coordinate project implementation is desirable.

(2) Concrete Implementation System

The ideas described in (1) are schematised in Fig. 7-12

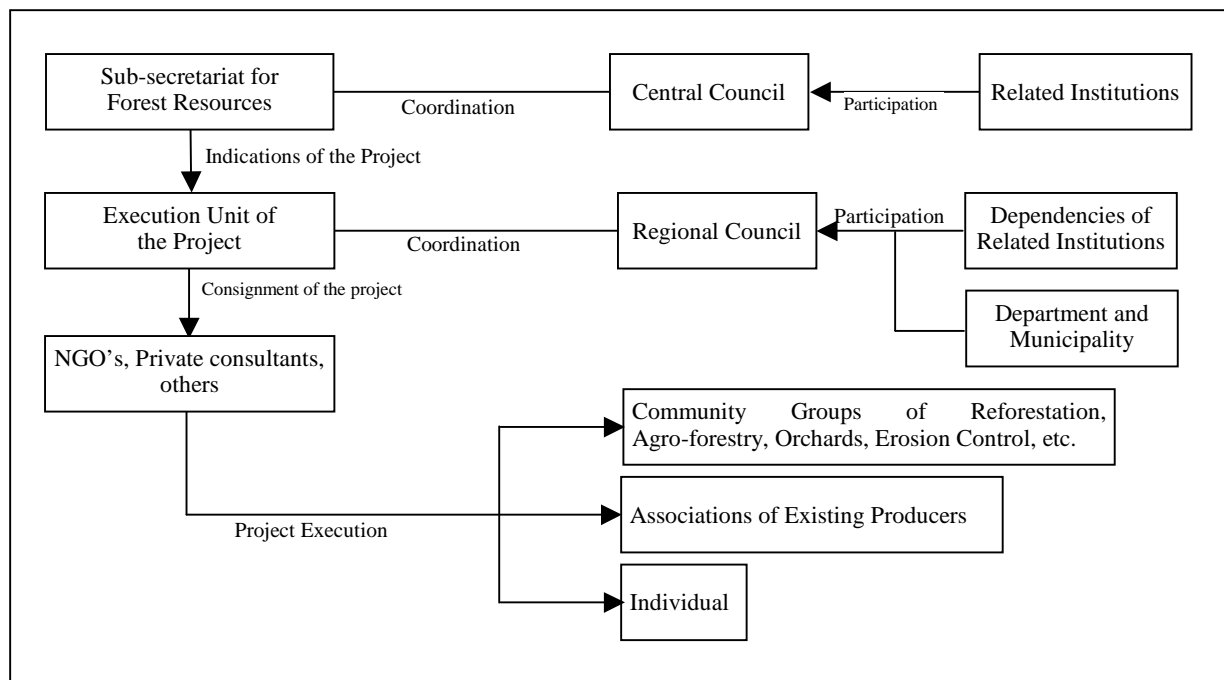


Fig. 7-12 Concrete Project Implementation System

The Under-Secretariat for Forest Resources organizes a meeting of the Central Council at the central level, formulates a long-term plan for the implementation of watershed management and secures the budget for project implementation.

The Project Implementation Office to be newly established for the purpose of implementing projects plays a central role in the implementation of the Master Plan. This office implements various projects in accordance with the long-term project implementation plan formulated by the Under-Secretariat for Forest Resources. It organizes meetings of the Local Council to determine the annual implementation programme while listening to local opinions. The actual implementation of projects is entrusted to NGOs and private consultants. These NGOs and private consultants conduct concrete activities, including workshops, at the project sites under the instruction of

extension officers of the Project Implementation Office. The roles and members of the Central Council and Local Council are described below.

- Central Council

Role : Review of the long-term plan for the implementation of watershed management

Secretariat : Under-Secretariat for Forest Resources

Members : Under-Secretariat for Water and Soil; INDRHI; Secretariat of State for Education; Secretariat of State for Public Works; National Municipal Council; Catholic Church; Fire Department of the Military; others

- Local Council

Role : Review of the annual watershed management plan

Secretariat : Project Implementation Office

Members : Local offices of various secretariats of state and the Military; Southwestern and Central Forest Management Offices; four municipal and six district authorities; village representatives

The Forest Planning and Policy Department of the Under-Secretariat for Forest Resources acts as the Secretariat for the Central Council with the Under-Secretary of the said Under-Secretariat acting as the Chairman of the Council. Meetings of the Central Council are, in principle, held once a year to discuss the long-term plan for watershed management prepared by the Under-Secretariat for Forest Resources, verify the progress of project implementation and submit its opinions to the Under-Secretariat for Forest Resources regarding the necessary changes of the long-term plan.

Meanwhile, the Project Implementation Office handles the administrative work of the Local Council and the Head of the Office acts as the Chairman of the Local Council. This Local Council discusses the annual project implementation plan. As it decides the concrete contents of projects together with the selection of project sites (villages), etc., it is essential for the heads of the four municipalities and eight districts and representatives of the 159 villages in the Study Area to be members of this Local Council.

Note : Four municipalities (Padre Las Casas; Guayabal; Boechio; Constanza)  
Six districts/sections (La Siembra; Monte Bonito; Las Canitas; Guayabal; Boechio; Arroyo Cano; Yaque; Madonado; Palero)

The Project Implementation Office is to be established by the Under-Secretariat for Forest Resources which is responsible for watershed management in the Dominican Republic and will implement projects under the Master Plan in response to instructions given by the Department of Planning of the Forest Planning and Policy Administration of the Under-Secretariat for Forest Resources. This Office is to be located at San Juan de la Maguana from which access is available for nearly 80% of the watershed area of the Sabana Yegua Dam. The organization of the Project Implementation Office is shown in Fig. 7-13.

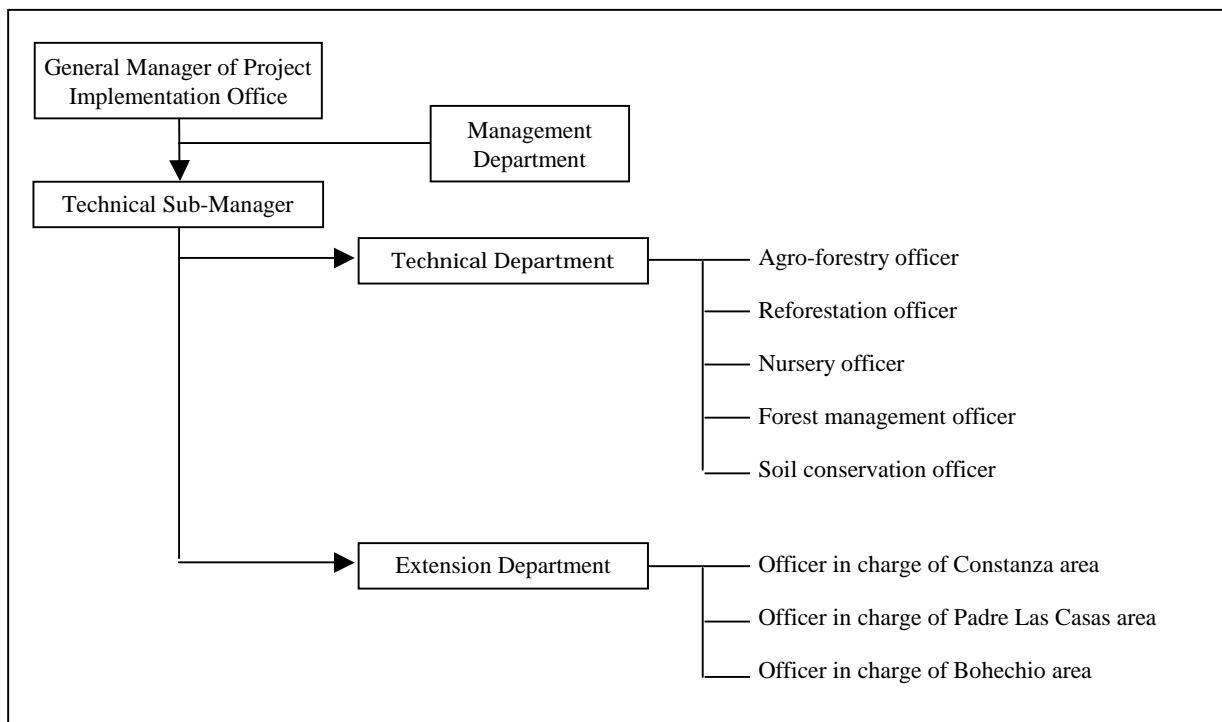


Fig. 7-13 Organization of Project Implementation Office

The General Manager of the Project Implementation Office has overall responsibility for the implementation of the Master Plan while the position of Technical Sub-Manager is introduced under the General Manager to be response for actual project implementation. This Technical Sub-Manager controls the extension officers who can be described as line staff and the technical officers who can be described as staff members.

In the Extension Department, one officer each is assigned to Constanza, Padre Las Casas and Boechio where the community project was implemented under the present Study. As the persons responsible for the assigned areas, these extension officers provide guidance and supervision for NGOs or private consultants to which project implementation has been entrusted by the Project Implementation Office. When the number of target villages

for projects in these areas increases, two assistants will be appointed for each officer to be responsible for specific villages.

Extension officers are expected to organize village workshops, to support daily project-related activities in villages, to organize local residents, to coordinate study visits to advanced areas and to coordinate with forest stations and other related bodies.

In the Technical Department, five technicians are assigned to be responsible for agroforestry, reforestation, nurseries, forest management and soil conservation respectively. Under the command of the Technical Sub-Manager, these officers are responsible for the technical aspects of project implementation in their own specialist field. They also provide advice on solutions for technical problems, etc. encountered by villages in collaboration with extension officers.

Training of the project staff for a smooth implementation of the project will involve staff of the Secretariat of State for Natural Resources and Environment (including extension workers and NGO), is a training within the project to support its progress and will be implemented throughout the project period. The training period will be 20 days per year, which will be implemented 10 days at the beginning of the year and another 10 days in mid year.

### (3) Development of Liaison System

For the implementation of the Master Plan, it is necessary for the government to issue a notice to authorise the project implementation system, which includes the establishment of the Project Implementation Office, to actually implement the Master Plan and examination of the implementation plan by the Councils, etc. It is desirable for this notice to be issued by the President as its contents related to various government offices, including the Secretariat of State for Environment and Natural Resources.

Following such an executive notice, it is also necessary to determine the guidelines for the implementation of the Master Plan. These guidelines must state that the Project Implementation Office is responsible for the implementation of projects, that the Project Implementation Office shall follow the instructions issued by the Forest Planning and Policy Administration of the Under-Secretariat for Forest Resources, that local forest management offices and others must cooperate with the Project Implementation Office and that project implementation shall be entrusted to NGOs and private consultants. In addition to these basic principles for project implementation, the guidelines must set forth other concrete issues, including the selection criteria for NGOs and private

consultants, the procedure to entrust project implementation and the formation of community groups, etc.

Although the implementation plan for the Master Plan is to be formulated by the Department of Planning of the Forest Planning and Policy Administration and the Project Implementation Office, the planning details of each component of this implementation plan are examined and finalised by the Department of Watershed Management and the Department of Reforestation and Management of the Reforestation Management Administration, the Department of Forest Fire Prevention and Control of the Forest Protection Administration and the Department of Extension of the Investigation and Training Administration. The Department of Planning of the Forest Planning and Policy Administration ensures the compatibility of all the plans for the components and formulates the overall implementation plan. It is essential that all types of work involved are conducted based on uniform ideas regarding the planning items and format, etc. Because of such need, the guidelines for the formulation of the Master Plan implementation plan must be examined and prepared in advance by the Under-Secretariat for Forest Resources. It is preferable for these two sets of guidelines to be issued as notices by the Secretary of State as their contents relate to all departments and other sections of the Secretariat of State for Environment and Natural Resources. Notices by the Under-Secretary should be issued regarding further details of these guidelines.

## **7.10.2 Implementation Schedule**

### **(1) Basic Concept of Project Implementation**

- 1) The project period is 15 years in view of the cutting period of fruit trees and other trees. This period is used as the plan period for the long-term watershed management plan which covers the entire Study Area.
- 2) Because the Study Area is as large as some 166,000 ha, a five year watershed management plan is formulated for priority areas, taking the topographical conditions, access and level of participation by local residents, etc. into consideration.
- 3) The six villages where the community project was introduced are deemed to form the core project areas. Four villages around each of these villages are also included in the priority areas. Consequently, projects will be implemented in 31 villages in the initial five year period. Thereafter, the number of target villages will be decided based on the project progress to expand the geographical scope of the projects.

- 4) The priority project to be implemented in the villages will be workshops which will mark the commencement of project implementation. From the viewpoint of watershed management in the Study Area, the most important issues are the construction of nurseries and the extension/promotion of agroforestry. These projects will, therefore, start immediately after the workshops.
- 5) Based on the five year watershed management plan, an annual management plan will be prepared each year to facilitate project implementation.

## (2) Long-Term Watershed Management Plan

For the implementation of the long-term plan, three phases are considered in view of the likely effects of the conservation measures to be applied, the degree of participation by local residents and financial management.

### 1) First Phase (Initial Five Years)

- Project commencement with understanding of the project purposes, etc. by local residents.
- Strengthening of community groups, education for core farmers and implementation of such components as nurseries, agroforestry and reforestation.
- Production of seedlings at nurseries and improved harvest of agricultural crops through improved farmland and practices.
- Extension activities aimed at local residents by local forestry officers and local consultants led by the Project Implementation Office.
- Promotion of self-help efforts and gender roles, etc. by the Project Implementation Office.
- Project finance by the government budget (for the National Reforestation Plan) and external sources.
- Involvement of 31 villages, including the six villages where the community project was implemented.
- Equal employment opportunity for male & female.

### 2) Intermediate Phase (5th to 10th Year)

- Implementation of the planned components by core farmers.
- Possible production of fruits and wood from fast growing species planted for agroforestry purposes. Development of market and small scale forestry business.



- Reduction of forest fires due to the implementation of forest fire control measures and reduction of sediment discharge to the watershed due to the soil conservation project.
- Possible implementation of projects financed by not only external funds but also funds of local residents which are built based on the forest management, agroforestry and livelihood improvement projects.
- 40 new target villages with a high level of urgency (because of the large discrepancy between the present state and the desirable state).

### 3) Final Phase (10th to 15th Year)

- Watershed management led by local residents with the Project Implementation Office playing a supporting role.
- Completion of planting at priority sites, resulting in improvement of the headwater conservation and soil erosion prevention functions in the watershed.
- Project implementation mainly using community funds with external funds being minimized.
- 88 new target villages (remaining villages) which are not included in the first and intermediate phases.

### (3) Five Year Watershed Management Plan

For the initial five years, individual components are to be implemented in 31 villages with the main focus placed on the six villages where the community project was implemented under the Study. The basic ideas for the implementation of each component (project) are explained in Table 7-23.

