JAPAN INTERNATIONAL COOPERATION AGENCY

NATIONAL INSTITUTE OF HYDRAULIC RESOURCES,

THE DOMINICAN REPUBLIC

THE STUDY ON INTEGRATED RURAL DEVELOPMENT PROJECT OF YAQUE DEL SUR RIVER BASIN IN THE DOMINICAN REPUBLIC

Volume III

ANNEX – 2 ; FEASIBILITY STUDY ON THE AGRICULTURAL DEVELOPMENT PROJECT IN THE LOWER YAQUE DEL SUR

JULY 1999

Nippon Koei Co., Ltd.

Pesco International Inc.

JAPAN INTERNATIONAL COOPERATION AGENCY

NATIONAL INSTITUTE OF HYDRAULIC RESOURCES,

THE DOMINICAN REPUBLIC

THE STUDY
ON
INTEGRATED RURAL DEVELOPMENT PROJECT
OF
YAQUE DEL SUR RIVER BASIN
IN
THE DOMINICAN REPUBLIC

Volume III

ANNEX – 2 ; FEASIBILITY STUDY ON
THE AGRICULTURAL DEVELOPMENT PROJECT
IN THE LOWER YAQUE DEL SUR

JULY 1999

Nippon Koei Co., Ltd.

Pasco International Inc.

LIST OF REPORTS

VOLUME I MAIN REPORT

VOLUME II ANNEX – 1 ;

MASTER PLAN STUDY ON THE AGRICULTURAL DEVELOPMENT IN THE YAQUE DEL SUR RIVER BASIN

VOLUME III ANNEX – 2 ;

FEASIBILITY STUDY ON THE AGRICULTURAL DEVELOPMENT IN THE LOWER YAQUE DEL SUR

THE STUDY
ON
THE INTEGRATED RURAL DEVELOPMENT PROJECT
OF
THE YAQUE DEL SUR RIVER BASIN
IN
THE DOMINICAN REPUBLIC

Volume – III

ANNEX – 2 : FEASIBILITY STUDY

CONTENTS

List of Tables

List of Figures

List of Drawings

ACRONYMS AND ABBREVIATIONS

AGLIPO	Project Aguacate Limon y el Pozo
Asentamiento	Agrarian Reform settlement
BAGRICOLA	Banco Agricola (Agricultural Bank)
BID	Banco Interamericano de Desarrollo (Inter-American Development Bank)
CAASD	Corporacion de Acueducto y Alcantarillado de Santo Domingo (Santo Domingo Water Supply and Sewerage Corporation)
CADER	Centro de Administración del Desarrollo Rural (Center for Administration of Rural Development)
CDE	Corporación Dominicana de Electricidad (Dominican Electric Corporation)
CEA	Consejo Estatal de Azúcar (Governmental Sugar Council)
CEDOIS	Centro Dominicano de Organizaciones de Interés Social (Dominican Center for Organizations of Social Concern
CESDEM	Centro de Estudios Sociales y Demograficos (Center for Demographic and Social Studies
CEVEMA	Centro de Venta de Materiales Agripecuaris (Agricultural Input Sub Centers)
CIAS	Centro de Investigación Agropecuaria de San Juan (Agricultural Research Center in San Juan)
CIAZA	Centro de Investigaciones Agricola en Zonas Aridas (Research Center for Arid Zone)
CIDA	Canadian International Development Agency
COEE	Emergency Reservoir Operation
CORAASAN	Corporacion de Acueducto y Alcantarillado de Santiago (Santiago Water Supply and Sewerage Corporation)
DEFINPRO	Central Bank's Department of Financing
DDR	Departmento Distritos de Riego (Irrigation District Department)
DGF	Dirección General Forestal (General Forestry Directorate)
DNP	Dirección Nacional Parque (National Parks Directorate)
DR	Dominican Repulbic
FAO	Food and Agriculture Organization of the United Nations
FDA	Fundación Para el Desarrollo Agropecuario (Agricultural Research Fundation)
FDD	Fundación Dominicana de Desarrollo (Dominican Foundation for Development)
FED	Fondo Europeo de Desarrollo (Europian Development Fund)
FEPROCA	Federación de Productores Campesinos (Federation of Farmers in Azua)
FTZ	Free Trade Zones
FUDECO	Fundación Para el Desarrollo Comunitario (Foundation for Community development)
FUNDASUR	Foundation for the Development of the South
GDP	Gross Domestic Product
GTZ	German Society of Technical Cooperation
IAD	Instituto Agrario Dominicano (Dominican Agrarion Institute)
IBRD	International Bank for Reconstruction and Development
IDB	Interamerican Development Bank
IFAD (FIDA)	Fondo Internacional Para el Desarrollo Agricola (International Fund for Agricurtural Development
IICA	Inter-American Institute for Agricultural Cooperation
IMF	International Monetary Fund
INAPA	Instituto Nacional de Aguas Potables y Alcantarillados (National Institute of Potable Water and Sewerage)
INDESUR	Instituto para el Desarrollo Del Suroeste (Institute for the Southwest Development)
INDOTEC	Instituto Dominicano de Tecnologia Industrial (Dominican Institute of Industrial Technology)

INDRHI	Instituto Nacional de Recursos Hidraulicos (National Institute of Hydraulic Resources)
INESPRE	Instituto Nacional de Estabilizacion de Precios (Price Stabilization Institute)
INPOSDOM	Instituto Postal Dominicano (Dominican Postal Institute)
IPM	Integrated Pest Management
ISA	Instituto Superior de Agricultura (Superior Institute for Agriculture, ISA)
JAD	Junta Agroempresareal Dominicana (Dominican Agribusiness Council)
JICA	Japan International Cooperation Agency
Juntas de Regantes	The highest level of water user organizaton: a grouping of Irrigation Associations
Junta Directiva	Board of Directors of the Junta de Regantes
MCM	Million Cubic Meter
NGO	Non-governmental Organization
nucleo	Lowest-level organizational unit in the Junta de Regantes, usually consisting of farmers sharing a single turnout
OEA (OAS)	Organización de Estados Americanos (American States Organization)
OFWMP	On-farm Water Management Project
ONAPLAN	Oficina Nacional de Planificación (National Planning Office)
ONAMET	Oficina Nacional de Meteorologia (National Office of Meteorology)
OTTT	Oficina Técnica de Transporte Terrestre (Technical Transportation Office)
PLANAR	Plan Nacional de Agua Rural (Rural Waterway National Plan)
PLANIACAS	Plan Nacional de Investigaíon, Aprovechamiento y Control de Aguas Subterráneas (National Plan of Study, Use and Control of ground Water)
PLANDZF	Plan Nacional de la Zona Fronteriza (Border Zone Development Plan)
PMF	Probable Maximum Flood
PRISA	Programa Integrado de Salud en el Suroeste (Intergrated Local Program in the Southwest)
PROFAMILIA	Asociación Dominicana Pro Bienestar de la Familia (Family Welfare Office)
PROSEMA	Programa de Servicios de Maquinarias Agricolas (Agricultural Machines Service Program)
PRODAS	Proyecto de desarrollo Agricola en San Juan dela Maguana (San Juan de la Maguana Agricultural Development Project)
PROMAF	Projcto Manejo de Aguas a Nivel de Finca (On-farm Water Management Project)
PROMASIR	Programa de Mejoramiento y Administracion de los Sistemas de Riego
PROMATREC	Projecto de Manejo deTierras Regadas y Cuenca
SCF	Standard conversion factor
SEA	Secretaria del Estado de Agricultura (Ministry of Agriculture)
SEEC	Secretaria de Estado de Education y Cultura (Secretary of State Education and Culture)
SEOPC	Secretaria de Estado de Obras Publicas y Comunicaiones (Secretary of Public Works and Communication)
SESPAS	Secretaria de Estado de Salud Pública y Asistencia Social (Secretary of State Pubic Health and Social Assistance)
SINACAR	Sistema Nacional de Capacitacion de Asociaciones de Regantes (National System for Training of Water Users Association's Member)
SINAPBRI	Sistema Nacional Autogestionario de Producción Bajo Riego (National System for Self-sustainable Irrigated Agriculture Production)
SSID	Servicio Social de Iglesias (Dominican Churches Social Services)
SURENA	Subsecretaria de Estado de Recursos Naturales (Subsecretary of Natural Resources)
tarea	Measure of land, 0.063 hectares
toma	Turnout
UASD	Universidad Autonoma de Santo Domingo (Authonomus University of Santo Doming)
UNPHU	Universidad Pedro Henriquez Urena (University Pedro Henriquez Urena).
USAID	United States Agency for International Development

WHO	World Health Organization
WMO	World Meteorological Organization
WTO	World Trade Organization
WUO	Water User Organization
YSURA	Yaque del Sur-Azua. Irrigation system serving Azua Valley

CURRENCY EQUIVALENTS

US $1 =Dominican Peso 14.0 = Japanese Yen 126
as of February 1998 (Master Plan Study)
US $1 =Dominican Peso 15.5 = Japanese Yen 112
as of January 1999 (Feasibility Study)

1. INTRODUCTION

This is Annex 2 of the Report which the JICA Study team prepared in accordance with the Scope of Work (S/W) for the Study on the Integrated Rural Development Project of the Yaque Del Sur River Basin in the Dominican Republic (the Study) agreed upon between the Government of the Dominican Republic (GORD) through the National Institute of Hydraulic Resources (INDRHI) and the Japan International Cooperation Agency (JICA) in July 2nd 1997.