Table 7-23 Basic Ideas for Implementation of Each Component

Component	Basic Ideas
Forest Management	<ul style="list-style-type: none"> <li>• The creation of village nurseries commences as soon as the workshops designed to strengthen community organizations end (the same applies for the production of seedlings of fruit trees for agroforestry).</li> <li>• For reforestation purposes, the formation of planting groups, the construction of village nurseries and coordination with the National Reforestation Plan are conducted, followed by actual planting.</li> <li>• The management of natural forests begins when planting activities are on track.</li> </ul>
Agroforestry	<ul style="list-style-type: none"> <li>• Through workshops, training and the introduction of fruit trees, improvement of the farming practices is gradually achieved. Silvo-pasture is introduced with the consent of resident landowners with a view to gradual expansion. This will commence in the fourth year.</li> </ul>
Soil Conservation (Erosion Control)	<ul style="list-style-type: none"> <li>• Gully erosion prevention measures at farmland commence in the first year as the model for the neighbouring area. Landslide prevention measures commence in the third year because of the scale. Urgent measures, however, are introduced at those sites requiring quick attention.</li> </ul>
Forest Fire Control	<ul style="list-style-type: none"> <li>• Workshops to form volunteer fire corps are held in the first year, followed by the provision of training and guidance for the volunteers to strengthen the monitoring and fire extinguishing system. Fire-fighting activities are not included in this implementation schedule as the frequency of forest fires varies from one year to another.</li> </ul>
Community Development	<ul style="list-style-type: none"> <li>• For livelihood improvement, measures which are easy to implement are applied first. Social infrastructure development commences once the agroforestry and other projects show smooth progress by community organizations. Accordingly, the commencement of social infrastructure development is in the second year or later.</li> </ul>
Strengthening of Community Organizations	<ul style="list-style-type: none"> <li>• This is one of the most important project components. PRA, various workshops and meetings of leaders are organized with project commencement. Study visits to advanced areas are arranged to reinforce community organizations while monitoring and evaluation are conducted from the viewpoints of reinforcing the said organizations and promoting self-help efforts.</li> </ul>
Extension and Training	<ul style="list-style-type: none"> <li>• Core farmers are identified through the PRA, nursery management, workshops and training. As in the case of the reinforcement of community organizations, target workers for extension must firstly be identified. These farmers are constantly encouraged to have a vision of the desirable direction by means of surveying advanced examples (T &amp; V) and exchanges with neighbouring villages.</li> </ul>
Support Activities	<ul style="list-style-type: none"> <li>• The Project Implementation Office is to be established with the assignment of officers responsible for the technical aspects and extension activities. In the field, extension officers, local forestry officials and NGOs are responsible for extension to and the education of farmers and also for technical support. Moreover, as a project support activity the project staff (including extension workers and NGO staff) will be trained within the project.</li> </ul>

Based on the above ideas, the tentative schedule for the five year watershed management plan in one target village is shown next.

Project Component	Activity	1	2	3	4	5
Forest Management	Management of natural forests				■	■
	Reforestation	■	■	■	■	
	Nursery construction	■				
Agroforestry	Agroforestry/improvement of farming practices	■	■	■	■	■
	Irrigated agriculture on slopes		■	■	■	■
	Sylvo-pasture				■	
Soil Conservation (Erosion Control)	Gully control	■	■	■		
	Landslide control				■	■
Forest Fire Control	Formation of volunteer fire corps	■				
	Improvement of fire-fighting infrastructure/deployment of equipment	■	■	■	■	■
	Improvement of fire-fighting techniques	■	■	■	■	■
Community Development	Improvement of livelihood	■				
	Social infrastructure development		■	■	■	■
Strengthening of Community Organizations	Workshops	■	■			
	Monitoring/evaluation			■		■
	Leader meetings	■	■	■		
	Visits to advanced areas	■	■			
Extension and Training	Fostering of core farmers	■	■	■		
	Various training	■	■	■	■	
Project Support	Establishment of Project Implementation Office	■				
	Extension workers	■	■	■	■	■
	NGOs	■	■	■	■	■

Fig. 7-14 Tentative Schedule for Five Year Watershed Management Plan

#### (4) Annual Watershed Management Plan

The annual watershed management plan is implemented in line with the above-mentioned five year plan and the details of this annual plan are determined based on the main plan and the relevant manuals.

#### **7.10.3 Planned Quantities**

The planned quantities of the project components are for the entire Study Area and these figures should be treated as yardsticks as the Master Plan is implemented mainly through the participation of local residents.

Table 7-24 List of Project-Related Quantities

Project	Components	Quantity	Description
Forest Management	Natural Forest Management	40,000 ha	40,000 ha of the 42,208 ha of natural forests subject to selective cutting is targeted in view of accessibility and forest physiognomy.
	Creation of Artificial Forests	20,000 ha	Under the National Reforestation Plan, the Study Area is supposed to plant an area of more than 1,360 ha in 2001, totalling some 20,000 ha in 15 years. The reforestation of 20,000 ha is planned out of the 323 ha of artificial forests with clear cutting and 7,652 ha of natural forest with selective cutting II and 26,108 ha prohibited cutting II.
	Village Nurseries	153 villages	One nursery in each village (including the production of fruit trees); the number of target villages is 153, i.e. 159 (number of villages in the Study Area) – 6 (number of villages subject to the community project).
	Forest Roads	630 km	New forest roads are planned to serve natural forest management and artificial forest development sites.
	Surveying to Certify Planting	8,000 ha	Use of GPS for new artificial forests outside national parks.
	Introduction of Land Ownership	8,000 ha	Includes ground surveying which is separately conducted from the surveying to certify planting and administrative work for land registration
Agroforestry	Agroforestry	129 villages	As agroforestry is conducted on the farmland of local farmers, the number of villages constitutes the project quantity, excluding 24 villages inside national parks.
	Improvement of Farming Practices	129 villages	The idea explained in agroforestry above applies.
	Irrigated Agriculture on Sloping Land	387 km	As water pipes stretching for an average of 3 km are laid in each village, the total length is 387 km (3 km x 129 villages subject to agroforestry and the improvement of farmland)
	Silvo-Pasture	25 villages	Target villages for silvo-pasture in the land use plan.
Soil Conservation (Erosion Control)	Small-Scale Gully Erosion Control	30 sites	Based on the soil conservation plan
	Landslide Prevention and Control	158 villages	Based on the soil conservation plan
Forest Fire Control	Formation of Voluntary Fire Corps	158 villages	The JICA Study found that only one village has a volunteer fire corps. One corp is to be formed in each village.
	Improvement of Fire Extinguishing Techniques	15 times	An annual pumping skill demonstration meeting is held by the fire companies of three forest stations and volunteer fire corps.
	Deployment of Fire Equipment and Tools	3 forest stations	Deployment of patrol vehicles and radio communication equipment, etc. at three forest stations.
	Equipment/Tools for Local Residents	159 villages	Fire beaters, dust protective masks and goggles (25 each) for each village.

Project	Components	Quantity	Description
Community Development	Livelihood Improvement	159 villages	Each village receives 10 sheep, 10 goats, five pigs, 60 rabbits and flowering plants.
	Social Infrastructure		To be described under irrigated agriculture on sloping land for agroforestry.
Strengthening of Community Organizations	Workshops	153 villages	Twice per village.
	Monitoring/ Evaluation	159 villages	Five times per village, every other year.
	Leader Meetings	32 areas	Twice per village, for three year.
	Study Visits to Advanced Areas	159 villages	Visits to Plan Sierra, Ocoa and other advanced areas; 20 participants per village; two years
Extension and Training	Training	153 villages	On-the-spot guidance on agroforestry in each village.
	Training Texts	153 villages	Distribution of texts on nursery development and the production of organic fertiliser to each village.
	AV Equipment	One set	One set of AV equipment (video deck and projector) required for extension work to each forest station.
	Vehicles	One set	Small truck (1) and motorcycles (2) are deployed in each of the three extension areas.
Project Support	Project Personnel	8	Assignment of eight people to the Project Implementation Office for 15 years.
	Extension Workers	9	Assignment of three workers each to the three forest stations for 10 years.
	NGO (Leader)	3	Assignment of one NGO leader to each forest station for five years.
	NGO (Staff)	6	Assignment of two NGO members to each forest station for five years.
	Training of the staff within the project	One set	Training is conducted for project implementation. Training period will be 20 days per year per staff.

#### 7.10.4 Estimation of Project Cost

##### (1) Preconditions for Estimation

The project cost is estimated based on the project component quantities (Table 7-24) and unit prices which are determined based on the field survey findings, community project results, interview results and relevant reference materials.

- 1) For forest management, estimation is made using the cost of improvement cutting to remove damaged trees in the case of natural forests. The reforestation cost is estimated using the unit cost of reforestation adopted by the National Reforestation Plan.
- 2) In the case of agroforestry, local residents conduct agroforestry on their own farmland and farmland improvement and the cost of only the necessary equipment is estimated.

- 3) For the simple erosion control facilities used for soil conservation, the wages for work and the material cost are estimated together.
- 4) For the project cost relating to forest fire control measures, the cost of the necessary equipment and the cost of the equipment supplied by the JICA are estimated together.
- 5) The cost of the reinforcement of community organizations includes the cost of meals for the participants and the travelling cost of NGO staff, etc.
- 6) In the case of livelihood and social infrastructure improvement, the costs of domestic animals and irrigation facilities are estimated.
- 7) The extension and training cost is estimated based on on-the-spot guidance, training textbooks and AV equipment.
- 8) The project support cost is estimated based on the personnel cost for project staff and NGO staff, etc.
- 9) GPS survey equipment, the fire-fighting equipment/tools and vehicles for extension work are replaced every five years.
- 10) A maintenance / management cost of 10%, a contingency cost of 5 % and inflation rate of 6% are added to the base project cost.
- 11) The US dollar exchange rate has been fluctuating in recent years. For the present estimation, exchange rates of RD\$16.7 to US\$1 and ¥7.0 to RD\$1 at the time of estimation are used.

## (2) Project Cost

The total project cost to implement the Master Plan in 15 years, maintenance / management and contingency costs added, is RD\$770 million at the base cost or RD\$1,270 million, inclusive of inflation rate. Meanwhile, the base cost of the five year plan, maintenance / management and contingency costs added, is RD\$230 million or RD\$270 million, inclusive of inflation rate. The breakdown and foundation of the estimation are shown in Table 7-25 and Table 7-26 respectively.

Table 7-25 Total Project Cost and Five Year Project Cost

( 1,000RD\$ )

Item	Component	Overall Watershed Managment Plan	5 Year Watershed Management Plan
1. Forest Management			
	Management of natural forests	55,120	17,914
	Reforestation	207,600	67,470
	Construction of nurseries	3,672	600
	Forest road	15,750	5,250
	Land survey for reforestation certification	2,460	820
	Establishment of land ownership	61,048	20,222
	① Sub-total	345,650	112,276
2. Agroforestry			
	Agroforestry & farmland improvement	24,381	4,725
	Agriculture in sloping land	23,607	4,575
	Silvipasture	1,250	400
	① Sub-total	49,238	9,700
3. Soil Conservation			
	Control of small gullies	1,380	460
	Control of small landslides	92,565	30,525
	① Sub-total	93,945	30,985
4. Forest Fire Control			
	Formation of fire corps	1,580	300
	Improvement of fire fighting techniques	300	100
	Stationing of fire fighting equipment	27,854	6,620
	Equipment for use by local inhabitants	21,160	2,852
	① Sub-total	50,894	9,872
5. Community development			
	Livelihood Improvement	4,102	800
	Social infrastructure improvement	0	0
	① Sub-total	4,102	800
6. Organizing Local Inhabitants			
	Workshops	970	159
	Monitoring/evaluation	4,756	621
	Leaders meeting	962	180
	Survey of advanced areas	55,536	9,968
	① Sub-total	62,224	10,928
7. Extension & Training			
	Training cost	2,678	438
	Training equipment cost	2,058	336
	Audio-visual equipment	1,926	642
	Vehicles (pick-up trucks)	5,114	1,955
	① Sub-total	11,775	3,370
8. Support Activities			
	Project staff	31,200	10,400
	Extension workers	11,700	5,850
	NGO leaders	3,300	3,300
	NGO staff	3,900	3,900
	Training of staff within the project	4,080	2,080
	① Sub-total	54,180	25,530
Grand Total ①		672,008	203,461
	Maintenance cost	67,201	20,346
Grand Total ② (maintenance cost + contingency cost)		772,809	233,980
Grand Total ③ (maintenance cost + contingency cost + inflation rate)		1,270,579	275,518



Table 7-26 Basis for Project Cost Estimation

Project	Components	Basis
Forest Management	Management of Natural Forests	The cutting cost to remove damaged trees constitutes the management cost of natural forests at RD\$1,378 per ha (according to Plan Sierra).
	Creation of Artificial Forests	RD\$10,380 per ha, inclusive of the ground clearance, seedlings, planting and weeding costs (according to the National Reforestation Plan)
	Village Nurseries	RD\$24,000 per village to create a nursery, inclusive of the barbed wire, cheesecloth and post costs (actual cost under the JICA community project)
	Forest Roads	RD\$25,000 per km (according to the Under-Secretariat for Forest Resources)
	Surveying to Certify Planting	Annual certification cost of RD\$58,400 (530 ha), inclusive of the travelling cost of drivers; RD\$528,000 for GPS processing equipment (including GPS) and the standard system (to be renewed in five years)
	Establishment of Land Ownership	RD\$7,631 per ha (according to the Under-Secretariat for Forest Resources)
Agroforestry	Agroforestry	RD\$60,000 per village for the distribution of fruit tree seedlings and seeds, etc. to commence agroforestry (actual cost under the JICA community project)
	Improvement of Farming Practices	RD\$129,000 per village to produce organic fertiliser to improve farming practices (actual cost under the JICA community project)
	Irrigated Agriculture on Sloping Land	RD\$61,000 per km based on the assumption that piping for 3 km is required in each village; the labour cost is borne by local residents (interview results at a village with such a pipeline)
	Silvo-Pasture	Involves the production of fodder trees and the creation of hedges; RD\$50,000 per village based on the cost of the fruit tree seedlings to be distributed under agroforestry (actual cost under the JICA community project)
Soil Conservation	Small-Scale Gully Control	RD\$46,000 per site to construct log check dams, masonry check dams and diversion channels (actual cost under the JICA community project)
	Small-Scale Landslide Control	RD\$165,000 per site to cover the cost of planting work and wicker works (actual cost under the JICA community project)
Forest Fires	Volunteer Fire Corps	Meetings are held twice in each village to form volunteer fire corps with 100 members; RD\$10,000 per village as lunch is provided for the attendants (RD\$50 per person; actual cost under the JICA forest fire control project)
	Improvement of Fire-Fighting Techniques	RD\$20,000 per annual pumping skill demonstration meeting to transport participants (actual cost under the JICA forest fire control project)
	Deployment of Fire Equipment/Tools	RD\$662,000 per 3 forest station to cover the cost of such fire prevention and monitoring equipment as patrol vehicles and radio communication equipment, etc., pump sets and fire-fighting equipment/tools, including fire hunters, and the cost of their transportation (actual cost under the JICA forest fire control project)
	Equipment/Tools for Local Residents	Total of RD\$92,000 to supply 25 fire beaters, dust protective masks and goggles each for each village
Community Development	Livelihood Improvement	RD\$25,800 per village to provide 10 sheep, 10 goats and five pigs, etc. for each village for livelihood improvement (interview results with a local NGO)
	Improvement of Social Infrastructure	The cost is accounted for under Agroforestry (Improvement of Farming Practices) as the introduction of irrigated agriculture on sloping land is the target for social infrastructure improvement.

Project	Components	Basis
Strengthening of Community Organizations	Workshops	RD\$6,340 per village to cover the cost of meals for the participating local residents and the travelling cost of NGO staff (actual cost under the JICA community project)
	Monitoring/Evaluation	RD\$6,680 per village to cover the cost of meals for the participants of the monitoring/evaluation workshops and the travelling cost of NGO staff (actual cost under the JICA community project)
	Leader Meetings	RD\$10,020 per area to cover the travelling and meal costs of NGO staff and community leaders attending the meetings (actual cost under the JICA community project)
	Visits to Advanced Areas	RD\$17,800 per village to cover the cost of visits to Plan Sierra and others (actual cost under the JICA community project)
Extension and Training	Training	RD\$17,500 per village to cover the on-the-spot guidance cost for agroforestry (nursery, cuttings and organic fertiliser, etc.) (actual cost under the JICA community project)
	Training Textbooks	RD\$13,450 per village to cover the training textbook cost for agroforestry (on nurseries and organic fertiliser, etc.) (actual cost under the JICA community project)
	AV Equipment	RD\$214,000 per forest station to procure video decks and projectors, etc. for extension and training activities in villages (actual cost under the JICA community project)
	Vehicles	RD\$1,053,000 to procure three pick-up trucks and six motorcycles and RD\$526,500 to cover the maintenance cost (estimated to be 50% of the vehicle cost), totalling RD\$1,579,500 and a fuel cost of RD\$17,500
Project Support	Project Personnel	RD\$20,000/month x 13 months x 15 years = RD\$3,900,000 (interview results at the Under-Secretariat for Forest Resources)
	Extension Workers	RD\$10,000/month x 13 months x 10 years = RD\$1,300,000 (interview results at the Under-Secretariat for Forest Resources)
	NGO (Leaders)	RD\$2,200/day x 100 days x 5 years = RD\$1,100,000 (actual cost under the JICA community project)
	NGO (Staff)	RD\$2,200/day x 200 days x 5 years = RD\$2,200,000 (actual cost under the JICA community project)
	Training of staff within the project	RD\$800/day x 20 days = RD\$16,000 (interview results at the Under-Secretariat for Forest Resources)

### 7.10.5 Establishment of Monitoring and Evaluation System for Plan Implementation

#### (1) Basic Ideas

The monitoring and evaluation system provides effective management techniques to regularly identify the achievements and problems. It is possible to make a major contribution to the operation and management of a forest management plan in progress or in the future through the application of these techniques.

Monitoring and evaluation indicators must be determined in line with the project targets and expected results and must be objectively verifiable. The data and information required to verify the indicators must also be obtainable.

A participatory monitoring and evaluation process is desirable as it can greatly contribute to the reinforcement of community organizations. The establishment of a monitoring and evaluation system will be conducted in unison with the planned organization of local residents described in 7.8.

## (2) Objectives

The monitoring and evaluation system is to be established to provide information and reference data which will make decision-making on the empowerment of project implementers and community organizations and also to firmly establish techniques for comprehensive project monitoring and evaluation.

## (3) Contents

The establishment of the monitoring and evaluation system will include the following activities.

- Reinforcement of community organizations through the provision of training for community leaders and residents
- Application of participatory monitoring and evaluation techniques, such as logical framework and project cycle management
- Determination of monitoring and evaluation indicators and preparation of a monitoring and evaluation plan
- Implementation of monitoring and evaluation by local residents led by community leaders
- Implementation of monitoring and evaluation led by the Project Implementation Office for the purpose of project management
- Certification of planting

The Under-Secretariat for Forest Resources will supervise the above activities and will certify planting throughout the project period. The certification of planting will be conducted for the first five months after planting. Project evaluation every two years is desirable and this evaluation work can be entrusted by the Under-Secretariat for Forest Resources to an outsider. Meanwhile, the Project Implementation Office must formulate

and implement a monitoring and evaluation plan. Community leaders will conduct participatory monitoring and evaluation with the assistance of the Project Implementation Office (see 7.8 for further details).

While the monitoring items will be established in line with the project targets and expected results, those indicators shown in the PDM for evaluation (which is attached to the separate report on the community project) may prove useful for the establishment of indicators.

For evaluation of the prospect of project implementation, the design quantities and estimated project cost described in 7.10 are adopted as the physical and financial targets of the project respectively and are classified into short-term, medium-term and long-term targets as shown in Tables 7-27 and 7-28. As these targets are tentatively conceived at the planning stage, it is more important to discuss why the targets are not achieved in the end, where the problems lie and how to solve the problems for the implementation of the Master Plan, for which resident participation is the main pillar, than the simple achievement of targets so that the next round of project implementation can be much improved.

Table 7-27 Physical Target of each Component

(1,000RD\$)

Plan Contents	Unit	Short Term	Mid Term	Long Term	Total
1. Forest Management					
Natural forest management	ha	13,000	13,000	14,000	40,000
Reforestation	ha	6,500	6,500	7,000	20,000
Nursery establishment	village	25	40	88	153
Forest road	km	210	210	210	630
Land survey for reforestation certification	ha	2,650	2,650	2,700	8,000
Land ownership establishment	ha	2,650	2,650	2,700	8,000
Sub-title					
2. Agroforestry					
Agroforestry & agriculture improvement	village	25	40	64	129
Sloping agriculture land	km	75	120	192	387
Silvipasture	village	8	8	9	25
Sub-title					
3. Soil Conservation					
Small scale gully	gully	10	10	10	30
Small scale landslide	landslide	185	185	191	561
Sub-title					
4. Forest Fire Control					
Fire company formation	village	30	40	88	158
Improvement of fire fighting techniques	time	5	5	5	15
Stationing of fire fighting equipment	set	1	1	1	3
Equipment for use by local residents	village	31	40	88	159
Sub-title					
5. Community Development					
Livelihood improvement	village	31	40	88	159
Social infrastructure development					
Sub-title					
6. Organizing Local Residents					
Workshop	village	25	40	88	153
Monitoring/evaluation	village	31	71	159	261
Leaders meeting	area	6	8	18	32
Survey of advanced areas	village	31	40	88	159
Sub-title					
7. Training & Extension for Local Residents					
Training cost	village	25	40	88	153
Training equipment	village	25	40	88	153
Audio-visual equipment	set	3	3	3	9
Vehicle (pick-up trucks)	set	3	3	3	9
Sub-title					
8. Support Activities					
Project staff	person	40	40	40	120
Extension worker	person	45	45	45	135
NGO Leader	person	15	0	0	15
NGO Staff	person	30	0	0	30
Training of staff within the project	person	130	85	40	225
Sub-title					
Grand-Total					

Table 7-28 Funding Target of each Component

(1,000RD\$)

Item	Short Term	Mid Term	Long Term	Total
<b>1. Forest Management</b>				
Natural forest management	17,914	17,914	19,292	55,120
Reforestation	67,470	67,470	72,660	207,600
Nursery establishment	600	960	2,112	3,672
Forest road	5,250	5,250	5,250	15,750
Land survey for reforestation certification	820	820	820	2,460
Land ownership right	20,222	20,222	20,604	61,048
① Sub-total	112,276	112,636	120,738	345,650
<b>2. Agroforestry</b>				
Agroforestry & farmland improvement	4,725	7,560	12,096	24,381
Sloping land agriculture	4,575	7,320	11,712	23,607
Silvipasture	400	400	450	1,250
① Sub-total	9,700	15,280	24,258	49,238
<b>3. Soil Conservation</b>				
Small gully control	460	460	460	1,380
Small landslide control	30,525	30,525	31,515	92,565
① Sub-total	30,985	30,985	31,975	93,945
<b>4. Forest Fire Control</b>				
Formation of fire corps	300	400	880	1,580
Improvement of fire fighting techniques	100	100	100	300
Stationing of fire fighting equipment	6,620	10,617	10,617	27,854
Equipment for Use by local residents	2,852	6,532	11,776	21,160
① Sub-total	9,872	17,649	23,373	50,894
<b>5. Community Development</b>				
Livelihood improvement	800	1,032	2,270	4,102
Social infrastructure improvement	0	0	0	0
① Sub-total	800	1,032	2,270	4,102
<b>6. Organizing Local Residents</b>				
Workshop	159	254	558	970
Monitoring/evaluation	621	1,216	2,919	4,756
Leaders meeting	180	240	541	962
Survey of advanced areas	9,968	14,240	31,328	55,536
① Sub-total	10,928	15,950	35,346	62,224
<b>7. Extension &amp; Training</b>				
Training cost	438	700	1,540	2,678
Training equipment cost	336	538	1,184	2,058
Audio-visual equipment	642	642	642	1,926
Vehicle (pick-up trucks)	1,955	1,580	1,580	5,114
① Sub-total	3,370	3,460	4,945	11,775
<b>8. Support Activities</b>				
Project staff	10,400	10,400	10,400	31,200
Extension workers	5,850	5,850	0	11,700
NGO leaders	3,300	0	0	3,300
NGO staff	3,900	0	0	3,900
Training of staff within the project	2,080	1,360	640	4,080
① Sub-total	25,530	17,610	11,040	54,180
<b>Grand-Total ①</b>	<b>203,461</b>	<b>214,602</b>	<b>253,945</b>	<b>672,008</b>
Maintenance cost (Total cost ① x 10%)	20,346	21,460	25,395	67,201
<b>Grand-Total ② (maintenance cost + contingency cost)</b>	<b>233,980</b>	<b>246,792</b>	<b>292,037</b>	<b>772,809</b>
<b>Grand-Total ③ (maintenance cost + contingency cost + inflation rate)</b>	<b>275,518</b>	<b>386,304</b>	<b>608,757</b>	<b>1,270,579</b>

## **CHAPTER 8 PROJECT EVALUATION**

## CHAPTER 8 PROJECT EVALUATION

### 8.1 Basic Framework of Project Evaluation

Evaluation of the Master Plan is carried out through; 1) an economic evaluation based on the internal rate of return, which takes into account the proposed land use plan assessing both public and agricultural benefits, 2) a financial evaluation analyzing the relationship between farm economy and soil erosion control, and 3) a planned assessment involving technical, social, organizational and management aspects.

The evaluation is carried out on the basis of the following basic framework.

- (1) The economic effects of the watershed conservation can be divided into two types: 1) external effects which are related to water resource conservation, soil erosion prevention, carbon dioxide absorption etc., 2) internal effects which are related to farm and forest production. In particular the latter effects are of public interest, and the beneficiaries include not only those in the target area but also an unspecified number of people nationwide.
- (2) The Master Plan suggests that the change from current land use to the desirable one is required in order to conserve the watershed and is the most important issue. It then proposes several measures on the basis of the land use plan. Evaluation of the Master Plan is examined based on effects occurring from the change of land use.
- (3) In addition, in a place such as the Study Area, where forest rehabilitation is highly required, conservation activities are more necessary than production activities; therefore, the importance of public interests should be focused on rather than investment efficiency.
- (4) The farming activities of farmers living in the watershed are closely linked with watershed conservation. Therefore, the activities of production and that of conservation should be compatible. Even temporally, to promote conservation activities would mean restraining production activities. Therefore, the sustainability of farm budgets should be examined.



## 8.2 Economic Evaluation

### 8.2.1 Classification of Benefit

(1) Classification of Land Use and Benefit

As discussed in detail in the land use plan of chapter 7, it became clear that the change to the desirable land use was necessary for watershed conservation. Effects of the Master Plan occurring from the change of land use before and after can be estimated generally. Table 8-1 shows that the effects of the Master Plan mainly consist of conservation effects through forest preservation and rehabilitation, and production stabilization of agriculture and forest.

Table 8-1 Change of Land Use and Benefit

Class	Content of Measure and Expected Benefit
1) Forest-1	To prevent soil erosion and promote forest production through reforestation considering the conservation effect
2) Forest-2	To prevent decrease of forest conservation effect through appropriate management
3) Forest-3	To keep as a preservation zone
3) Grazing-1	To keep the present situation
4) Grazing-2	To prevent soil erosion through sylvo-pastoral measures
5) Agriculture-1	To stabilize agricultural production through improvement of agricultural practices
6) Agriculture-2	To prevent soil erosion and to stabilize agricultural production through agroforestry practices (live barrier and fruit trees)

Note : The detailed measures are referred to Chapter 7.

(2) Benefits

Benefits from the Master Plan are divided into two types: 1) production benefits as a result of production activity; 2) public benefits through the preservation of forest functions. Each kind of benefit is characterized as shown in Table 8-2. Local people as well as the whole nation receive the benefits of the Master Plan.

As shown in the land use plan, the forest area is 121,614ha, of which 2,575ha (forestry-1) is equivalent to 2.0% of all and stands for forest production. As for the other forestry classes, production benefits are not calculated because the purpose is not for production but for conservation. The production benefit of forest is calculated for "forestry-1" class even though it is only a small part. In addition, the benefit of agroforestry with soil conservation measures is examined as a model case.

As for public benefits, the benefit of soil conservation is examined in this report.

Table 8-2 Kinds of Benefits

	Contents of Benefit	Beneficiaries
Production Benefit	<p>Production benefits for forest and agriculture are expected. These benefits are estimated based on the market price of timber, beans and vegetable etc. And the benefits are evaluated based on the production (value) following the land use changes.</p> <p>In order to quantify the benefits, the present land use and the land use plan in future are premises. These benefits are influenced greatly by whether public land use can or not be implemented in the target area where vegetable cultivation on steep slopes and shifting cultivation are widely executed.</p>	Directly landowners and farmers
Public Benefit	<p>This effect can be calculated based on the effect occurring from maintaining and rehabilitating public function of the forest. Although it is possible to estimate the production effect in monetary value based on the market price, the public effect is difficult to estimate in monetary value because the market price does not exist.</p> <p>There are the following public functions.</p> <ul style="list-style-type: none"> <li>A function of water resource conservation</li> <li>A function of soil erosion control</li> <li>A function of land slide prevention</li> <li>A function of wild birds and beasts conservation</li> <li>A function of air quality conservation</li> <li>A function of recreational amenity</li> </ul> <p>Although it is difficult to compare the value of the production effects and the public effects on the same standard, it is becoming widely apparent that the public effects are greater than the production effects. Therefore even if they are qualitative expressions of the effect of the Master Plan, the public effects should be considered much more important than the production effects.</p>	Local people and nationwide

Note : Refer to the document of the Forestry Agency (Japan).

## 8.2.2 Cost-Benefit Analysis

Among the public effects and the production effects, tangible benefits are examined based on the land use plan.