The objectives of the Study are

(1) to prepare a Master Plan on an Integrated Rural Development Project of the Yaque Del Sur river basin of which components shall include water resources development and agricultural and rural development,

(2) to conduct a feasibility study of priority areas selected in the Master Plan and

(3) to transfer technology, which is used for this study, to the Dominican Republic counterpart personnel through on-the-job training in the course of the Study.

In Phase-1, JICA study team formulated an Agricultural Development Master Plan in the Yaque del Sur river basin. And a high priority area was selected for the feasibility. The lower reaches of Santana headworks are proposed as a high priority area because these areas are suffering form the chronic water shortage due to the deteriorated facilities and suspension of the pump operation as well as the most depressed area in terms of living conditions of the peoples. The priority area is about 6,000 ha excluding the area under Barahona Sugar Corporation. Distribution program is further recommended in the master plan because the selected area requires more precise discharge control at Villarpando. After the explanation and discussion about the Interim report that presents an agricultural development master plan, It was agreed between INDRHI and JICA study team that feasibility study for the selected high priority area should be carried out. This Annex 2 presents all the results of the feasibility study on the high priority area in the lower reaches of the Santana weir.

2. PROJECT BACKGROUND

2.1 General Economic Conditions in the Dominican Republic

The Dominican Republic's estimated population of 7.89 million has grown at a 2 percent annual rate in the 1990's decreasing from 2.9 percent in the 1970's and 2.3 percent in 1980's. Despite the fact that 45% of the population is rural, urbanization rapid and 2.4 million people live in Santo Domingo, the capital. The unemployment rate was estimated at 16.6 % in 1996 in addition to a sizable informal sector. Of the economically active population, the service sector employed 27.2% in 1997, while commerce absorbed 23.2%, Industry 17% and agriculture 13.8% (Central Bank, 1997). Tourism and export processing operations (Free Export Zones) have become significant source of growth for the country.

In 1990 the Government undertook a new Economic Program that combined stringent stabilization measures and unification of foreign exchange market with financial system, trade, pricing and tax reforms. In September 1994 the Government moved again to stabilize the economy following the fiscal and monetary excesses. Since then growth has been positive and real GDP growth was estimated at 5 % in 1997. Per capita growth averaged 4 % during 1994-1997 period. Inflation rate has been very low achieving a record low of 3.95% in 1996 (Central Bank, 1997).

Trade reform was initiated in 1990 and the country's membership in the WTO has brought about further liberalization commitments in 1994 after the conclusion of the Multilateral Trade of Agreement of the Uruguay Round. In 1995 import surcharges were removed which lowered average duties on imports.

Later on the Government introduced a technical rectification before the World Trade Organization (WTO) for eight commodities considered very sensitive for the Dominican agriculture. Those commodities are: Poultry parts, powdered milk, red beans, rice, garlic, onion, corn and refined sugar. For those commodities the country set a different bound tariff and special safeguards.

In June 1997 the Government enacted a law eliminating import tariff for agricultural inputs and agricultural machinery.

During the last two years, the Government has carried out a major reform effort aimed at improving transparency and effectiveness of the laws affecting competition. New custom regulations have been instituted. Major elements of the tax laws and the labor code have reformed with new implementing regulations under development. Banking law was also reformed. A new Foreign Investment Law was enacted by the executive branch on November 1995.

Infrastructure is good and the country has an advanced telecommunication system, but suffers from electrical shortages which has forced industries and private homes to buy their own power generators.

Manufactures contributes 17 percent of GDP. Free zones have shown outstanding performance. In 1996 there were around 434 companies operating in 34 industrial parks and providing employment to 164,639 people. In 1996 free zones exports reached US$1,869 million (ONAPLAN, 1997).

Tourism has become the principal source of foreign exchange, contributing some US$1,837 millions in 1996. For 1997 revenues from tourism were estimated in US$2,047 millions. During 1996 about 2,064 people visited the Dominican Republic with a per capita spending of US$91/day and an average stay of 11 nights/person (Central Bank, 1997).

The country is endowed with a diverse topography and abundant rainfall across most of the country allowing year around agricultural production with limited amount of irrigation. However, there are some geographical areas, specially the southwest region where there is not enough rainfall throughout the year to sustain agricultural production. The agricultural sector has been losing importance due to government interest in promoting growth of free zones and the array of government interventions which introduced price distortion and reduced the sector competitiveness.

Because of that, the country has to import significant amount of food stuff to satisfy domestic demand. The main imported foodstuff are wheat, corn, dairy products, sorghum, milk, cooking oil, rice and red beans. In 1996 food import accounted for US$535 million (17% of total imports).

The main exports commodities are sugar and by-products, tobacco and cigars, cocoa, and coffee, which are considered the traditional export along with mineral exports such as Ferro nickel and dore (a combination of gold and silver). Export earning in 1996 amounted US$821 millions. Other agricultural commodities exported include banana, pineapple and yautia.

The current account of the balance of payments has registered persistent deficits, due mainly to growing merchandise trade deficit. Merchandise imports were valued at U$3,216 million in 1996 against exports of US$821 million. Although surpluses in services expanded, they have not compensated for the goods deficits. In order to bridge the gap the country depends on unilateral transfer mainly remittances from Dominican living abroad.

Rice is the main staple food along with red beans, cassava and plantain. Rice is produced mainly in the Cibao area and San Juan in the south. Plantains are produced in great quantity in the Cibao area as well as in the southwest specially Barahona and Azua. Cattle production is concentrated in the higher quality range lands of the central and eastern regions. Commercial pork and poultry are being raised in the Cibao valley.

2.2. National Development Policy

In August 1996 the new administration explained the country's social and economic development strategy based on six broad objectives:

(1) To achieve a sustained annual GDP growth of 7-8%;

(2) To strengthen an economy based on the private sector and oriented towards foreign trade;

(3) To keep an inflation rate of below 10 percent a year;

(4) To keep a financial equilibrium of the consolidated public sector, a rational Government expenditure and an increase in taxes to 20 percent of GDP;

(5) To increase (double) Government spending in social expenditure giving greater emphasis to health services, social security and also to basic technical and vocational education; and

(6) A Government fundamentally dedicated to facilitating a competitive economy, to ensure investment in infrastructure and putting into effect an integrated strategy to improve equity and eradicate poverty.

In order to achieve those goals, the Government decided to re-orient Government spending on the following area:

(1) Increase salaries of public employee, in greater proportion to teachers and physicians working in public places.

(2) Increase Government funding to the electricity company, the State University (Universidad Autonoma de Santo Domingo), as well as other decentralized institutions such as INDRHI, the National Institute for Housing (INVI), the Special Fund for Agricultural Development (FEDA) and the State Sugar Council (CEA).

(3) Increase the amount of funding being devoted to honor the external debt.

The restructuring of Government spending toward social sectors together with further economic reform is expected to bring about a positive impact on production and would help to mitigate poverty through job creation and income generation.

The Government sectoral policy in agriculture have been defined in the following areas:

(a) Agricultural Production:

- Promote food production to achieve self-sufficiency on the main staple food (rice, red beans, plantain and cassava)
- Promote production of traditional and non-traditional export crops to increase foreign exchange earning.
- Enhance the level of agricultural production from small farms and increase their level of income.

(b) Marketing and Price Policies

- Promote the elimination of all tariff and non tariff barrier to domestic agricultural production and trade.
- Promote trade liberalization and market access for agricultural commodities.
- Reduce price controls on both agricultural inputs and final goods and keeping some price intervention for some sensible crops.
- Promote private initiatives which would strengthen domestic agricultural markets.