### (1) Benefit Calculation

#### 1) Public effect (Soil erosion control)

The benefit of soil erosion control is examined. But the data observed at Plan Sierra<sup>7</sup> are applied to estimate soil erosion before and after the plan because there are no data regarding soil erosion in the Study Area.

<sup>7</sup> These data were prepared by the Plan Sierra project office in July 2001.

The results are shown in Table 8-3, which indicate that about five million tons of soil was prevented from erosion outflow with the implementation of the Master Plan. This value represents 55% of the outflow per year before the plan. Among the land use classes, the prevention of outflow is the biggest in pastureland and occupies 76 % of the total. This is related to the introduction of agroforestry with soil conservation measures including the change to forest. Subsequently, the prevention effect in the forest is big; good forest maintenance through appropriate management after the plan, and prevention of soil outflow being the main factors.

Table 8-3 Calculations of Benefits

Land Use	Before			After			Difference= -	
	Area ha	Soil Loss 1,000t/ha/y	Prod.Benefit 1,000RD\$/y	Area ha	Soil Loss 1,000t/y	Prod.Benefit 1,000RD\$/y	Soil Loss 1,000t/y	Prod.Benefit 1,000RD\$/y
1. Forest	87,531	4,377	0	121,614	3,105	6,438	<b>-1,272</b>	<b>6,438</b>
2. Bush land	6,301	435	0	0	0	0	<b>-435</b>	<b>0</b>
3. Intensive grazing	2,580	172	6,192	2,448	77	6,934	<b>-96</b>	<b>742</b>
4. Pasture	51,724	4,034	37,759	0	0	0	<b>-4,034</b>	<b>-37,759</b>
5. Agriculture	10,355	487	23,133	34,429	1,033	96,005	<b>546</b>	<b>72,872</b>
<b>Total</b>	<b>158,491</b>	<b>9,505</b>	<b>67,084</b>	<b>158,491</b>	<b>4,215</b>	<b>109,377</b>	<b>-5,291</b>	<b>42,293</b>

Note : The details are cf. ANNEX.

Note : The soil loss and benefits mentioned above are at the stable year of land use.

## 2) Production Benefits

The production effects are based on the land use plan, and calculated from the incremental benefits before and after the plan. The "forest-1" among the land use classes in the plan is targeted to be a production forest, which is used to calculate the production benefits. In addition, the benefit of intensive grazing land is calculated on the basis of the balance of milk production as related to the feeding potential in each land use class. The benefit of the present pasture land is calculated in consideration with shifting cultivation.

The results are shown in Table 8-3, which indicate that the benefit after the plan becomes 1.6 times bigger than that before the plan. This is based on the benefit increase through the change from pasture land to agriculture land with agroforestry.

## (2) Results of Cost-Benefit Analysis

The following conditions or assumptions were applied to the analysis.

- 1) Project life under analysis is 50 years after commencement of Master Plan.
- 2) Most of the O&M costs occurring in the target year should be also expended every additional year through the project life, in order to keep the same conservation level as in the target year.
- 3) Erosion control benefits commences to occur in the second year of the Master Plan implementation, in a way proportional towards the target year, and then is constant from the target year to the end of the project life.
- 4) All prices are expressed in 2001 constant prices with an exchange rate of 2001(RD\$16.7/US\$).
- 5) Transfer payments such as taxes are excluded from economic cost.
- 6) The estimated financial costs are re-calculated as economic costs by multiplying them with the standard conversion factor (SCF) of 0.87.
- 7) The financial unskilled-labor costs are re-calculated as economic costs by multiplying them with the labor conservation factor (LCF) of 0.44.
- 8) Evaluation of erosion control benefits in monetary terms is based on the preventive expenditure method.

The economic internal rate of return (EIRR) is calculated on the basis of cost and benefit flow as shown in Appendix. The internal rate of return is estimated at 7.3%. To assess socioeconomic feasibility of the Master Plan, this EIRR figure has to be compared with “opportunity cost of capital”. Referring to the rate such as 12% of World Bank, it can be justified that the Master Plan implementation is economically acceptable, taking account of the following factors.

- 1) Intangible benefits of the plan such as educational and ecological values as well as non-use value were not fully counted in the cost-benefit analysis.
- 2) Appearance of early benefits cannot be expected in the Study Area where the land is sloping and a long period is required to recovery adequate vegetation because it is necessary for weight to be fully established.

### (3) Sensitivity Analysis

A sensitivity analysis is carried out to evaluate the soundness of the Master Plan implementation against possible adverse changes in the future in the following cases:

- 1) In case that agroforestry measures are adapted by 80% of target farmers.
- 2) In case that agroforestry measures are adapted by 60% of target farmers.
- 3) In case that agroforestry measures are adapted by 40% of target farmers.

The results are summarized below.

Table 8-4 Sensitivity Analysis

Case	Original	1)	2)	3)
EIRR(%)	7.3	6.1	5.0	4.0

To bring EIRR up to 12%, it is necessary that additional benefits increase the present public benefits 1.6 times, or that production benefits increase 6.5 times more than the present level.

### 8.2.3 Justification of Land Use Plan

As examined above, in the project soil erosion shows a decrease of 5.5 million tons soil outflow per year. Additionally, the production benefit after the plan shows an increase of 1.6 times than before the plan. These effects are brought mainly by returning pasture land to agriculture land with agroforestry and forest. Therefore, it may be said that the relevance of land use plan in the Master Plan is high because it considers ongoing changes to desirable land use from both the standpoints of soil erosion prevention and of production.

### 8.3 Financial Evaluation

Financial evaluation is carried out through the farm budget analysis. Farm budget analysis with soil conservation measures are examined and the sustainability of farm management is discussed here.

#### 8.3.1 Farm Budget Analyses and Soil Erosion Control

The farmers, who would participate in agroforestry activities under sustainable land use, are a major beneficiary group of the Master Plan because their incomes are expected to increase in

the mid and long term. With such income improvement, there would be a strong incentive for them to participate in agroforestry.

The farm budget analysis and the estimation of soil erosion are examined referring to the study reports of World Bank in Dominican Republic because there was no data and information regarding soil erosion and crop yield for the Study Area.

#### (1) Basic Assumption

The farm budget analysis including soil erosion, is made under three different cases: without project, with project-1, with project-2. A decrease ratio of crop yield and an outflow ratio of the soil refer to aforesaid document of the World Bank, and it is assumed that these figures increase and decrease in a proportional way.

Without : Habichuela 0.5ha, Guandul 0.5ha, total 1.0ha

With 1 : Habichuela 0.45ha, Guandul 0.45ha, soil conservation facility 0.1ha, total 1.0ha

With 2 : Habichuela 0.4ha, Guandul 0.4ha, fruit tree (avocado) 0.1ha, soil conservation facility 0.1ha, total 1.0ha

#### (2) Results

The results are shown in Table 8-5. The table shows the yearly average farm income/expenditure and the accumulation of soil outflow, which are calculated for 4, 10 and 15 year's periods. For the 4 years period, the yearly balance of both with project-1 and with project-2 is negative. Similarly, for the 10 years period, the balance with project-2 shows an increase of 8 %. Furthermore, the balance of both types shows an increase of 24% and 44%, respectively during the 15 years period. On the other hand, as for the accumulation of soil loss, it is possible to control about 20% and 15 %, respectively during the average 15 years period.

In this way, the farm budget becomes negative in the short term but positive in the middle/long term with soil conservation measures imposed on farmers. It is necessary to raise the incentives of a farmer through the irrigation, production and application of organic fertilizers, introduction of high return fruit trees along with the reduction of cost. As the prevention effect of soil erosion seems to be highly expected, the expansion of the sustainable land use is necessary considering the assistance in initial cost and then the reduction of the cost for farmer's payment.

Table 8-5 Annual Income and Expenditure and Soil Outflow

(Unit:RD\$ / ha / year)

Items	1st 4 years			1st 10 years			1st 15 years		
	Without	With-1	With-2	Without	With-1	With-2	Without	With-1	With-2
Income	6,080	5,781	5,939	5,419	5,645	6,521	4,784	5,531	6,641
Expenditure	2,550	3,138	3,412	2,550	2,841	3,427	2,550	2,794	3,431
Balance	3,530	2,646	2,527	2,869	2,804	3,094	2,234	2,767	3,210
Difference	0	-884	-1,003	0	-65	225	0	533	976
Rate	-	0.75	0.72	-	0.98	1.08	-	1.24	1.44
Soil outflow	237	50	35	521	110	77	758	160	112

Note ; Included the initial cost of soil conservation facilities(3,000RD\$/ha) and maintenance cost(300RD\$/ha/year).  
 ; Difference=the balance of with project – the balance of without project  
 ; Rate= the balance of with project ÷ the balance of without project  
 ; Accumulation soil outflow in each year(t/ha)

### (3) Calculation of Internal Rate of Return

Internal rates of return with soil conservation measures are shown in the following table. These rates of return are calculated for 15 and 20 years periods and are based on the financial prices. In this way, the rate of return exceeds 10% because the balance without the project falls remarkably with the increasing accumulation of soil outflow. The rate of return is low in short term and time is needed for benefits to appear. This rate of return does not include soil outflow prevention effects. The social rate of return seems to be higher than the numerical values shown below if these effects could be calculated as environmental benefits. However, a farmer is highly interested in the early appearance of benefits.

Table 8-6 Calculation of Internal Rate of Return

	With-project 1	With-project 2
IRR (15 years)	10.2%	14.1%
IRR (20 years)	13.9%	16.9%

### 8.3.2 Justification of Farm Management

The result of farm budget analysis suggests that farmers may hesitate to get involved in conservation activities due to a short-term demerit. World Bank reports in the above-mentioned study that more than half of the local farmers continue the soil conservation activities even 5 years after the project ends. The measures to raise incentives of a farmer such as irrigation and early maturing fruit tree can be coped with depending on areas. For example, it is reported that the yield of Grandul after irrigation doubled in San Jun area, which is located in the Study Area. As there is economically sound farm budget in the middle

and long term, it is necessary for farmers to take appropriate measures at the beginning. Considering the above-mentioned results, the Master Plan planned the introduction of irrigation and fruit tree planting in order to stabilize farm budgets in the early stage when a farmer practices soil conservation. Thus, it is judged that the Master Plan is sound from the viewpoint of farm budgets.

#### **8.4 Assessment on Technical Aspect**

Technical examination is described and summarized in the previous Chapter 6 and 7. This section assesses the Master Plan technically based on the demonstration projects.

First, it is verified whether villagers independently can carry out the demonstration projects based on existing technology, which is not new.

Secondly, a long-term perspective is necessary after establishment of local agricultural system for the effects to come out like in agroforestry. It is also necessary for the adopted technology to take into account different steps of a stage. This point is fully taken into account in the Master Plan. The measures both of the live barrier and the non-live barrier were proven to be technically acceptable by villagers as a simplified soil erosion facility. But according to the opinion of a farmer, the measures of engineering works (non-live barrier) may bring obstacles to daily agricultural activities. It may be said that there are a few technical problems over the other demonstration projects.

The Master Plan considered in this way, is technically sound and is easy to be accepted by villagers.

#### **8.5 Assessment on Social Aspects**

First, in the assessment on social aspects, social problems of a village provided through the implementation of the demonstration projects are pointed out. Peculiar Problems are as follows.

- (1) Distrust in administration authorities
- (2) Frictions between people in the setting of the project implementation place
- (3) The project implementation by man's leadership
- (4) Decrease of project participants



Although these problems overlap with lessons learned from the demonstration projects described in Chapter 6, they can be dealt with as follows.

Distrust in administration authorities relates to the case of agriculture practices in a Protected Area (national park in the Study Area) and felling right after planting. As for the former, the team proposes to exclude the measures for agriculture practices in the national park from the Master Plan and follow the plan of the national park for efficiency. As for the latter, felling rights can be provided through application to the forest management offices and which examines whether or not the target area is outside a Protected Area. In such a way, the problem becomes simpler, and enough explanations can be given to people before the project starts. Consideration is necessary, about (2) setting up the project implementation location, for the project executor to grasp the distribution of houses in a village, the location of the project sites in a specific district, or the necessity to implement the projects at more than one location. A problem of men's leadership associated with (3) the project implementation occurred in one village among the 6 villages, which carried out the demonstration projects. Local characteristics such as scale of the village, geographical and social conditions should be considered from the initial stage because the village, where the problem occurred, was comparatively bigger than the other villages. About (4) decrease of project participants, few reasons are discussed in the previous Chapter 6. In particular what should be emphasized here is reason why most villagers canceled participation was that the projects were mainly based on the "self-help effort" principle. And these villagers expected to find some type of employment with the project implementation at the beginning of the study. However, after the halfway point of the study, it was noted that the participation attitude of villagers became positive. Time is needed to solve this kind of problem, and gives clues on how to organize people.

The problem mentioned above is considered to be common in each village where the Master Plan is implemented based on a participatory approach. The problem described above was explained by people at the evaluation workshop of the demonstration projects. And people personally suggested a solution to the problem. Therefore, it is necessary for the project executor to support solutions proposed by the people in a workshop. The Master Plan proposes using various tools of PRA at the project's start to try to understand village conditions and real needs. Through early PRA workshops, it is possible to understand and bring countermeasures to potential problems. In addition, the Master Plan suggests solving problems of project management in a workshop and an intermediate evaluation by people during the implementation. Judging from this, there may be some social problems raised, but the soundness of the projects on social aspects can be raised through adequate workshop management.

Second, the problem related to land tenure is pointed out. This may be the biggest constraint on achieving watershed conservation. How much area is not clear, but big landowners seem to own considerable land area. Cooperation was not provided by several landowners when constructing the soil conservation facilities. Although these people should be included in the measures of watershed conservation, the solution is not clear as to how to concretely cope with them, requiring the national level support such as National Reforestation Program etc. Taking into account the above, the Master Plan proposes that the conservation activities initiated by people start with the village and the surrounding area. To do this, cooperation of landowners is necessary, as there is little common land in villages. This problem may heavily influence the Master Plan implementation. Therefore, administrative support is required to mitigate obstacles.

## **8.6 Assessment on Institutional Aspect**

The Master Plan positions organization of people as a priority item to carry out the watershed conservation through a participatory approach. Therefore, in organizing people, the Master Plan proposes two approaches: (1) capacity building for local people along with; (2) capacity building for leaders. This approach seems to be considerably effective for the Study Area where the demonstration projects were executed and where the existing farmers organizations were not active. It is easily guessed that this situation is common in other villages. In this way, the Master Plan, which focuses on the training of leaders at the initial stage, can be sound. In addition, people organization is to be promoted through village nursery management carried out in cooperation, reforestation activities based on mutual cooperation, goat breeding also carried out in cooperation etc. Two of the above-mentioned organizational activities obtained good results in the demonstration projects, therefore it can be said that the Master Plan takes organizational activities in high consideration.

On the other hand, through the demonstration projects, some lessons of organization are obtained. At first there are some political considerations to be taken into account in each village. Hence for the project executor, the initial approach to a village is very important in order not to create exclusivity in the organization of people. Next, "mind of self-help effort" is necessary for people organization to be sustainable. The person in charge of a project needs to offer ongoing support to local people groups' action and to lead them to fruitful experiences. The Master Plan described that it is important because fruitful experiences from their efforts lead to further activities. Furthermore, people needs are different and require a different management form, such as that for an owner farmer or a day laborer. In such cases, the person in charge of a project needs to change the weight of the components according to local conditions, and needs to pay attention to attract the interest of the people.

As mentioned above, although there are some constraints in organizational activities based on self-help effort, these activities can proceed smoothly when taking into account the considerations mentioned above. The Master Plan regards a workshop as a very important tool to solve these problems with local people, and recommends that the persons in charge of projects include a talented person as a facilitator. Taking into account the above considerations when the Master Plan is being implemented, the projects can become highly sound organizationally.

## **8.7 Assessment on Management Aspect**

In this study, the demonstration projects were carried out in advance of formulating the Master Plan. And then the lessons learned were duly reflected in the Master Plan. In the Master Plan, the villages, which carried out the demonstration projects, are positioned as core villages to extend the project to neighboring villages. The study team considers that these 6 villages have already reached a certain level and seem to be able to develop the projects as a nucleus. In addition, the study team suggests that the project management office cooperate with NGOs and consultants, having good knowledge of local conditions for an easy implementation of the projects.

In addition, as needs are different from one village to another, the progress of the demonstration projects would also be different during the implementation of “the 5 Year Watershed Management Plan”. Therefore, it is suggested that this plan be revised yearly through a “Yearly Watershed Management Plan” to be formulated annually based on the 5 Year Master Plan. In other words, the Master Plan suggests that the plan be evaluated and re-planned according to the progress and village conditions appropriately. In this way the Master Plan suggests the establishment of a new project office that will cooperate with a related organization for an early implementation of the plan, the problem of budget of Dominica government being avoided. It is necessary to take those budgeting measures immediately in the future.

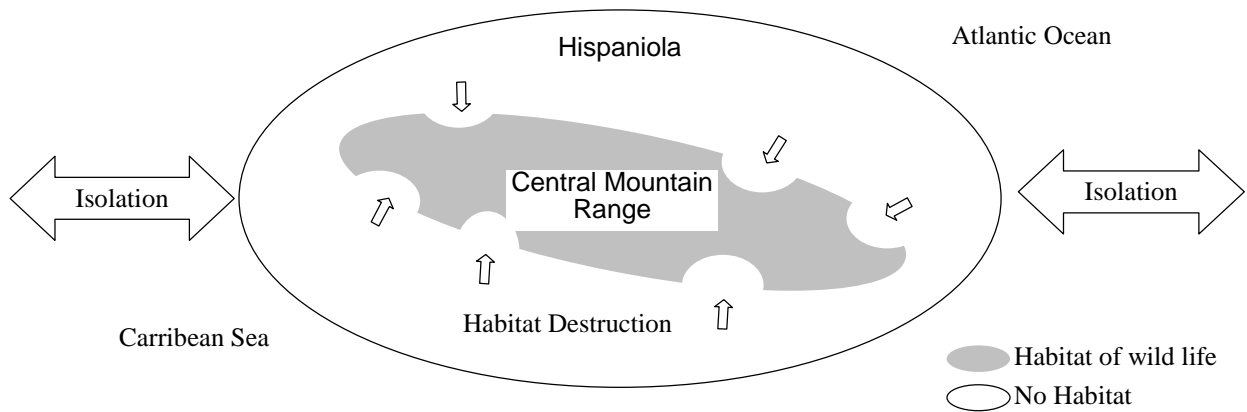
## **CHAPTER 9 ENVIRONMENTAL CONSIDERATION**

## CHAPTER 9 ENVIRONMENTAL CONSIDERATION

### 9.1 Environmental Characteristics

The Study Area is situated almost at the centre of Hispaniola Island and to the south of Mt. Duarte (El. 3,175 m), the highest mountain on the Caribbean Islands. Its topography shows great undulation with an elevation range of approximately 400 m to more than 3,000 m, producing a greatly varying micro-climate from one area to another. The geographical as well as topographical conditions of Hispaniola Island where the geology shows a complicated process of the formation and distribution of soil units and which was isolated from the continent in ancient times have produced a biodiversity of as well as unique fauna and flora with a high proportion of indigenous species. This uniqueness of the fauna and flora is particularly evident in the case of mammals which represent the present situation of fauna on the island. To be more precise, there are more species which are now extinct than surviving species and naturally bred species are hardly observed in areas other than those near the Central Mountain Range (Central Cordillera). The fact is that the once rich fauna have declined due to the destruction of habitat and have been driven to survive in areas where human impacts are relatively small. This argument is also backed by the distribution of vegetation in the Study Area where shifting cultivation sites and grazing land spread over a huge expanse of land, leaving forests in areas near the Central Mountain Range. As the Study Area has steep topography, soil development is not naturally easy. In addition, shifting cultivation with a short cycle, excessive grazing and burning result in the soil quickly losing its fertility, forcing local residents to abandon farming land and to move to new sites. The pressure of human activities, typified by migratory farming, has been increasing, almost reaching the Central Mountain Range.

The northwestern part of the Study Area is included in the Jose del Carmen Ramírez National Park which was established to ensure the permanent preservation of local fauna and flora in order to maintain the genetic properties of wildlife on Hispaniola Island, which are unique in the neo-tropical Caribbean region, and the process of special evolution.



## 9.2 Scope and Scale of Impacts

Following the revision of the law in 2001, it is now necessary to conduct an environmental impacts assessment (EIA) for projects which fall under certain conditions. Although the present Master Plan is not required to conduct an EIA under these conditions, it is believed necessary to clarify the scope and scale of the possible environmental impacts of the projects to be implemented under the Master Plan given the huge size of the target area of 165,000 ha. For this reason, scoping was conducted by comparing the environmental elements to be affected by the components of the Master Plan after identifying the environmental characteristics of the Study Area.

The planned projects under the Master Plan and the results of this scoping are shown in Tables 9-1 through 9-3.

Table 9-1 Description of Components of Master Plan

Component	Description
Land Use Plan	Land of which the use as forest is desirable and land which can be used as farmland or grazing land is ranked in terms of its potential productivity to identify its desirable use from the viewpoint of watershed management.
Forest Management Plan	Forest is restored at sites of which the use as forest is desirable while preserving existing forests. Forests are classified into three types, i.e. protected forests, conservation forests and production forests, and forest management corresponding to the purpose of each type of forest and target forest type is conducted. The introduction of exotic species is minimal in view of the flora on Hispaniola Island where many species are indigenous.
Forest Fire Control Plan	Extension and education activities regarding forest fire prevention are conducted through the formation of volunteer fire corps, strengthening of the educational programme, PR and guidance on shifting cultivation for the purpose of protecting forests from fire. At the same time, the foundations for a monitoring and fire extinguishing system are developed and fire extinguishing skills are improved.
Agroforestry/Farmland Management Plan	Farming practices involving small-scale planting near farmland, contour cultivation, agroforestry with line planting, cultivation of fruit and/or irrigation with mobile pipes, etc. are introduced to assist the coexistence of the agricultural activities of local farmers and watershed conservation. In addition, training on farming techniques is provided.
Soil Conservation Plan	Conservation measures using simple civil engineering structures and the creation of riparian forests, etc. are implemented in correspondence with the type and scale of soil erosion, such as gully erosion, landslides and torrents (bank erosion), etc.
Community Development Plan	Community organizations are rebuilt or newly created to facilitate the development of social infrastructure, increase of employment opportunities and improvement of income through the activities of local residents themselves. In addition, educational activities are conducted to make local residents develop the ability to solve problems.
Extension and Training Plan	Techniques regarding agricultural production and forest management by means of agroforestry are extended and core farmers to become agroforestry leaders are fostered.
Management and Control Plan	For the efficient and smooth promotion of the Master Plan with the participation of local residents, the system and style of implementing various plans (projects) through collaboration with related government bodies, such as the SUREF and the INDHRI, local public bodies and NGOs, etc. are examined.

Table 9-2 Matrix for Field Scoping

Environmental Elements (Primary Element) (Secondary Element) (Tertiary Element)	Evaluation								Remarks
	Development Activities (Plans)								
	Land Use	Forest Management	Forest Fire Control	Agroforestry & Farmland Management	Soil Conservation	Community Development	Extension and Training	Management and Control	
1. Social Life									
(1) Community Life									
1. Planned resettlement				+					Change of land use
2. Involuntary resettlement				Δ					Change of land use
3. Change of lifestyle				+		+			Improvement of living conditions
4. Conflict between local residents				Δ		+		+	Change of land use and lifestyle
5. Indigenous people/small tribes/nomads									Irrelevant
(2) Demographic Problems									
1. Population increase									Irrelevant
2. Rapid change of demographic composition									Irrelevant
(3) Economic Activities of Local Residents									
1. Relocation of base for economic activities				+			+		Improvement of farming practices
2. Change of economic activities and unemployment		+	+	+		+	+	+	Increase of employment opportunities
3. Widening of income gap				+		+	+	+	Improvement of farming practices
(4) Institutional System and Customs									
1. Readjustment of the right of forest use	Δ	Δ	Δ						Limitations on land use, etc.
2. Change of social composition through grouping, etc.		Δ	Δ	Δ	Δ	Δ	Δ	+	Improvement and strengthening of community organizations
3. Reform of existing systems and customs			+	+	+	+	+	+	Improvement of systems and bad habits
2. Health and Hygiene									
1. Increase of the use of agrochemicals				+			+		Improvement of farming practices
2. Occurrence of local diseases						+			Improved awareness due to change of lifestyle
3. Epidemics of infectious diseases						+			Improved awareness due to change of lifestyle
4. Accumulation of residual toxicity (pesticides, etc.)				+			+		Improvement of farming practices
5. Increase of waste and excrement						+			Improved awareness due to change of lifestyle



Environmental Elements (Primary Element) (Secondary Element) (Tertiary Element)	Evaluation								Remarks
	Development Activities (Plans)								
	Land Use	Forest Management	Forest Fire Control	Agroforestry & Farmland Management	Soil Conservation	Community Development	Extension and Training	Management and Control	
3. Historic Sites, Cultural Heritage and Scenery, etc.									
1. Damage and destruction of historical sites and cultural heritage									Irrelevant
2. Loss of important scenery	+	+	+		+		+		Restoration of vegetation
3. Impacts on underground resources	Δ	Δ	Δ		Δ				Limitations on land use
4. Rare Wildlife and Important Ecosystems									
1. Change of vegetation	+	+	+	Δ	+		+		Change of land use and restoration of vegetation
2. Impacts on rare species and indigenous fauna and flora	+	+	+	Δ	+		+		Change of land use and restoration of vegetation
3. Decline of biodiversity	+	+	+	Δ	+		+		Change of land use and restoration of vegetation
4. Invasion and propagation of harmful species	Δ	Δ	Δ	Δ	Δ		Δ		Propagation of exotic species
5. Disappearance of wet land and peat bogs									Irrelevant
6. Deterioration of natural forests	+	+	+	+	+		+		Change of land use and restoration of vegetation
7. Destruction of mangrove forests									Irrelevant
8. Destruction of coral reef									Irrelevant
5. Soil and Land									
(1) Soil									
1. Soil erosion	+	+	+	+	+		+		Restoration of vegetation
2. Salination of soil	+	+	+	+	+		+		Restoration of vegetation
3. Decline of soil fertility	+	+	+	+	+		+		Restoration of vegetation
4. Soil contamination									Irrelevant
5. Acidification of soil	+	+	+	+	+		+		Restoration of vegetation
(2) Land									
1. Devastation of land (including desertification)	+	+	+	+	+		+		Restoration of vegetation
2. Occurrence of landslides	+	+	+		+				Restoration of vegetation
3. Decline of windbreak, sand control, tide control, fire prevention and other functions	+	+	+	+	+		+		Restoration of vegetation
4. Subsidence									Irrelevant

Environmental Elements (Primary Element) (Secondary Element) (Tertiary Element)	Evaluation								Remarks
	Development Activities (Plans)								
	Land Use	Forest Management	Forest Fire Control	Agroforestry & Farmland Management	Soil Conservation	Community Development	Extension and Training	Management and Control	
6. Hydrology and Water Quality, etc.									
(1) Hydrology									
1. Change of flow regime (water level) of surface water	+	+	+		+		+		Restoration of vegetation
2. Change of flow regime and water level of groundwater	+	+	+		+		+		Restoration of vegetation
3. Occurrence of droughts or floods	+ Δ	+ Δ	+ Δ		+ Δ		+ Δ		Restoration of vegetation
4. Sedimentation	+	+	+		+		+		Restoration of vegetation
5. Lowering of riverbed									Irrelevant
6. Impacts on shipping									Irrelevant
(2) Water Quality and Water Temperature									
1. Contamination and decline of water quality	+	+	+		+		+		Restoration of vegetation
2. Eutrophication	+	+	+		+		+		Restoration of vegetation
3. Invasion by salt water									Irrelevant
4. Change of water temperature	+	+	+				+		Restoration of vegetation
(3) Atmosphere									
1. Air pollution	Δ	Δ	+	Δ	Δ	Δ			Use of machinery and vehicles Prevention of forest fires
2. Generation of CO <sub>2</sub>	Δ	Δ	+	Δ	Δ	Δ			Use of machinery and vehicles Prevention of forest fires
3. Change of micro-climate	+	+	+						Restoration of vegetation
4. Noise	Δ	Δ	Δ	Δ	Δ	Δ			Use of machinery and vehicles
7. Sustainability of Forest Resources and Functions									
1. Termination of sustainability of resources	+	+	+	+	+	+	+	+	Implementation of each project
2. Termination of sustainability of environmental conservation function	+	+	+	+	+	+	+	+	Implementation of each project

Symbols: - strong adverse impact; - adverse impact; Δ - adverse impact may occur; + positive impact;  
space = irrelevant

Table 9-3 Check List for Field Scoping

Environmental Elements (Primary Element) (Secondary Element) (Tertiary Element)	Evaluation					Basis for Judgement
	A	B	C	D	P	
1. Social Life						
(1) Community Life						
1. Planned resettlement						Relocation of houses near villages
2. Involuntary resettlement						Same as (1)-1
3. Change of lifestyle						Improvement of living infrastructure
4. Conflict between local residents						Sense of unfairness caused by change of land use
5. Indigenous people/small tribes/nomads						Irrelevant
(2) Demographic Problems						
1. Population increase						Irrelevant
2. Rapid change of demographic composition						Irrelevant
(3) Economic Activities of Local Residents						
1. Relocation of base for economic activities						Improved profitability due to improved farming practices
2. Change of economic activities and unemployment						Increased employment opportunities and same as (3)-1
3. Widening of income gap						Same as (3)-1
(4) Institutional System and Customs						
1. Readjustment of the right of forest use						No major change from the present situation
2. Change of social composition through grouping, etc.						Improvement and reinforcement of organizations; acquisition of ability to solve problems
3. Reform of existing systems and customs						Improvement of bad customs, etc. by means of (4)-2
2. Health and Hygiene						
1. Increase of the use of agrochemicals						Change of farming with less use of agrochemicals due to improved farming practices
2. Occurrence of local diseases						Irrelevant
3. Epidemics of infectious diseases						Irrelevant
4. Accumulation of residual toxicity (pesticides, etc.)						Same as 2-1
5. Increase of waste and excrement						Irrelevant