(c) Credit Policy

- Increase credit access to the agricultural sector through Budgetary allocation to the Agricultural Bank and the Reserves Bank
- Continue credit support to the main food crops (specially rice) to the agrarian reform settlement and small farmers.

(d) Land Reform Policy

- Provide Land Reform Settlers with definite titles to increase their capacity to obtain credit.
- Consolidate and strengthen settlements support services on production, infrastructure and market development.

(e) Irrigation Policy

- Increase investment on irrigation facilities and maintenance of the existing facilities.
- Improve irrigation system management by extending and increasing water charges and transfer of the irrigation system to water users.
- Promote the enactment and implementation of the National Water Code
- Promote a new legal and institutional arrangement for the management of major river basins.

(f) Natural Resource Policy

- Promote recuperation and protection measures to prevent soil erosion .
- Encourage crop zoning according to soil quality and water availability
- Adopt a holistic approach on watershed management putting more attention to agricultural production systems and the needs of small farmers.

(g) Research and Extension Policy

- Promote coordination between research and extension systems.
- Promote efficient management mechanism of Agricultural Research Centers decentralizing their operation and incorporating the private sector and farmers.

2.3. Regional Development in the Basin of the Yaque del Sur

The Yaque del Sur river basin (the Study Area) is located in the Southwest region where is the least developed part of the country. The highest concentration of poverty persists in the southwest. According to the Study "Focalizacion de la Pobreza en la Republica Dominicana" (Focusing Poverty in The Dominican Republic), the Region comprises the highest percentage of poor household with more than 75% living in poverty. Similarly 55 percent of the population earn less than DR$750 a month and 24 percent between DR$750 and DR$1,000 in 1993. The Government has identified that region has the top priority for the regional development to reduce poverty and regional imbalances.

Bahoruco, Azua and Barahona, which are the main provinces in the Study Area, are among the provinces with the highest level of poverty in the Southwest region. A Government Study showed that 82% of aqueduct does not use chlorine to disinfect water that does not guarantee the water quality for human consumption. Similarly 68 percent of the household does not have access to latrines and the global deficit in nutrition in pre-school children was 10%.

3. RESULTS OF THE FIELD SURVEY

3.1. Administration and Socio-Rural Conditions

3.1.1. Administration and Areas

Administratively, the Project area is under the jurisdiction of two provinces, 5 municipal districts and 13 rural sections. Rural sections are the most basic subordinate organization in the community. The total population of the Area related to the administrative jurisdiction to the Project is estimated at about 75,000 in 1998. The total number of household is estimated at 17,435 out which 23% owns farms. The average family size is 4.3. The population density is very low with 82 person/km^2 for Bahoruco and 94.8 person/km^2 for Barahona. During the 1980's began a strong migration process from the Project area (especially Vicente Noble and Tamayo) to Europe and The United States. The administrative structure and population is summarized below in Table 3.1.1.

3.1.2. Land Tenure

Land ownership is highly concentrated in the Project area. Information from the Agricultural Census of 1981 (the latest figures available) shows that around 85% of the farms owns less than 80 tareas (5 ha) with an average size of one hectare. Information gathered through INDRHI shows an average size farm of 1.3 ha, and the net irrigable area of the Project area is 5,885 ha.

3.1.3 General Information of the Households in the Project area

In order to elicit in more detail the needs and wants of the communities within the Project area, a series if four workshops were held. The workshops included producers, Non Government Organizations (NGO's), health workers, Women Organizations and local Government administrators.

The methodology used was called the Participatory Community Approach (PCA). At the beginning of each workshop a Member of the JICA study team explained the objectives of the workshop and the methodology to be used. The JICA study team members stressed the need of community participation to properly identify the basic problems faced by each community.

Then the audience was divided up into five small groups of 5 to 6 people to identify problems affecting the community in a specific area (health, education, agriculture and so on). The JICA study member provided each group with a guideline sheet with key questions to be addressed within each group. In addition, each group was asked to identify the main problem of the community and their willingness to participate in development activities. Each group had a facilitator who usually wrote down all problems and alternatives identified by members of the group. The group session lasted for 90 minutes.

Each group facilitator presented the group's findings and received comments from the audience. The JICA team collected and processed the information gathered on the workshops. A summary of the main problems and alternatives is presented in Table 3.1.2.

During the workshop participants were asked to identify the main problems on their communities. Problems were identified in five broad categories: agriculture, health, education, basic services (drinkable water, electricity and garbage disposal) and women's issues.

Regarding agriculture there was consensus among the different communities that irrigation water was not sufficient. That in turn is affecting the possibility of increasing agricultural production and income. In the case of the communities of Fundación, Jaquimeyes, Palo Alto, Peñon, and Tamayo identified as a major problem the effect of flooding (caused by Hurricane George) on their plots. Two other problems identified in all communities were the inability to access credit for crop production and the high concentration of intermediaries in the Project area.

In regard to health issue, the lack of doctors and health centers were cited as the main problems faced the communities in the Project area. In the case of Uvilla, El Jobo and Mena they have to travel several kilometers to receive medical attention. The same is true for residents in Pescadería, Jaquimeyes and Canoa. Participants identified the most common diseases as water related diseases such as Respiratory Infections, Diarrhea, parasites, and skin problems.

Regarding education, the lack of school facilities and the high illiteracy rate were considered the most compelling problems in the Project area. In the case of Vicente Noble there has been an increase in the dropout rate among those students who have parents living abroad.

Most of the communities do not have garbage disposal system and aqueducts. In the case of Mena, El Jobo and Uvilla, the lack of sanitary system (latrines) was identified as a major problem that is affecting the health of community dwellers.

The lack of employment opportunity was seen as a major problem for women in the Project area. As a consequence women are the one migrating outside the country. This situation is more acute in Vicente Noble and Tamayo.

The main actions identified by participants who could increase the standard of living were the construction of irrigation infrastructure and construction of social infrastructure such as clinics, school and latrines.

The agricultural economic survey was conducted for about 60 farmer samples in the Project area. The general information of the households in the Project area is outlined below based on information about 62 farmers in the Project area selected from the previous survey during Phase-1 period. The details are shown as annex tables.

Most farmers interviewed in the Project area own some land with an average size of 20 tareas (1.3 ha). Some farmers were beneficiaries of the Government land reforms program with an average plot of 32 tareas (2 ha). A list of Land Reform settlement in the Project area is presented in Table 3.1.3.

Some farmers interviewed engaged in sharecropping giving away between 33% and 50% of their production to the land owner. The annual rates for leased land vary among villages and depends on soil quality and access to water. In the Project area few own livestock or grassland.

The average households consists of 5 members including the spouse and children and headed mostly by a male. Regarding education, 51.6% of farmers only achieved a primary. The illiteracy rate in the Project area quite high and was estimated at 31% in 1993. (see Table 3.1.4)

Farmers in the area produce plantain as the major food crop. Additionally, some farmers grow banana, cassava, corn, and industrial tomato. As livestock is concerned, cattle, swine, sheep and poultry are produced in small scales mostly for family consumption.

Although households depend on agricultural activities as the main source of income, an important percentage (78%) derived income from such activities as working in other farms, as employee of public or quaisi public enterprises and engaging in commercial activities. Some households receive remittances from relatives leaving outside de village especially in the United States and Spain. In fact 38 % of the household interviewed received remittances in 1998. There has been some migration to both Santo Domingo and abroad specially The United States and Spain. Young females are the segment of the population who migrates to Europe. In terms of household monthly expenses 60% is devoted to food consumption. The average monthly expense for the survey sample was DR$7,473.

Regarding drinkable water only 65% of the population in the Project area have access due to lack of aqueducts at the villages. About 78% have access to electricity although there is some power shortages during the day (see Table 3.1.4). The electric power shortages have severely affected irrigation on those farms that have electrical water pumps specially in Penon, Jaquimeyes, Fundación and La Hoya.

Most of the production in the Project area is being channeled into the market through local Middlemen (90%). Plantain production is sold mainly outside the area in Santo Domingo. The great majority of animals are sold within the Project area from farmers to middlemen.

The average wage paid to hired labor in the Project area DR$80/day plus breakfasts. At present there is not seasonal shortages of labor. Farmers rely on machinery (95%) for land preparation. All of them use the machine service from the government (SEA) at a subsidized rate.

In the Project area few farmers (38.7%) participated in training course on cropping technology. SEA and Non Government Organization sponsored most courses. The level of participation in the association activities is very limited (46.7%). Those who belonged to any association did so to obtain credit (54.8%), to market their crops (22.5%) ; and to have access to irrigation water (9.6%).