Environmental Elements		Evaluation					Basis for Judgement
(Primary Element)		A	B	C	D	P	
(Secondary Element)							
(Tertiary Element)							
3. Historic Sites, Cultural Heritage and Scenery, etc.							
	1. Damage and destruction of historical sites and cultural heritage						Irrelevant
	2. Loss of important scenery						Restoration of forest scenery due to restoration of vegetation
	3. Impacts on underground resources						No major change from the present situation
4. Rare Wildlife and Important Ecosystems							
	1. Change of vegetation						Restoration of vegetation and protection from forest fires
	2. Impacts on rare species and indigenous fauna and flora						Conservation of habitat by means of 4-1
	3. Decline of biodiversity						Same as 4-2
	4. Invasion and propagation of harmful species						No major change from the present situation
	5. Disappearance of wet land and peat bogs						Irrelevant
	6. Deterioration of natural forests						Same as 4-1
	7. Destruction of mangrove forests						Irrelevant
	8. Destruction of coral reef						Irrelevant
5. Soil and Land							
(1) Soil							
	1. Soil erosion						Enhancement of undergrowth through restoration of vegetation and forest protection
	2. Salination of soil						Prevention of dry conditions through restoration of vegetation and forest protection
	3. Decline of soil fertility						Chemical reduction of litter through restoration of vegetation and forest protection
	4. Soil contamination						Irrelevant
	5. Acidification of soil						Conservation through prevention of soil erosion and decline of fertility
(2) Land							
	1. Devastation of land (including desertification)						Same as 5-(1)-5
	2. Occurrence of landslides						Same as 5-(1)-5
	3. Decline of windbreak, sand control, tide control, fire prevention and other functions						Functional improvement through restoration of vegetation and forest protection
	4. Subsidence						Irrelevant

Environmental Elements (Primary Element) (Secondary Element) (Tertiary Element)	Evaluation					Basis for Judgement
	A	B	C	D	P	
<b>6. Hydrology and Water Quality, etc.</b>						
<b>(1) Hydrology</b>						
1. Change of flow regime (water level) of surface water						Decrease of discharge through restoration of vegetation
2. Change of flow regime and water level of groundwater						Increased volume of permeation through enhanced undergrowth
3. Occurrence of droughts or floods						Same as 6-(1)-1
4. Sedimentation						Same as 6-(1)-1
5. Lowering of riverbed						Irrelevant
6. Impacts on shipping						Irrelevant
<b>(2) Water Quality and Water Temperature</b>						
1. Contamination and decline of water quality						Same as 6-(1)-1
2. Eutrophication						Same as 6-(1)-1
3. Invasion by salt water						Irrelevant
4. Change of water temperature						Shading through creation of riparian forests
<b>(3) Atmosphere</b>						
1. Air pollution						No major change of the size of pollution source(s)
2. Generation of CO <sub>2</sub>						Same as 6-(3)-1
3. Change of micro-climate						Mitigation of temperature through restoration of forests
4. Noise						Same as 6-(3)-1
<b>7. Sustainability of Forest Resources and Functions</b>						
1. Termination of sustainability of resources						Implementation of each project
2. Termination of sustainability of environmental conservation function						Same as 7-1

Symbols : A - serious adverse impact;

B – possibly serious adverse impact;

C – no serious adverse impact;

D – unknown;

P – positive impact

### 9.3 Overall Evaluation

The overall evaluation results shown in Table 9-4 are produced based on the findings of the field scoping work.

Table 9-4 Overall Evaluation Results

Environmental Element	Evaluation Results	Foundations for Judgement and Necessary Future Considerations, etc.
Social Life	C	The development of social infrastructure, increase of employment opportunities and improvement of income are expected to take place in the future through the reinforcement of community organizations and acquisition of the ability to solve problems due to the implementation of the community development plan (project) which is one component of the Master Plan.
Health and Hygiene	P	The improvement of farming practices is expected to change the present style of agriculture which relies on the use of harmful agrochemicals to wildlife. The change of lifestyle due to stabilised income and improvement of the living standard is expected to improve the awareness of local residents of the importance of health and hygiene.
Historic Sites, Cultural Heritage and Scenery	C	The restoration and conservation of forests, introduction of agroforestry and change of land use, etc. can be expected to restore the mountain scenery and forest scenery which are currently being destroyed. As no historic site or cultural heritage exists in the Study Area, the Master Plan has no implications in these aspects.
Rare Wildlife and Ecosystem	P	Although the direct objective of the Master Plan is water and soil conservation, the Plan also contributes to the conservation of the natural environment because of the restoration and preservation of vegetation, adequate forest management and adequate land use being used as the main means of achieving the said objective. Therefore, there is little likelihood that the Plan will have any adverse impacts of rare wildlife and the ecosystem and is instead expected to contribute to the restoration of rare wildlife and the ecosystem. Given the unique fauna and flora with many indigenous species on Hispaniola Island and in the Study Area, the introduction of exotic species must be minimised in order to avoid any genetic disturbance. Reforestation and fruit culture using exotic species should be confined to areas around dwelling sites while local species should be introduced in distant areas. As quick greening using fast growing species is necessary, the use of exotic fast growing species in places with the harshest soil erosion, i.e. farmland near dwelling sites and along roads, should not be problematic.
Soil and Land	P	Measures aimed at achieving a change of land use, restoration and preservation of vegetation, prevention of forest fires and soil conservation are expected to prevent soil erosion and land devastation, to restore the healthy state of soil and land and to educate local residents on the importance of soil conservation.
Hydrology and Water Quality	P	As the volumes of evaporation by solar radiation and transpiration by vegetation in the Study Area are not established, the normal and droughty river flows are unclear. However, the implementation of the relevant project will clearly contribute to reducing the flood peak flow. This effect on the flood peak flow will be the main benefit of project implementation.
Sustainability of Forest Resources and Functions	P	At present, forest resources and functions are not properly sustained in the Study Area. All of the components of the Master Plan will prove beneficial to develop such sustainability. Apart from such directly-related components as forest management, the decrease of shifting cultivation with the implementation of the plan to improve farming practices and the improved awareness of local residents with the implementation of the community development plan, etc. will indirectly contribute to improving the sustainability of forest resources and functions.

Evaluation Results : A – serious adverse impact,  
 B – possibly serious adverse impact;  
 C – no serious adverse impact;  
 D – unknown; P – positive impact

## **CHAPTER 10 GIS**

## CHAPTER 10 GIS

### 10.1 GIS Specifications

The installation status and specifications for hardware newly installed in the Forest Policy and Planning Department of the Sub-Secretariat for Forest Resources, and the software usage status and specifications are as follows.

#### (1) Hardware Installation Status and Specifications

Two personal computers (PCs), one scanner, and one plotter were installed on a network within the Forest Policy and Planning Department of the Sub-Secretariat for Forest Resources and all of these equipment have been operating without problem.

Table 10-1 Hardware Installation Status

Equipment Configuration	Specifications
2 PCs	CPU : Pentium III 860; RAM Memory: 256M; Hard Disk : 20GB; Monitors: 15 inches, LAN board mounted OS : Windows2000
1 color scanner	Maximum input image width : 36 inches; Image resolution: 50~800 DPI Input speed : 1.0 inch/s
1 color plotter	Maximum output image width : 42 inches; Resolution : 2400 × 1200 DPI

#### (2) Software Usage Status and Specifications

Arc View (GIS basic analysis software), 3D Analyst (3-dimensional analysis software), Spacil Analyst (grid analysis software), and Image Analysis (image analysis software) had been installed on two PCs and were operating without problem.

### 10.2 Creation of Various Thematic Maps

In order to prepare the watershed management plan, land use and forest type maps, soil maps, watershed maps, land potential maps, and watershed management plan maps were created using the following methods.

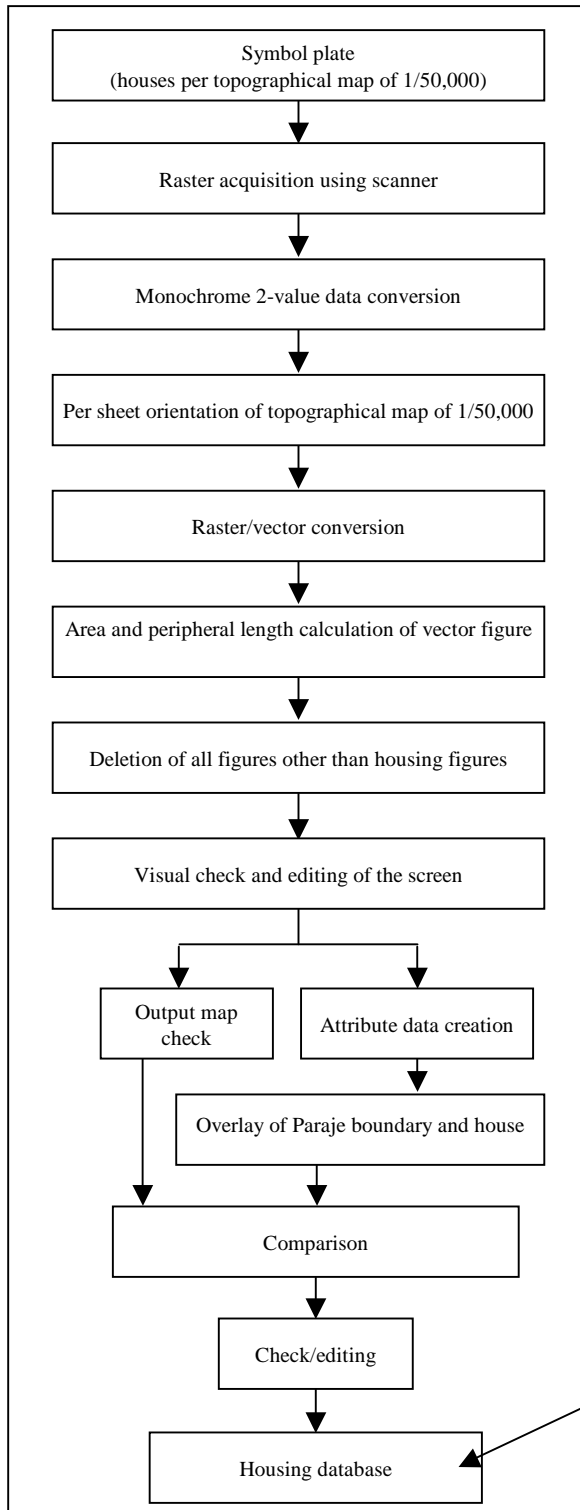


## (1) Creation and Input of Various Maps Using GIS

- 1) Input the land use and forest type maps, soil maps, watershed maps, land use potential maps, and village distribution and road maps. Scan the completed thematic maps (i.e. land use and forest type maps, soil maps, watershed maps, land use potential maps, and village distribution and road maps) using input systems such as a scanner, classify them per layer by screen digitizing, and convert them to vectored data. When attributes need to be added, input while recording part of the attribute information, and create various thematic maps.

House symbol extraction method for village distribution maps and various other thematic map creation methods are shown in the following flow chart.

### House Symbol Extraction



### Creation of Various Thematic Maps

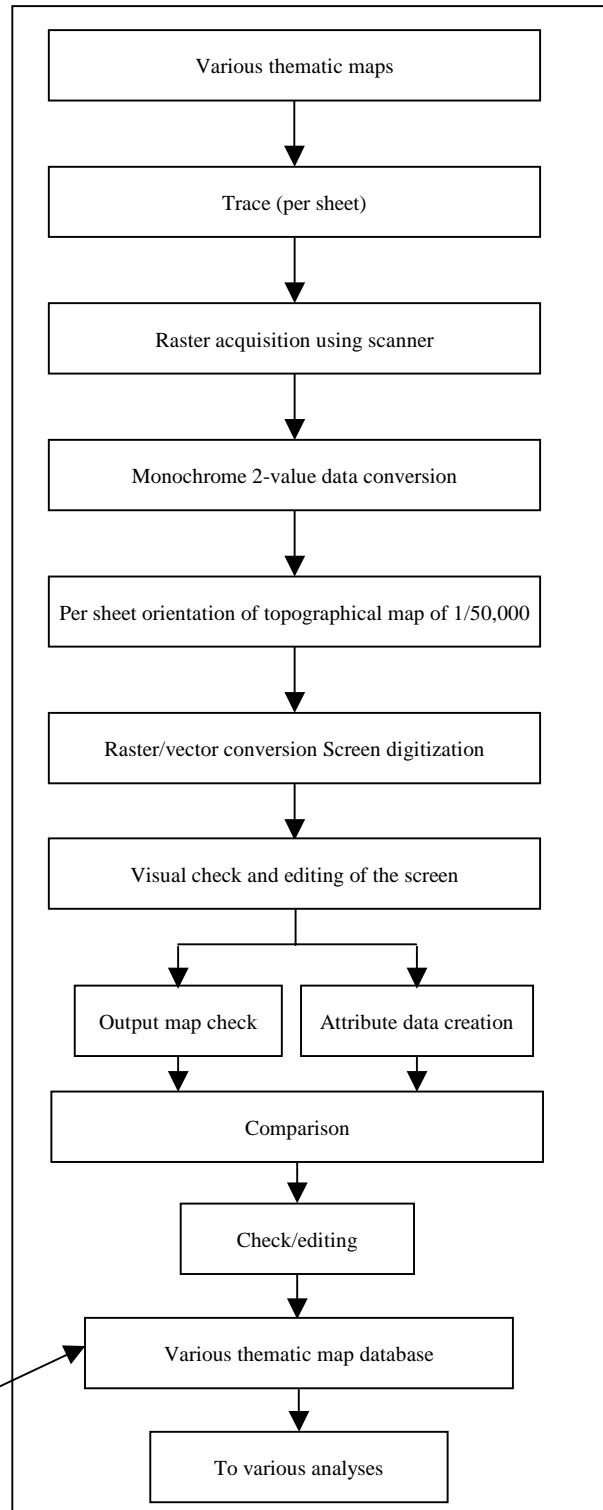


Fig. 10-1 Flow Chart of the Thematic Map Creation Method

## 2) Structural Editing / Database Creation

Logical checks, such as closure of surface data per layer of the thematic maps, disconnection of line data, and duplication of figure data, were carried out on digital data from various thematic maps that had been created, editing and correction were done, and databases were created using the existing general-purpose format.