According to the survey 67.7% of the farmers could not get credit needed to buy agricultural inputs. Farmers who obtained loans for their crops got them from the Agricultural Bank (BAGRICOLA) at an interest rate ranging from 18% to 28% annually. Most farmers (90.3%) used local lenders to borrow money for their agricultural operations. The interest rate paid in most cases was around 20%/month. Few farmers (9.7%) obtained loans for their crop activities from Non Government Organization.

3.2 Natural Conditions

3.2.1 Land Resources

(1) Soils

A soil study at semi-detail level was made by INDRHI in 1982 covering a total land area of approximately 8,040 ha; That soil study includes the entire area of about 6,960 ha subject to the present Feasibility Study. The soil study report made by INDRHI includes soil and land capability maps at scale 1:20,000. That soil study identified six (6) soil series named as: series Fundación (Fu), Canoa (Ca), Santana (Sa), Tamayo (Ta), Habanero (Ha), and series Vicente Noble (VN); and five (5) associations of soil series named: Fundación-Bombita (Fu-Bo), Canoa-Bombita (Ca-Bo), Jaquimeyes-Tamayo (Ja-Ta), and Tamayo-Fundación (Ta-Fu). The main characteristics of each soil series are described below and summarized in Table 3.2.1, and their field distribution is indicated in Figure3.2.1.

(a) Series Fundación (2,270 ha): This soil series is classified as Ustic Torrifluvents, fine loamy. This soil is formed from fine alluvial material, with texture varying from silty loam, loamy clay, and sandy loam. The basic infiltration rate is 1.2 cm/hr. The soil is moderately deep. The pH is slightly alkaline; Cation exchange capacity is from medium to high, and base saturation percentage is high. Some areas present slightly accumulation of salts due to inadequate irrigation and drainage.

(b) Series Canoa (130 ha): Classified as Aquollic Salortids, fine clayey. Formed from fine alluvial material with high content of carbonates. The texture is mostly clay and silty loam. The basic intake rate is 1.1 cm/hr. The soil depth is medium. The pH is alkaline; Cation exchange capacity and base saturation percentage are high. Some parts of this soil present salinity problem, aggravated by poor drainage conditions.

(c) Series Santana (80 ha): Classified as Typic Ustipsamment; Include soils located along the margins of Yaque del Sur river, with high content of sand and frequently affected by floods. This soil series is shallow, with excessive natural drainage;

(d) Series Tamayo (1,470 ha): Classified as Typic Ustifluvent, fine loamy, calcareous. Alluvial soils, with little development of profile differentiation. The soil is deep, with silty loam texture, well drained and medium to high water holding capacity; Basic infiltration rate is 0.4 cm/hr. The cation exchange capacity and base saturation percentage are high. The pH is 7.5. This soil does not present salinity problem.

(e) Series Habanero (350 ha): Classified as Typic Calciorthid, loamy; Formed from medium and fine alluvial calcareous materials. Moderately deep. The texture is loam and clay loam; The soils are well drained and do not present problem of surface stones neither erosion. The cation exchange capacity varies between low to medium, and the base saturation percentage is high; the pH is 7.7.

(f) Series Vicente Noble (150 ha): Classified as Typic Torriorthent, fine loamy, calcareous; Formed from fine alluvial materials; The texture is clay loam; Well drained; the basic infiltration rate is 0.8 cm/hr. The cation exchange capacity and the base saturation percentage are high; the pH is 7.4.

The soil association present in the Project area are Fundación-Bombita (840 ha), Canoa-Bombita (180 ha), Jaquimeyes-Tamayo (345 ha), association Tamayo-Fundación (260 ha), and others non-classified areas (885 ha).

(2) Land Capability

The soil study made by INDRHI in 1982 presents an assessment of land capability for the land area of the present Feasibility study. The land capability assessment was made following the USDA classification system, and the result is summarized below (Ref. Figure 3.2.1).

Soil Series or Association	Map Symbol	Capability Class	Area (ha)	% of Total Study Area	Limiting Factors	Recommended Use
Fundación	Fu	IIs	2,270	32.6	Salinity risk if irrigation is not properly manage.	Plantain, banana,
Fundación-Bombita	Fu-Bo	IIIsh	840	12.1	The salinity risk is higher than Fundación series. Irrigation & Drainage must be properly managed.	Rice, plantain, banana
Canoa- Bombita	Ca-Bo	VIs	180	2.6	Imperfect natural drainage, salinity	Rice, coconut, pasture.
Canoa	Ca	VIsh	130	1.9	Imperfect natural drainage, salinity risks.	Rice
Santana	Sa	VIsh	80	1.1	Coarse texture & Frequent Flood risk	Vegetables during dry season
Jaquimeyes-Tamayo	Ja-Ta	IIIsh	345	5.0	Poor drainage	Plantain, Tomato, Banana
Tamayo-Fundación	Ta-Fu	IIs	260	3.7	Little limitations	Plantain, banana, tomato, pepper
Tamayo	Ta	IIs	1,470	21.1	Little limitations	Plantain, banana, tomato, pepper
Habanero	Ha	IIIes	350	5.0	High content of carbonates	Improved pasture
Vicente Noble	VN	IIIes	150	2.2	Erosion risk,	Plantain, banana, tomato, pepper
Others no Classified			885	12.7		
TOTAL			6,960	100		

Land capability classification	Definition of class
Class-I	Class-1 soils can be used continuously for intensive crop production with minimum attention other than good farming practices.
Class-II	Class-2 soils have more limitation than Class-1 soils for intensive crop production, such as moderately steep slopes (2-5%).
Class-III	Class-3 soils have severe limitations and require more special conservation practices than Class-2 soils to keep them continuously productive. They have shallow soil, steep slopes of about 6-10% or shallow water tables.
Class-IV	Class-4 soils have severe limitations and need a greater intensity of conservation practices for cultivated crops than Class-3 soils. Most of the time these soils should be in "permanent" crops, such as pastures
Class-V	Class-5 soils are not likely to erode but have other limitations, such as boulders or wetness, which are impractical to correct and thus cannot be cultivated. They should be used for pasture, range, woodland, or wildlife habitat.
Class-VI	Class-6 soils are suitable for the same uses as Class -5 soils, but they have a greater need for good management to maintain production because of such limitations as steep slopes or shallow soils.
Class-VII	Class-7 soils have very severe limitations and require extreme care to protect the soil, even with low intensity use for grazing, wildlife, or timber
Class-VIII	Class-8 soils have such severe limitations (steep slopes, rock lands, swamps, delicate plant cover) that they can be wisely used only for wildlife, recreation, watersheds, and esthetic appreciation.

3.2.2 Agricultural Climate

The climatic data for the Feasibility Study Area are taken from INDRHI's meteorological station located in Penon, at North latitude of 18°17'47" and West longitude of 71°11'16", and elevation of about 4 m.a.s.l. The maximum elevation in the Feasibility Study Area is about 30 m.a.s.l. The main climatic feature of the Project area is its arid condition, with the potential evapotranspiration being higher than rainfall in all months of the year. The average annual rainfall is 662 mm; with two short raining period, first from May to June, and second from September to October. The highest monthly rainfall is in September with average of 105 mm/month, and the lowest rainfall occurs in January and February, with about 17 mm/month, respectively. The average annual evapotranspiration is 2,077 mm; The highest monthly evapotranspiration is in July with average of 207 mm/month, and the lowest average evapotranspiration occurs in December, with about 131 mm/month (Ref. Table 3.2.2).

There are not large variations in the average monthly temperature; The hottest months are July and August, with mean monthly average temperature of 27.7 °C respectively, and lowest mean monthly temperature is about 24.4 °C on January (Ref. Table 3.2.2).

3.2.3 Hydrology

(1) Yaque del Sur River in the Project area

The area of "Yaque del Sur Lower Reaches Irrigation and Drainage Project" is located on the downstream of Santana headworks, of which catchment area is 4,587 km^2. The headworks are situated at 51 km from the Caribbean Sea and the average river gradient below is 1/1,700 or 0.0005882.

The Yaque del Sur River runs south-westerly from Quita Coraza through a valley which ends near Santana headworks to the north of Vicente Noble. From this point, the river turns its course to the south. Tamayo is situated at right in the flow direction of the river and subject to get inundated.

From here, the river flows southward to Mena and then turns toward Canoa to the south of Vicente Noble. A part of the waters, particularly during the wet season, flow southerly through Caño Trujillo and Dren Los Tomates toward Rincon Lagoon. From Canoa, the river goes southward to Palo Alto. The river stretch between Canoa and Palo Alto is sandwiched by the national road and a railway or another national road, which block the flood waters and causes inundation in the area.