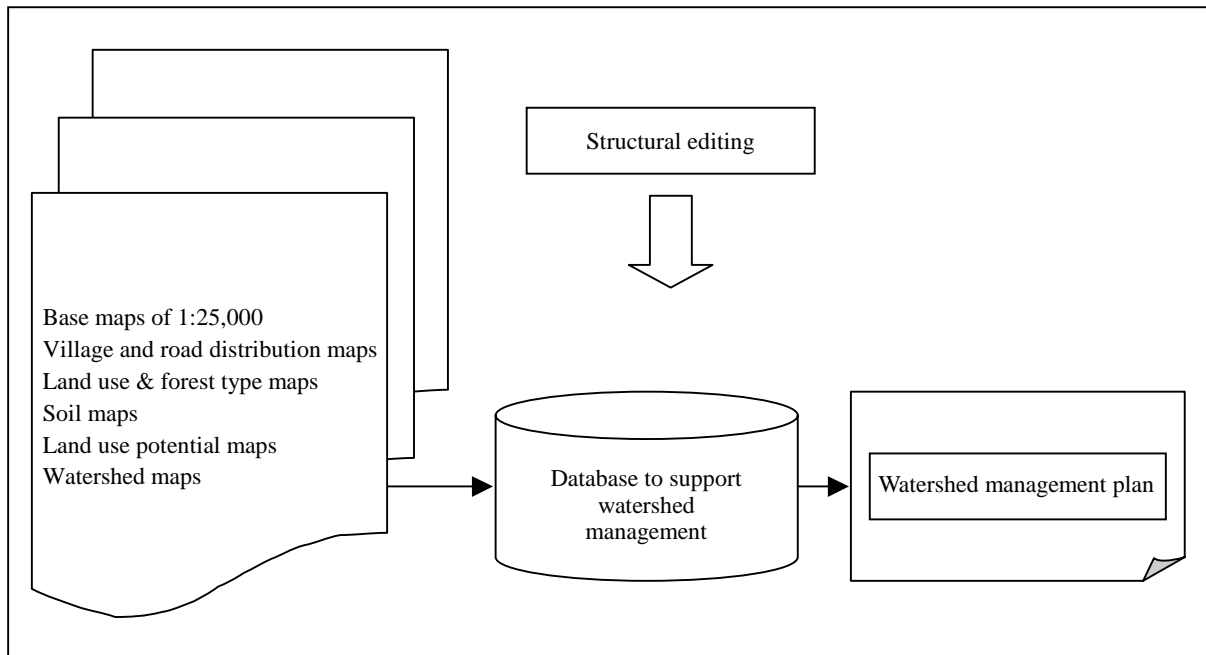


Fig. 10-2 Database Outline

## 3) Creation of Slope Classification Maps

Contour lines were scanned in from existing 1/50,000 topographical maps, and a 3D model was created using these contour lines and altitude data. A 250m-mesh slope classification maps was created using the classification conditions and mesh intervals that had been set.

### 10.3 Creation of Watershed Management Plan Maps

Watershed management plan maps were prepared using GIS by creating analysis conditions for zone evaluation and ranking based on the analysis condition matrix for creating such maps, and land use potential data required for the watershed management plan using a pre-established database to support watershed management.

## 10.4 Utilization of GIS

Creation of output maps, display of totaled and analysis results, and new thematic data generation, etc., was enabled in accordance with the purpose by utilizing a GIS function to establish watershed management plan using the constructed database. Representative processes are listed as follows.

- 1) Search display in accordance with attributes and color-separated classification displays/output maps per thematic map.

Example : Land use and forest type maps and soil maps were displayed and output per forestry category and soil category were produced.

- 2) Areas and peripheral lengths of polygon themes on various thematic maps were calculated, and the calculated values displayed on the maps.

Example : In terms of land use and forest type maps, areas and peripheral lengths, etc. per forestry group were calculated, and displayed on the maps or the maps could be output.

- 3) Spatial Analysis

Each piece of attribute information could be joined by linking various geographically overlapping spatial data based on the location information.

Example : Straight-line distances from the road to each house were calculated with regard to access.

- 4) Polygon Overlay

Segmented polygons were generated by overlaying two different themes (thematic maps), enabling analysis that takes both thematic attributes into consideration.

Example : Zones in which discrepancies were generated when overlaying land use and forest type maps on pre-established land use potential maps (i.e. even though steeply inclined land is essentially unsuited to agriculture, the area shows soil conservation-related problems through shifting cultivation self-sufficient farming) were extracted, priorities were ranked, and countermeasures required for each were set up. Appropriate land use was selected by overlaying polygons based on themes such as access and legal regulations.

#### 5) Buffer Search

Spatial condition searches were carried out by generating areas equidistant from the features expressed on the map. New themes were set up, totaled, and analyzed based on attribute data and features that have been extracted using the buffer search.

The following models were created based on various thematic maps.

- 1) 3D model per watershed in the Study Area was created, and a bird's eye view of the watershed was expressed by overlaying various thematic maps.
- 2) Inputting boundary data per village enabled the totaling of land use areas per village by overlaying thematic maps such as soil maps and land use and forest type maps. Links with attribute data such as socioeconomic information enabled integrated management with map information per village.
- 3) By using the data prepared through GIS utilization, future changes in forest land area in the subject areas can be monitored.

**CHAPTER 11 TECHNOLOGY TRANSFER AND  
INSTITUTIONAL  
STRENGTHENING**

# CHAPTER 11 TECHNOLOGY TRANSFER AND INSTITUTIONAL STRENGTHENING

## 11.1 Technology Transfer

### 11.1.1 Contents and Method of Technology Transfer

#### (1) Progress of Technology Transfer

The Master Plan aims at achieving the restoration and preservation of the headwater conservation function and other functions of the watershed in question through the restoration of depleted or degraded forests by means of the prevention and control of forest fires, agroforestry and community development, etc. in the Study Area.

As the implementation of the formulated Master Plan will be led by government organizations of the Dominican Republic, it is necessary for government officials acting as the C/Ps for the Study to master sufficient technical expertise regarding conservation and other activities as well as forest management capability. For this purpose, the transfer of technologies (skills) to the Dominican C/Ps through the implementation of the Study was considered necessary. While the concrete contents and method, etc. of the technology transfer are described in a separate document entitled “Technology Transfer Plan”, the main technologies (skills) transferred through OJT on the formulation of watershed management plans, technology transfer in third countries and a technology transfer seminar were (i) the basic ideas and principles for the formulation of such plans and (ii) the methods to survey the socioeconomic conditions, agricultural and forestry conditions and natural conditions regarding forest resources, soil, vegetation and fauna, etc. in the Study Area in order to obtain an accurate understanding of these conditions which is essential for the formulation of the said plan. In addition, in individual fields, the method to implement forest fire prevention and control measures, project evaluation method, community project implementation method, technology (skill) transfer method and method to establish a GIS, etc. were transferred.

A total of 13 government officials were assigned to the Study as C/Ps, i.e. nine from the Under-Secretariat for Forest Resources, three from the Under-Secretariat for Water and Soil and one from the INDHRI. All of these C/Ps have at least a bachelor’s degree and work in departments related to watershed management at their respective offices. They are all excellent officials with first-hand experience of watershed management. Although they were assigned as C/Ps as appropriate persons in their respective fields, their

technical level as C/Ps was not uniform, presumably because of personally different levels of experience of actual work.

## (2) OJT on Formulation of Master Plan

OJT was the principal component of the technology transfer and aimed at equipping the C/Ps with technical expertise regarding reforestation and forest preservation, etc. and forest management capability through the joint formulation of the Master Plan by the Study Team members and the C/Ps. Such joint activities included (i) technology transfer through the participation of the C/Ps in the examination and formulation of the survey plan for individual fields, (ii) technology transfer through the preparation of various reports, (iii) planning of the demonstration project consisting of the community project and forest fire prevention and control project and (iv) workshops on GIS. In short, the planned technology transfer was smoothly conducted through several field survey periods.

In general, all of the C/Ps had sufficient basic knowledge of watershed management and various surveys and were capable of conducting not only the planning and preparation of surveys but also the actual implementation of surveys. However, they appeared to be weak in data gathering and processing. In particular, they had little experience of quantitatively analysing survey data and of compiling the analysis results in the form of a manual, etc. and the technology transfer focused on these points. In regard to specialist and individual fields, their experience of (i) implementing integrated measures where individual techniques related to forest fire prevention and agroforestry, etc. are applied to actual sites, (ii) preparing forest type maps and vegetation maps and (iii) the advanced use of GIS appeared to be insufficient. Therefore, the technology transfer also focused on these points.

## (3) Technology Transfer in Third Countries

As a technology transfer in third countries, the C/Ps visited technical cooperation sites of the JICA and other international aid organizations and such research/educational institutions as the CATIE and the Smithsonian Institute in Panama and Costa Rica for two weeks commencing on 1<sup>st</sup> July, 2001 for the purposes of investigating (i) watershed management techniques which would be useful for the formulation and implementation of the watershed management plan for the upper reaches of the Sabana Yegua Dam, (ii) agroforestry techniques and (iii) participatory development techniques.

As listed below, the actual contents of technology transfer in third countries were very diverse, ranging from basic ideas of watershed management to actual practices by



advanced farmers. It is believed that the C/Ps found this to be quite useful for the formulation and implementation of the Master Plan.

- ① Basic ideas of watershed management, including the current situation of the Panama Canal watershed and the desirable management of this watershed
- ② Policies to encourage reforestation, including subsidies and tax reduction
- ③ Current situation of a participatory watershed management project designed to conserve water resources
- ④ Operation of an environmental service fund focusing on the public benefit functions of the conservation of available water resources and the preservation of biodiversity, etc.
- ⑤ Systematic watershed management system at the national level and its state of actual operation
- ⑥ Operation of a fund designed to achieve watershed management, regional development and environmental conservation
- ⑦ Actual implementation situation of large-scale industrial reforestation which also aims at achieving watershed conservation
- ⑧ Current situation of research on watershed management and agroforestry, etc. at research/educational institutions
- ⑨ Current situation of a JICA technical cooperation project
- ⑩ Current situation of measures employed by advanced farmers to contribute to watershed management, including soil conservation and organic farming

#### (4) Technology Transfer Seminar

The technology transfer seminar was conducted during the third field survey period in the third year of the Study to put all the achievements of the technology transfer activities, which were conducted during the study period using the formulated Master Plan and various manuals, together taking the implementation processes of the Study and the plan formulation techniques into consideration.

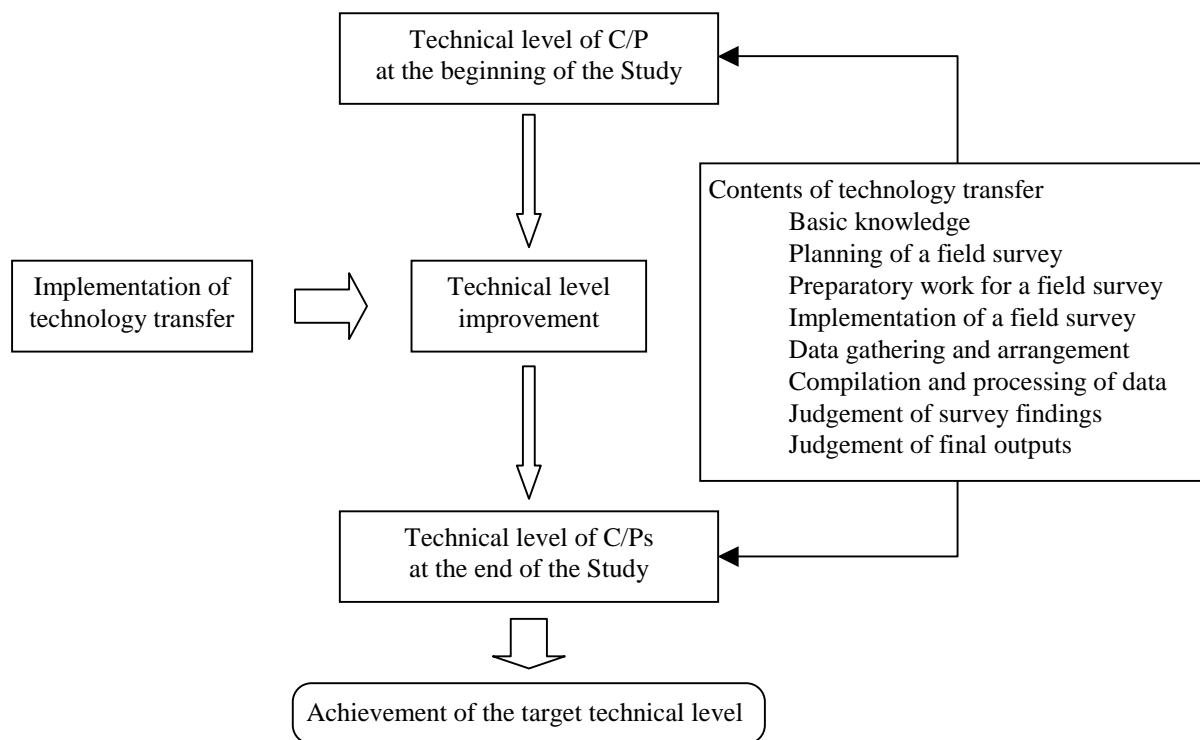
To be more precise, not only was the outline of the Master Plan and the progress of technology transfer but also the achievements of the technology transfer to the C/Ps were explained. These achievements were related to seven points: ① use of GIS for the formulation of a watershed management plan, ② preparation of watershed management plan maps, ③ capacity building, ④ progress of the community project, ⑤ soil

conservation, ⑥ reaction to forest fire prevention and control measures and ⑦ project evaluation.

### 11.1.2 Evaluation of Level of Achievement of Technology Transfer

#### (1) Evaluation Method

Although it is difficult to quantify the level of achievement of technology transfer, possession of the basic knowledge and capability to conduct a field survey on the part of the counterparts (C/Ps) was evaluated at the beginning and end of the Study to check any improvement. The purpose of this evaluation was not to evaluate the technical level of the C/Ps after the completion of technology transfer but to understand whether or not the knowledge and techniques regarding the formulation and implementation of a watershed management plan were sufficiently transferred and, if not, what types of knowledge and technical expertise were insufficient from the viewpoint of securing the feasibility of watershed management.



Technology Transfer Evaluation Flow

The technical level of the C/Ps at the beginning of the Study was evaluated in terms of eight points for each technology transfer item listed in the technology transfer plan taking the opinions of the C/Ps into consideration. These eight points are ① possession of basic

knowledge, ② ability to plan a field survey, ③ ability to prepare for a field survey, ④ ability to implement a field survey, ⑤ ability to gather and arrange data, ⑥ ability to compile and process data, ⑦ ability to analyse and judge the study findings and ⑧ ability to produce results.

Evaluation of the technology transfer results at the end of the Study was similarly conducted for each item of evaluation at the beginning of the Study. Moreover, the level of achievement of the target technical level described in the technology transfer plan was evaluated in a comprehensive manner, including the self-evaluation results of the C/Ps.

## (2) Evaluation at Beginning of the Study

The general evaluation results at the beginning of the Study are described below.