From Palo Alto, the river turns to the southwest flowing to Cabral, then turned to the east towards the Caribbean Sea. The tide affects the river water level up to La Hoya, which is located at 5 km from the confluence.

(2) Available Water at the Yaque del Sur River

During the Phase-1 period of the Study, available waters were estimated by month using actual hydrological records and simulation models. According to the results, the available water at Villarpando headworks amounts to 1,053 MCM/year on the average under present condition, while that at Santana headworks (Conuquito) totals to 779 MCM/year. Out of the available water at Santana headworks, 320 MCM/year is extracted to the Santana Main Canal, 244 MCM/year is used or available on the downstream, and 270 MCM/year is discharged to the Caribbean Sea. The results of the simulation are given in Table 3.2.3.

Monthly dependable flows of 1 in 5 years and 1 in 10 years were also estimated on the basis of the river discharge records. The 80 % dependable discharges at Santana headworks vary from 11 to 20 m^3/sec. The dependable discharges at Palo Alto changed largely after completion of Sabana Yegua Dam in 1979. The dependable flow increased by 2 to 3 m^3/sec during the dry season, whereas the floods have been controlled as well during the wet season.

The dependable flow at Villarpando headworks, Santana headworks and Palo Alto is given below:

unit: m^3/sec

Station	Period	Probability	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Villarpando	1960-1982	Mean	25.2	19.7	18.4	20.2	36.9	54.5	46.4	48.8	66.6	70.9	53.9	39.3
		80%	12.1	8.1	8.5	8.9	18.7	23.0	20.9	28.4	39.8	42.7	33.0	20.8
		90%	9.2	5.9	6.4	6.6	14.3	16.6	15.5	22.8	32.4	34.8	27.1	16.2
Conuquito	1984-1993	Mean	19.0	17.4	17.8	17.4	25.2	29.4	22.4	21.7	33.4	29.0	28.1	21.9
		80%	13.2	12.7	13.0	11.4	13.0	12.8	12.7	14.3	17.8	19.2	18.0	16.7
		90%	11.2	-	11.3	-	-	9.4	-	-	13.7	-	-	-
Palo Alto	1968-1979	Mean	6.3	3.0	3.3	5.3	19.0	29.3	21.6	20.4	43.6	50.2	33.5	19.4
		80%	2.5	1.1	0.9	0.8	5.5	9.7	4.8	9.8	27.6	30.5	19.3	7.2
		90%	1.8	0.7	0.6	0.4	3.5	6.4	2.8	7.3	22.7	24.7	15.4	4.9
Palo Alto	1980-1990	Mean	9.8	7.8	6.6	7.0	17.1	18.1	20.3	12.1	17.4	21.6	14.5	9.1
		80%	4.8	4.2	3.8	3.4	5.6	6.0	4.0	5.5	7.1	10.8	5.8	6.0
		90%	-	-	3.0	2.6	-	4.0	-	4.0	5.1	8.2	4.1	-

(3) Flood

Gumbel and Log Pearson Methods were employed to estimate frequency of floods. The peak flood discharges at Villarpando derived from rivergauge records of 20 years before the completion of Sabana Yegua dam, are 832 m^3/sec for 50 years return period, and 950 m^3/sec for 100 years, while the design flood for Villarpando headworks (concrete ogee weir of 115 m long) is 1,250 m^3/sec. However, taking into account the area and rainfall of its catchment (3,720 km^2, 1,500~2,000 mm/year), the estimated floods are considered rather small.

In order to estimate design floods properly, design floods for other Projects can be referred. The design floods of Hatillo and Aguacate dams are compared below:

Headworks/dams	Catchment Area (km^2)	Flood (100 years, m^3/sec)	Specific discharge (m^3/sec)
Villarpando HW	3,720	1,250 1)	0.34
Hatillo dam	1,192	1,848	1.55
Aguacate dam	747	1,965	2.63

Note: 1) Return period is not known. This is the design flood discharge for the concrete ogee weir.

Flood discharges are also estimated by Creager's formula with regional constant "C" as follows:

$$Q = CA^{(A^{-0.05}-1)}$$

where, Q; discharge (m^3/sec)
C; constant
A; catchment area (km^2),

The "C" value for the design floods of 1 in 100 years of Hatillo and Aguacate dams are 12.8 and 17.0, respectively. If these C values are adopted for Villarpando, the floods are estimated to be 2,980 (0.8 m^3/sec/km^2) and 3,958 m^3/sec (1.1 m^3/sec/km^2), respectively. Judging from the hydrological conditions and circumstances, both the C values and specific discharges for 100 years are considered reasonable.

Lack of long-term rivergauge records, it is quite difficult to estimate the probable floods of 1 in 100 years or more at Santana headworks or lower reach. Using seven years records before the Sabana Yegua dam, 1 in 50 years flood is estimated at 397 m^3/sec by the Gumbel Method, but it is considered too small. Assuming the same C values (12.8 and 17.0), the 1 in 100 year floods at Santana headworks are estimated at 3,231 and 4,291 m^3/sec, of which specific discharges are 0.7 m^3/sec/km^2 and 0.9 m^3/sec/km^2, respectively.

Floods brought by Hurricane Georges are evaluated in Section 3.9.

(4) Water Quality

Water quality was checked on pH and salinity (electric conductivity) to compare with the previous field tests. The pH and electric conductivity (EC) values at Santana headworks, El Jobo, Palo Alto, and Cachón are given below:

Location	Phase-2 (Dec, 1998)		Phase-1 (Jan 1998)	
	pH	EC (mS/cm)	pH	EC (mS/cm)
Santana Headworks	7.6	0.49	8.1	0.91
El Jobo	7.8	0.49	7.7	1.09
Palo Alto	7.9	0.47	7.9	1.36
Habanero	7.8	0.56	7.8	1.36
El Cachon	7.8	0.54	7.2	0.95

Mainly due to more river flow during this study period (Phase-2), both the pH and EC values are considered low enough for irrigation at any location along the Yaque del Sur River.

3.3 Agriculture Production

3.3.1 Present Land Use

The Feasibility Study covers a total area of about 6,960 ha. The present land use of this area is estimated using the topographic map at scale 1:10,000 prepared by JICA Study Team, statistical data from INDRHI and Ministry of Agriculture, and field survey. An estimated net area of approximately 5,885 ha or about 84.6 % of the total Project area is devoted to irrigated agriculture production. The land covered by irrigation systems is used at low intensity rate, mainly due shortage of irrigation water. The land use for the rest of the Project area is occupied by towns, villages, roads, and other buildup areas about 760 ha; Shrubs and bush about 190 ha; and rivers and other water bodies about 125 ha (Ref. Figure 3.3.1).

3.3.2 Cropping Pattern and Farming Practices

(1) Main Crops and Cropping Patterns

The main crop planted in the Feasibility Study Area is plantain which occupy about 77 % of total planted area; Other important crops are banana, cassava, pepper, tomato, corn, melon, papaya, beans, and rice. Coconut is planted along the edges of a large percentage of farms, mainly to indicate the boundaries of farms. The 5 years average of total area planted under irrigation conditions within the Feasibility Study Area is about 4,430 ha; This data is based on statistics reports from INDRHI. The crops most extensively planted are plantain, which covers some 3,430 ha, that represents 77.4 % of total planted area; Banana is the second most extensively planted crop, with about 180 ha or 4.1 % of the total average annual planted area. The average annual area planted by crops under irrigation conditions within the Feasibility Study Area is indicated below. The present cropping pattern is indicated in Figure 3.3.2.

Crop	Average Planted Area (ha)	% of Total planted area
Plantain	3,430	77.4
Banana	170	3.8
Cassava	160	3.6
Pepper	140	3.2
Tomato	120	2.7
Melon	115	2.6
Papaya	110	2.5
Corn	70	1.6
Beans	50	1.1
Rice	20	0.5
Sweat potato	20	0.5
Pigeon pea	10	0.2
Eggplant	15	0.3
TOTAL	4,430	100.0

(2) Farming Practices

Present farming practices in the Feasibility Study Area were investigated based mainly on the results of interview to 59 farmers, getting information from extension workers of Ministry of Agriculture (SEA), and local staff of irrigation district offices. Farming practices implemented by a large percentage of farmers within the Feasibility Study Area are inadequate, and this is one important cause of low yields obtained in this area. Inadequate farming practices are caused by problems such as: i) lack of water and therefore long irrigation intervals, and inadequate on-farm water management; ii) lack of tractors for land preparation; iii) use of poor quality seedlings and seeds; iv) lack of farmer' knowledge on right amount, kind, and timing of fertilizer application; v) lack of farmers' knowledge on adequate control of insects and nematodes problems; vi) often late control of weeds that cause competitions on water and nutrients with the crops; and vii) low coverage and quality of extension services. Present farming practices of main crops in the Study area are shown in Table 3.3.1 and summarized below.