In regard to ① basic knowledge, while two C/Ps were assigned to work which they had never done before, all of the others had sufficient experience of the work to which they were assigned. Even though the latter still needed to learn new knowledge, they were evaluated as having sufficient ability to formulate and implement a watershed management plan. In regard to ② planning, ③ preliminary work and ④ implementation, all of which are related to field surveys, most of the C/Ps had previous experience of conducting a field survey and, therefore, were judged to be capable of conducting such work. However, as ability to see the whole picture and coordination with related people are required for ② the planning of a field survey, the ability of the C/Ps in some of these aspects was judged to be insufficient. Accordingly, it was evaluated that the C/Ps were required to develop their systematic planning ability in the future. In regard to items related to the gathering and analysis of data, i.e. ⑤ data collection and arrangement, ⑥ compilation and processing of data, ⑦ analysis and judgement of the survey findings and ⑧ preparation of final outputs, the C/Ps were evaluated as having sufficient knowledge and understanding of the issues involved. However, as not many C/Ps had experience of actually gathering and arranging data and of statistically processing data after compilation, it was judged necessary for the C/Ps to accumulate data processing experience in the future. As the analysis and judgement of processed data requires judgement ability as well as knowledge backed by appropriate experience, it was judged that the C/Ps should work on these points on a voluntary basis. In regard to the preparation of final outputs, hardly any of the C/Ps had experience of preparing manuals. As it would, therefore, be difficult for the C/Ps to prepare such outputs without external assistance, the active participation of the C/Ps in the preparation of various reports for the Study was judged to be desirable.

### (3) Evaluation at End of the Study

The general evaluation results at the end of the Study are described below.

In regard to ① basic knowledge, those with no previous experience of the work to which they were assigned steadily learned new knowledge. However, the limited time for joint work with the experts meant that it was difficult for them to learn all the necessary basic knowledge in their assigned fields and, therefore, further efforts to learn new knowledge were believed necessary. All other C/Ps learned the required knowledge during the Study Period and their level of knowledge was judged to be sufficient for the formulation and implementation of a watershed management plan. It is, however, necessary for them to repeatedly apply their newly acquired knowledge to their actual work to develop true ability to use their knowledge in full. In regard to ② planning, ③ preparatory work and ④ implementation of a field survey, the C/Ps were judged to fall short of some requirements regarding ② planning and still in need of systematic training of their planning ability in the future. Throughout the study period, technology transfer was conducted so that the C/Ps could implement a series of work based on their own judgement. While the planning of field work appeared to be quite a burden for those C/Ps with little previous experience of the work in question, most of the C/Ps were evaluated as being capable of conducting a series of field work in general. As much experience is required to plan and implement a field survey based on own ideas, the active involvement of the C/Ps in the implementation stage of watershed management plans (particularly the Master Plan) is hoped for. In regard to items related to data gathering and analysis, i.e. ⑤ data gathering and arrangement, ⑥ compilation and processing of data and ⑦ analysis and judgement of the survey findings, fairly advanced data processing is required in some fields and it was difficult to transfer all of the necessary techniques, etc. during the limited period of the Study. Despite such difficulty, however, the processing of data related to the preparation of a thematic maps, etc. was conducted in each field, resulting in improvement of the data processing skills. Given the existence of many data processing methods, however, it is necessary for the C/Ps to continue to accumulate the relevant experience by actually gathering, arranging and compiling data for statistical processing. Finally, with regard to ⑧ preparation of final outputs, the evaluation results at the beginning of the Study suggested that it would be difficult for most of the C/Ps to prepare such outputs without external assistance because of their lack of the relevant experience and that the active participation of the C/Ps in the preparation of various reports for the Study was desirable. At the end of the Study, the C/Ps were evaluated as being capable of preparing manuals and other outputs based on the study (survey) findings as a result of the technology transfer through reporting to the workshop to formulate the Master Plan and the preparation of manuals for agroforestry, etc. As

there were few opportunities for the C/Ps to prepare manuals, etc. on their own during the study period, their active commitment to the implementation of watershed management plans, such as the Master Plan, will be essential.

#### (4) Achievement of Target Technical Level

The technology transfer plan sets the target technology level for several items, including understanding of the study concept and learning of the plan formulation method, and technology transfer was conducted for the purpose of making the C/Ps reach such technical level. The overall judgement of the C/Ps' achievements based on evaluation by the experts as well as the C/Ps themselves is that the target level was roughly achieved for each item given an achievement score of 80 – 90%. However, the achievement score was relatively low for highly specialised items and items with an abstract concept. Given the limited study period, such results are believed to be inevitable. The results of the overall evaluation of the technology transfer through the Study are described next.

Although the C/Ps had experience of watershed management work at their respective offices, the content and level of their experience were diverse. Improvement of the skills regarding the implementation of various surveys relating to watershed management, analysis of the survey findings and the method to prepare the final outputs, etc. was observed through the assigned work for each C/P and the technical level of each C/P at the end of the Study is believed to have generally reached the target level. From the technical point of view, therefore, the C/Ps are now capable of sufficiently performing their respective work for watershed management and the planned technology transfer is judged to have fulfilled its original objective. Nevertheless, the ability of the C/Ps to plan and conduct the required work on their own initiative is important to ensure the feasibility of watershed management. Unlike the transfer of knowledge and technology (skills), such initiative demands reform of the consciousness of C/Ps and this reform cannot be fully achieved in a limited period. It is, therefore, believed necessary for the C/Ps to accumulate practical experience by applying their newly acquired knowledge and skills during the study period to the planning, preparation and implementation of field surveys in the coming years from the viewpoint of enhancing their ability to take the initiative.

## **11.2 Institutional Strengthening**

### **11.2.1 Objectives of and Direction for Institutional Strengthening**

In the Dominican Republic, a shift to a forest and forestry administration which aims at achieving the rational as well as sustainable use of forests is in progress. As part of this shift, the national administrative institution responsible for forests and forestry has changed from the DGF and the CONATEF to the INARIF and further to the Under-Secretariat for Forest Resources which is part of the Secretariat of State for Environment and Natural Resources which was newly established in August, 2000.

Such institutional reform has taken place to implement forest management which more actively values the multiple functions of forests, including wood production, water resources conservation and national land conservation, and which ensures the full performance of these functions instead of the conventional exploitive forest management or strict forest protection which rejects any form of interference with forests.

However, the unsteadiness of the internal structure and the scope of business under the jurisdiction of the Under-Secretariat for Forest Resources as set forth by the Additional Provisions of the Forest Law has been demonstrated by the fact that the Forest Protection Department, the establishment of which is stipulated by the Additional Provisions, has practically ceased to exist. As the Under-Secretariat for Forest Resources has basically inherited the business under its jurisdiction and authorities, etc. from the INAREF, its newly established internal structure is not truly compatible with the inherited business and authorities. The reality is that forest management is conducted in a conventional manner by eight forest management offices inherited from the INAREF. Because of the unclear division of work between the different administrations of the Under-Secretariat for Forest Resources, the Forest Operation Department which controls the eight forest management offices plays a comparatively prominent role.

As the internal structure and business under its jurisdiction are expected to be defined in more detail in the coming years, it is desirable for such definitions to adopt the following line of thinking. The Division of Forest Policies of the Forest Planning and Policy Department should be responsible for the planning of concrete policies and measures to achieve new forest and forestry practices while the Division of Planning should be responsible for the formulation of a national forest plan which determines the methods to handle forests. Meanwhile, the Reforestation Management Department should be responsible for a wide range of forest management work, including the production of seedlings and planting, based

on such policies and plan. On its part, the Department of Watershed Management should be responsible for the coordination of forest management by various bodies in order to achieve the conformity of forest management in each watershed throughout the country. The Department of Reforestation Management should be responsible for the introduction / application of reforestation and forest management techniques which contribute to the rational management of forests. It is also necessary to clearly define the roles of those offices inherited from the INAREF. For example, the encouragement of participation in forest management to ensure the effectiveness of forest preservation and utilisation projects should be clearly stated as the main business of the Division of Extension of the Investigation and Training Department. Furthermore, collaboration with local residents should be clearly stated to be part of the business of the Division of Forest Fire Prevention and Control and the Division of Forest Surveillance of the Forest Protection Department.

### **11.2.2 Human Resources Development**

Some 200 forestry engineers with a degree in forestry or who have graduated from a forestry college are employed by the Under-Secretariat for Forest Resources. There are no clear recruitment principles for forestry engineers, however, and these engineers are recruited at the personal initiative of the heads of divisions / departments. There is also no training system for recruited forestry engineers. The only training opportunities are those provided by international aid organizations and others and no systematic or regular training is provided by the Under-Secretariat for Forest Resources. Moreover, the lack of systematic human resources development is illustrated by the frequent transfer of personnel, including forestry engineers and other personnel, and the retirement of well-experienced forestry engineers in connection with changes of the government.

For the steady implementation of new forest and forestry policies from the viewpoint of rational and sustainable forest use, it is important to not only strengthen the organizations which have been set up but to also develop the necessary human resources to operate such organizations. Recruitment principles for forestry engineers, methodological job assignment after recruitment and a training system to improve the technical level of personnel must, therefore, be introduced or improved.

For the recruitment of forestry engineers, regular recruitment through examinations is basically preferable with the number of recruits and the subject fields of specialisation being decided in advance. Job assignment after recruitment should be based on basic appointment criteria which must be newly determined so that those with a higher technical level achieved by training, etc. and better work experience can be appointed to more important positions.

Training should be classified into two categories, i.e. staff training to foster capable staff members of the Under-Secretariat for Forest Resources and specialist technical training to equip engineers with specialist technical expertise on erosion control and other matters. Although the transfer of staff in connection with changes of the government may be inevitable, it must be minimised as much as possible in order to maintain the organizational coherence and ability of the Under-Secretariat for Forest Resources.



## **RECOMMENDATIONS**

## **RECOMMENDATIONS**

The Under-Secretariat for Forest Resources will be the main body responsible for the implementation of various projects based on the Master Plan. While the close vertical as well as horizontal collaboration of all related organizations is essential for the smooth progress of these projects for which the participation of local residents is a precondition, enhancement of the mutual trust between local offices of the said Under-Secretariat and local residents' organizations as the basis for a firmly established collaborative relationship is deemed to be more important. Many recommendations for different sectors are already made in the present report. The following recommendations have been compiled from these earlier recommendations to address issues requiring special attention by the Government of the Dominican Republic in the course of its implementation of vital projects.

### **1. Urgent Implementation of Planned Projects**

Any unchecked further progress of the degradation of watersheds will produce a number of problems, including a high risk of frequent floods due to deterioration of the dam function. In addition, there is concern in regard to significantly negative impacts on the lives of local residents in the upper reaches, including a decline of agricultural production due to soil loss and other reasons. In view of such a prospect, the Under-Secretariat for Forest Resources should attempt to implement the various projects envisaged by the Master Plan as soon as possible.

### **2. Strengthening of Collaboration with Local Residents**

At the beginning of the first field survey, the insufficient presence of the Under-Secretariat for Forest Resources in the Study Area was pointed out by local residents and it is understood that the Under-Secretariat itself recognises this situation. During the study period, the frequent visits by the team members and C/Ps coupled with activities by the NGO, etc. subcontracted to conduct the socioeconomic survey stimulated the interest of local residents in the Study and good communication with local residents was achieved.

Following the formulation of the Master Plan, the Under-Secretariat for Forest Resources will play a central role in the implementation of various projects. However, even if the Executive Office for the Master Plan Project is established to coordinate project implementation by the organizations concerned, strengthening of the collaboration with local residents is not an automatic conclusion. What is required is as many visits as possible to the project sites by staff members of the said Under-Secretariat's local offices. The active assistance of the

government is also required to promote, organize and consolidate voluntary community projects by local residents.

### **3. Organizational Strengthening and Human Resources Development**

Strengthening of the organization of the Under-Secretariat for Forest Resources is essential for the implementation of the various projects envisaged by the Master Plan. For this purpose, the planned direction for forest and forestry administration must be compatible with its organization and measures to establish such compatibility must be examined as soon as possible.

As the basis for the strengthening of the organization in the coming years, the most important thing will be human resources development. While the present staff members of the Under-Secretariat perform their duties in their respective fields of work, the recruitment criteria must be clarified for the employment of capable personnel to ensure recruitment which is based on merit.

While training at various stages after recruitment is important to enhance the abilities of staff members, the existing training system falls short of the system required to contribute to ability-building. Even though the development of human resources does not immediately lead to strengthening of the organization, it is the key to a strong organization. Serious efforts must, therefore, be made to develop human resources.

### **4. Forest Management and Forest Protection**

In principle, existing forests in the Study Area should be preserved while land where shifting cultivation or grazing is conducted because of its unsuitability for cultivation or other purposes should be converted to forests. However, these principles should not be unconditionally applied and temporary measures should be introduced, including the approval of shifting cultivation at certain sites until agroforestry and other alternative farming methods are established for poor farmers whose livelihood currently depends on shifting cultivation. In this case, however, stricter guidance on the handling of fire must be provided and the introduction of firebreaks should be made a mandatory requirement, backed by appropriate punishments for those disobeying such guidance.

As far as landowners engaged in stock raising are concerned, the reality is that their interest in forest management or protection is lower than that of farmers regardless of the size of

land-holding. Because there are many cases of a fire spreading from grazing land, the provision of education for landowners on the need for forest protection is necessary.

As already mentioned in 2. above, forest management and forest protection, i.e. the main components of the Master Plan, cannot be achieved without the collaboration of local residents. Active support for local residents is necessary together with strict punishments for illegal activities. A successful outcome depends on the determination of and a strong commitment by the Under-Secretariat to preventing the further progress of forest destruction.

## **5. How to Proceed with Various Projects**

All of the projects based on the Master Plan assume the participation of local residents and are designed to contribute to preventing forest degradation and promoting forest resources development. To realise the participation of local residents, some incentives are required.

While micro loans are assumed to be the most effective incentive, there is a chance of failure unless such loans are carefully provided based on the degree of poverty. Among the possible incentives indicated in the livelihood improvement plan, assistance for the supply and production of flowering plant seeds appears to be one of the most realistic incentives.

As farmers endeavour to improve their livelihood, it is desirable to give the first priority to projects which contribute to livelihood improvement in order to raise the interest of farmers in projects. However, there is a general tendency among poor farmers to be only interested in those projects which are directly linked to the improvement of their own livelihood while ignoring projects to establish infrastructure to improve their livelihood. In the face of such a tendency, it is essential to make farmers understand the importance of the Master Plan through workshops and other means prior to the implementation of projects together with efforts to raise their sense of participation and to organize them to improve their capability to voluntarily solve problems. Throughout these efforts, it is essential to be aware of the need to foster core farmers who will play a leading role in project implementation.

## **6. Securing of Project Funds**

Needless to say, the Under-Secretariat for Forest Resources must make efforts to secure the budget to finance projects within the Secretariat of State for Environment and Natural Resources. The further introduction of funds from the World Bank and other banks assisting development and also from aid organizations in donor countries must also be actively promoted. Moreover, the use of engineers dispatched by these organizations should be

encouraged. For these purposes, it is essential for the Under-Secretariat for Forest Resources to learn from the experience of and techniques used by the Secretariat of State for Public Works, the Dominican Farmland Institute, the National Institute of Water Resources, etc. which have experience of securing overseas funding for their own projects.