(a) Farming Practices for Plantain and Banana:

The farming practices normally implemented by producers of plantain and banana are very similar. Land preparation consists in harrowing and plowing; Small farm size farmers make land preparation using a combination of tractors and bulls. Medium and large farm size farmers use only tractors. Some 44 % of interviewed farmer said that some times they have difficulties in obtaining tractors for preparing their land.

Plantain and banana are planted after opening holes by hand at planting distance of 2.5 m by 3 m, resulting in an average density of about 1,300 plants per ha. Recently, few advanced farmers have adopted a more dense planting distance of up to 2,000 plants/ha. Many farmers plant annual crops such as melon and pepper intercroped to plantain when it is still small. Seedlings of plantain and banana are taken from old plantations and in many cases treatment to prevent the transmission of diseases, insects, and nematodes are not adequate. A large percentage of plantain and banana farmers do not replant their field for periods as long as 30 years, although the yield begins to decrease after a plantation is 6 years old. The varieties of plantain most commonly planted within the Project area are "Macho por Hembra", "Gigante" and "Enano"; The varieties of banana are "Media mata", "Cavendich", and "Gross Michel".

The result of farm survey indicates a wide range in the amount of fertilizer applied to plantain and banana. About 30 % of farmers do not apply fertilizers. A large number of those farmers that apply fertilizers do not know the recommended quantities and kind of fertilizer that they should apply; Neither they know the adequate timing and method of fertilizer application. The range of N fertilizer applied to plantain varies from as little as 5 kg/ha to as high as 267 kg/ha. The application of P fertilizer varies from as little as 5 kg/ha to as high as 135 kg/ha; and K fertilizer varies from as little as 5 kg/ha to as high as 128 kg/ha. The average cost of fertilizer input represents about 9 % of total production costs.

Many farmers reported the incidence of some insects, specifically Cosmopolitan sp., and nematodes. But most farmers do not know if it is economically profitable to apply pesticides for the control of insects and nematodes; neither they know the appropriate kind and quantities of pesticides to apply. Some 36 % of interviewed farmers said that they do not use pesticides. Some few advanced farmers have observed increase in yield when they do not apply insecticides and nematicides.

Because of scarcity of irrigation water, irrigation intervals are too long (often 30 to 45 days) and this is an important cause in reduction of yield of plantain. The control of weeds is done manually by almost all farmers. Often, weed control is done late after weed have grown too much and compete with the crop for water and nutrients. Harvesting and handling of plantain and banana are done manually, at intervals varying between every 15 to 30 days; the most common harvesting interval is every 21 days.

(b) Farming practices in Cassava:

Cassava is a crop preferred by a relatively high percentage of farmers because it can withstand long irrigation intervals, and because it simplicity of management. A large percentage of cost for production of cassava is the inputs on labor. Plantain materials are mostly obtaining from previous harvest in the same field or from neighbor farmers. Most farmers use a mixture of traditional varieties. Long irrigation intervals cause yield decrease. Farmers in the Project area apply only small quantities of fertilizers, and seldom use pesticides. An important problem that sometimes affects the cassava plantations is attack of insect Elliotys sp.

(c) Farming Practices for Tomato Production:

The Ministry of Agriculture has defined some farming practices that should be applied by tomato farmers because of the high risk of contamination of tomato plantation with the deadly virus disease transmitted by the White fly (Bemisia tabaci). The regulation measures adopted by MA include the limitation of planting period of tomato from October to December, and some norms for the management of the crop from seedling up to harvest. Among the requirement for tomato plantation indicated by the Ministry of Agriculture are: i) to grow seedling free from virus infection, ii) there should no be a long difference of time in planting contiguous land areas, iii) to make efficient chemical control of White fly

(Bemisia tabaci), iv) monitoring of the population of White fly, etc.

Tomato is mostly planted by transplanting method. Tomato seedlings are grown largely in open field seedbed and in less extend in seedling trays kept in shaded areas. Irrigation is applied at intervals between 8 to 10 days. The large majority of farmers have not receive training on the proper application of irrigation water. Application of irrigation water is very poorly managed by most farmers in Azua area, causing frequent excess or deficit of water available in the root zone of the crop.

Poor management of on-farm irrigation on tomato fields is one of the main causes of soil degradation such as waterloging, salinization, and loss of natural and applied plant nutrients, and therefore causing low yield of tomato. Fertilizers are applied twice during the growing period of tomato; the first amount of fertilizers is applied shortly after transplanting, and the second application is made at the beginning of flowering stage. Very few farmers make soil analysis to determining the amount of fertilizers required by the crop. The average amount of fertilizer applied varies in the range of 10 to 15 kg/ha of nitrogen, and 5 to 10 kg/ha of phosphorous and potassium nutrients. Weed control is done manually using hoe. Harvesting of tomato in done manually.

3.3.3 Present Crop Yield and Crop Production

(1) Crop Yield

The average yield by crops within the Project area is estimated based on results of farm survey and statistical data obtained from the Ministry of Agriculture. The average yield of plantain obtained from interviewed farmers is 18 ton/ha/year. There is a wide range in yield of plantain obtained by interviewed farmers; The lowest reported yield is about 7 ton/ha/year and the highest reported yield is about 26 ton/ha/year. Some 53 % of farmers reported yield of plantain lower than the average. Average yield of others crops is summarized bellow.

Crop	Average Yield,(interview data) (ton/ha)
Plantain	18
Banana	24
Cassava	6.5
Pepper	13
Tomato	21
Melon	30
Papaya	44
Corn	1.8
Beans	0.9
Rice	2.2
Eggplant	15
Sweat potato	12
Pigeon pea	1.5

(2) Crop Production

Present crop production within the Feasibility Study area is much lower than potentially attainable production. As described in farming practices section, the main

limiting factors for attaining high agricultural production are: i) low cropping intensity, averaging only about 75 %; ii) lack of irrigation water that causes long irrigation intervals and inadequate on-farm water management; iii) use of poor quality seedlings and seeds; iv) difficulty in land preparation due to lack of tractors; (v) inadequate application and management of fertilizers; (vi) inadequate control of insects and nematodes; and (vii) inadequate control of weeds.

The estimated 5 years average crop production within the Feasibility Study area is estimated as shown in table below.

Crop	Average Yield (ton/ha)	Average Planted Area (ha)	Total Annual Production (ton)
Plantain	18	3,430	61,740
Banana	24	170	4,080
Cassava	6.5	160	1,040
Pepper	13	140	1,820
Tomato	21	120	2,520
Melon	30	115	3,450
Papaya	44	110	4,840
Corn	1.8	70	126
Beans	0.9	50	45
Rice	2.2	20	44
Sweat potato	12	20	240
Eggplant	15	15	225
Pigeon pea	1.5	10	15

Livestock production within the Feasibility Study area is negligible; There is not irrigated land area used for pasture production. Only few farmers are keeping cows using grass from areas of poor drainage conditions and leaf-over from sugarcane and agriculture.

3.3.4 Main Problems in Agriculture Production

The agricultural production within the Feasibility Study area is characterized by low production out put. Low production out put is caused by low cropping intensity and low yield of crops. The main problems causing low cropping intensity and low yield of crops are briefly described below (Ref. Figure 3.3.3).

(1) Lack of tractors for land preparation and bulldozers for land leveling. There only 13 tractors providing land preparation service for a large area, including the Project area; Almost all the land preparation services within the Study area are provided by the Ministry of Agriculture. The private sector is not providing service of land preparation in this area.

(2) Inadequate on-farm water management. This is related to scarcity of irrigation water that causes long irrigation intervals. Also, it is due to the lack of farmers knowledge on water application. Some times water logging in the planting field is observed, and this is a cause of loss of plant nutrients.

(3) Use of poor quality seedlings and seeds. Seedlings of plantain are taken directly by farmer from old plantations, and farmers do not do proper treated to control transmission of diseases and nematodes. The seedlings used are mixtures of several varieties, therefore the plantations are not uniform. Small farmers have difficulties

in finding good quality seeds of pepper, melon, and papaya because local supply is erratic.

(4) Inadequate application of fertilizers: Some 29 % of farmers that were interviewed do not apply fertilizers; There are a large differences, in the amount of fertilizers applied by neighboring farmers within the Study area. For example the application of nitrogen to plantain vary in the range from 5 kg/ha up to 267 kg/ha, and similar for phosphorus and potassium fertilizers. One important cause of this problem is due to lack of farmer's knowledge on right amount to apply, right kind of fertilizer, adequate timing of application and adequate placement of fertilizer.

(5) Inadequate control of insects and nematodes, especially in plantain, due to the lack of farmers knowledge on pest management, kind and quantities of pesticides to use: About 36 percent of farmers interviewed during the field investigation do not apply pesticides for control of insects, nematodes, and diseases. Majorities of farmers that apply pesticides do not know what are the most effective pesticides or economic method of pest control.

(6) Use of unsuitable planting densities or planting distances for each crop, and lack of implementation of intensive cropping patterns.

3.4. Marketing and Prices

The marketing system for agricultural commodities in the Project area is not well developed and there is not sufficient production of the basic staple food to satisfy local demand

In the Project area plantains, Banana is the only crops with some surplus to be channeled mostly to Santo Domingo and export. There occur some production of papaya, industrial tomato and melon that traded outside the Project area. Cassava, corn and bean are produced to satisfy local demands.

3.4.1 Marketing System of Main Agricultural Crop Production

The agricultural marketing system is very simple in the Project area. Five different level were identify from the farm gate to the final consumer. Plantain growers sell their production directly to truckers and local middlemen at the farm gate. It was estimated that 90% of plantain production in the Project area are classified as class one and is transported to the Santo Domingo market or to export. The remaining 10% is considered second class and channeled to local markets within the Project area. In the case of banana, the entire production is sold at the farm gate to local intermediaries and channeled to local market outlets. Figure 3.4.1 and Figure 3.4.2 show the marketing system for plantain and banana in the Project area.

Cassava, red beans and corn production is oriented mainly to satisfy domestic demand (Figure 3.4.3 and 3.4.5).

The marketing of industrial tomato is highly organized and simple. Production is contracted directly from the processing plants. There exist an agreement between producers, agro processing plants and the Ministry of Agriculture to establish price, the area to be planted and buying conditions. About 95% of the industrial tomato is processed.

Similarly, melon is produced under contract with local exporters. Only a small fraction of the production that does not meet the requirement for export is sold at local market and Santo Domingo.

Papaya and pepper have similar marketing channels. Production is sold at the farm gate by middlemen who transport them to Santo Domingo. Farmer participation on marketing activities is very limited. (see Figure 3.4.4).

Livestock products are marketed at a local level. Both meat and milk are sold directly to consumer at the local market and door to door.

3.4.2. Marketing of Farm Inputs

In the Project area farmers obtain fertilizers agrochemical inputs and seed from the Center for Input Sales (CEVEMA) run by the SEA and private agrochemical stores located in the agricultural areas.

Plantain seedlings are obtained from SEA and from previous production. There is not a selection mechanism to obtain and transport seed material that has greatly affected plantain yield in the Project area. The rest of the demand is met by private store or provided to farmers by agro processing or export firm (as it is the case of industrial tomato and melon).

In regard to Agricultural Machines SEA provides machines services for land preparation through the Center for Machine Services (CESMA) located in Barahona. There are few private tractors but are mainly used by their owners. The Service rate of Government owned tractors is much lower than the private ones and in some cases is free which prevents private firms from providing this kind of service

The coverage of the Government machinery service is small due to the availability of tractors and equipment. In the case of Barahona 50% of the machinery is in critical condition and only 13 tractors are available for land preparation.

3.4.3. Marketing of Consumer Goods

Most of the consumption of consumer goods is done through small local stores and public market plazas. Some sellers of consumers' goods offer their products at the local plaza once a week and provide local stores of consumer goods. In the last five years it has become common the sale of merchandise on the street (called flea market) with

merchandise coming from Haiti. Similarly, some local vendors obtain merchandise at the Haitian border to market them in their villages.

3.4.4. Trade Condition

Within the area, there are exports of plantains to the United States and Europe. There are also some unreported exports to Haiti. The production of plantain from the area receives better prices than the rest of the plantain cultivated in the country. Plantains cultivated in Tamayo and Vicente Noble are called "Barahona plantain" and usually have higher price both at the national and export markets other than plantain coming from the north. Most of the export are shipped through Haina Port, which is about 70 miles from the area. The Barahona International airport was open but it is not in full operation.

There is some government intervention in the marketing of agricultural products in the region. INESPRE has been reactivated by the Government to provide assistance to producers and consumers, especially those affected by Hurricane George. Although most of the plantain production was wiped out by the Hurricane, the Government has not allowed import of plantain. In some cases the Government has banned plantain exports to avoid shortage at the domestic market.

3.4.5. Marketing Information System

The marketing information system is practically non existent in the Project area. Price information at the different level in the marketing channel is collected by extension agents and sent to Santo Domingo in an irregular basis. In Santo Domingo the data collected is used for statistical purposes more than to establish marketing policy actions and develop and setting policy objectives.

3.4.6. Market Place Condition

The market infrastructure in the Project area is not adequate or nonexistent. Only in Vicente Noble and Tamayo exist infrastructure. However, there not exist facilities for the display and storage of products. Most of the time agricultural produces are displayed on the ground and there is not much concern for their quality and preservation. The degree of value added is minimal and prevails an array of measures and weights for buying-selling transactions. There is not supervision by the local authorities or any public institution (such as Secretariat for Public Health and Social Welfare) on safety and product standards.

3.4.7. Prices of Agricultural Products

Farm gate prices for plantain, the main crops in the Project area, show some fluctuation throughout the year. After the Hurricane George plantain prices skyrocketed. At the consumer level, plantain price went up from DR$1.25/unit in august to DR$6.50 in November. The marketing margin between producer and consumer price ranges from 35 to 70% of the final price. For most cases, prices are determined by the market with a heavy influence of local middlemen. In the case of industrial tomato there is a

predetermined price established in production contract by the agroindustries (Ref. Figure 3.4.6).

3.4.8. Agroprocessing Facilities

The level of agroprocessing in the area is very low. Plantain does not undergo any kind of transformation and industrial tomato production is transported to processing plants in Azua. Papaya and melon are also transported fresh to the nearest port in Haina. The only processing plant within the Project area is a rice mill located in Canoa. In the city of Barahona, nearby the Project area, operates some rice mill and export warehouses.

3.5 Irrigation and Drainage

3.5.1 Present Irrigation Areas and their Systems

(1) Present Irrigation Areas

The objective area in the Phase II stage, which is shown in Figure 3.5.1 is the irrigation area served by the Yaque del Sur river in the downstream of the Santana headworks except the area managed by CEA. The area is largely classified into four areas. First is the upstream right bank of the Yaque del Sur river, so-called the Tamayo area. Second is the upstream left bank area, so-called the Vicente Noble area. Third is the Canoa-Palo Alto area in the middle reaches. Fourth is the Peñon-Fundación area in the lower reaches. The irrigation area was measured by use of the detailed maps on the scale of 1 : 5,000 prepared in the beginning of Phase II by our JICA Study Team. The irrigation area is estimated at 5,885 ha in net in the downstream of the Santana headworks. The results are summarized as follows.

-	Tamayo area	940 ha
	Area served by small irrigation system	(624 ha)
	Area served by Santana system	(316 ha)
	Vicente Noble area	1,393 ha
-	Canoa-Palo Alto area	815 ha
-	Peñon-Fundación area	2,737 ha
	Total	5,885 ha

Note : measured by planimeter excluding settlement area and hilly area and then multiplied by 0.9.

The Tamayo and Vicente Noble areas are served by gravity irrigation system. One -third of the Canoa-Palo Alto areas belong to the Vicente Noble irrigation system. Two-third of the Canoa-Palo Alto areas and the Peñon-Fundación areas are totally served by pumps.

The Tamayo and Vicente Noble areas have been severely damaged by the flood caused by Hurricane George along the Yaque del Sur river. Many fields became uneven into small patches by erosion and sediment, which urgently need land leveling for application of

irrigation water. Farmers are gradually making a land leveling by tractors and motor graders. The Palo Alto and Peñon-Fundación areas are not severely damaged.

(2) Irrigation Systems

Existing irrigation systems are shown in Figure 3.5.1 and listed in Table 3.5.1.

There exist several small gravity irrigation canal systems in the Tamayo area. One is a system diverted from the Santana headworks, which is managed by CEA. It is called the Habitantes canal. The head intake of this canal is one of the seven intake gates of the Santana headworks, i.e., the other six gates are served for the Santana main canal. Others are two canal systems called the Charco Blanco and the Añon-Uvilla canals. Both canals divert water from the Yaque del Sur river by free intakes. All these canals are totally earthen. It is characterized that they are deep especially in the upstream reaches and meander.

Besides the Lateral B and Lateral H canals of the Santana canal system, which is supplying water to the sugarcane plantation under the management of CEA serve limited private lands located on the way of these canals.

The Vicente Noble area is served by one gravity irrigation canal system. This system consists of an head intake, a headrace and two main canals and several laterals diverting from these main canals. The intake has not a weir. The two main canals are provided with stone masonry lining in the most reaches. The laterals are of earthen-made. It is also characterized that all the canals are excessive deep and wide and meandering. It needs much amount of water to raise the water level to divert to supply water to fields. Private-owned small diesel pumps can be seen along the river.

Most of the canals in the Tamayo and Vicente Noble areas were buried with sediment or washed away by the flood of Hurricane George in 23 September, 1998. INDRHI is doing his best to restore the damaged canal system. As of the end of December 1998, many canals were restored.

The Canoa-Palo Alto area and Peñon-Fundación area are mostly served by pump irrigation canal systems. There are 29 pumping stations including two CEA pump stations and five IAD pumping stations along the Yaque del Sur river.

All the pumps are of electric motor-driven type and had functioned well except a few pumps. But, the flood of Hurricane George damaged most of the pumping stations. Pump stations working well as of the end of December 1998 are nearly half of all the stations. Suction pits are buried with sediment in most pumping stations located in Canoa-Palo Alto area. Some of pumps were inundated with flooding water in 23 September 1998. Canals are mostly earth canal type and partly provided with concrete lining or stone masonry. Canal systems are not maintained well and more or less deteriorated.

Canal-related structures are also deteriorated or do not exist. Most of major canals have no inspection roads.

(3) Villarpando Headworks

The headworks consists of a weir and an intake equipped with three sluice gates to YSURA Head Race, and a sand flushing sluice equipped with one radial gate. To lead river water from the center of the river to the intake, an access canal has been provided. The weir portion has a crest length of 870 m across the river, which is largely divided into two parts such as an overflow section of 115 m wide and an earthfill dam section in the remaining part. The overflow section is made by rock masonry works. The crest elevation is El. 287.60 m. The earthfill section has a crest elevation of El. 292.60 m in the portion contacting to the intake and the flow section so that even maximum design flood of 1,250 m^3/sec is safely drained at the water level of El. 291.00 m, and El. 290.00 m in the other part, which are designed to function at the time of the design flood of more than 740 m^3/sec. The earthfill section is center core type protected by random rock fill in the upstream and downstream surfaces.

All the intake gates are manually operated. At present, of three only one gate can be operated and the other two gates are damaged in the spindles. The gate operation is carried out by hoisting and hanging by a backhoe according to the Azua irrigation zone staff. It is impossible to operate frequently and timely as required. The sand flushing gate has also been damaged in the hoisting equipment and left in closed position. Due to no opening of the gates, water way to and in front of the intake gate suffers from the sedimentation of sand and gravel. Such conditions allow silt, sand, and gravel easy access into YSURA head race.

The headworks was largely damaged in the right side earthfill section by the flood of Hurricane George on September 23 1998. According to the gate operator, the river water level reached at peak at AM. 7:30. The water level had been over the crest of the intake structure. After that, the water level suddenly decreased. This time is estimated that the right side dike was broken. Concrete structures are little damaged. The sand scouring sluice, which was out of order and left in closed position was completely damaged with twisting in the gate leaf. The right side earthfill section was almost completely washed away in all the sections, although center core of the earth dike is remained in some parts. The river water coming from the San Juan river is flowing through the damaged portion. Water coming from the Sabana Yegua dam is being led to the intake structure by simple training-dike tentatively made with river deposit. INDRHI is making a plan to reconstruct the right side dike as emergency works.

3.5.2 Organization for Operation and Maintenance

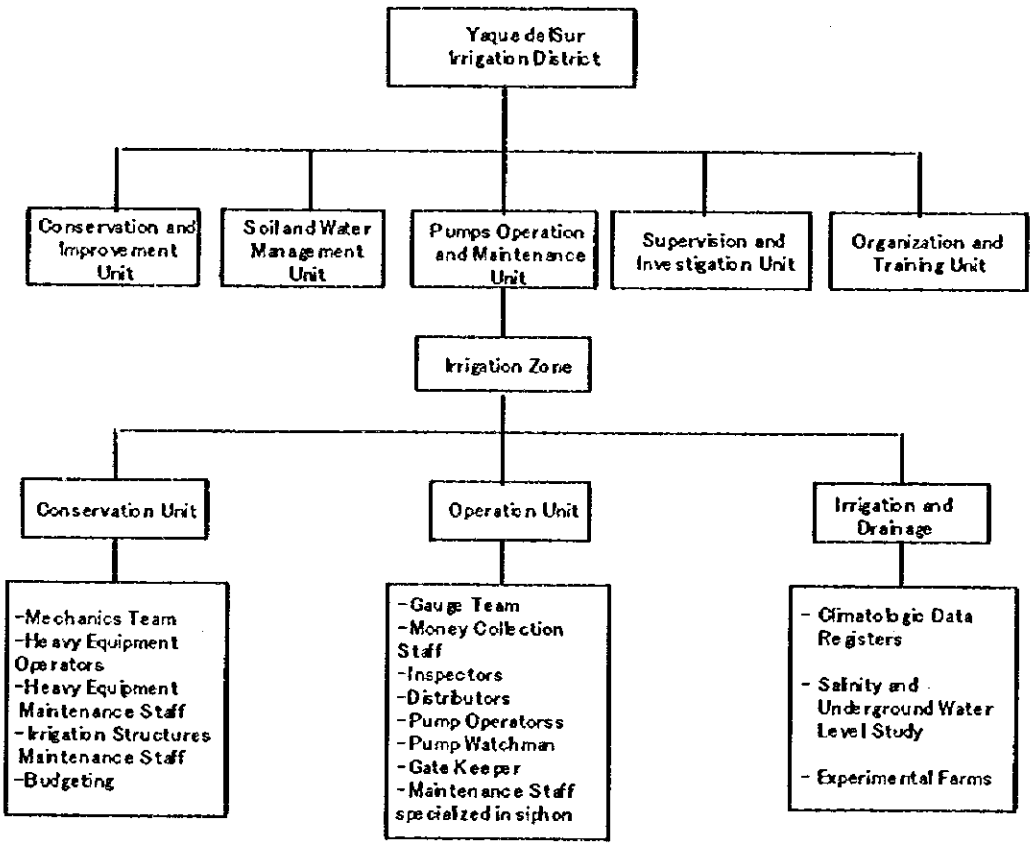
The Project area belongs to Yaque del Sur Irrigation District except for the Tamayo area, which belongs to the I.D. Lago Enriquillo.

(1) Irrigation District Office

(a) Organization

Organization structures of Yaque del Sur and Lago Enriquillo Irrigation District are the same as other Irrigation. The District office has five units: Conservation and Improvement, Water and Soil Management, Pumps Operation and Maintenance, Supervision and Investigation, and Organization and Training. Under a district manager, one or two staffs are assigned in each of the units and one irrigation zone office exists. This zone office substantially works for operation and maintenance of irrigation.

Organization of Yaque del Sur Irrigation District



The unit of conservation consists of a mechanic team, operators of heavy equipment, maintenance staff of heavy equipment, maintenance staff of irrigation and drainage facilities, etc. The unit of operation consists of a gauging team, water charge collectors, irrigation inspectors, irrigation distribution staffs, pump operators, pump watchmen, etc. The unit of irrigation and drainage consists of staffs of climate data compilation and soil investigation.

(b) Budget

Total budget of the I.D. Yaque del Sur is about DR$ 23 million as shown in the following table. Personnel payroll accounts for about one-fourth and rehabilitation and maintenance of irrigation and drainage facilities account for nearly a half of the total budget. Excluding the budget for the canal construction contracted in Santo Domingo (54.82 km), it is about DR$ 19.5 million. Budget per one hectare is around DR$ 710.

Budget during the last two (2) years:

Unit : DR$

Year	1996	1997
Personnel payroll	5,688,348.00	6,324,240.00
Fuel and lubricant expense	943,735.70	900,437.00
Administrative expenses	150,251.00	250,313.00
Vehicle repairing	101,240.00	240,343.54
Pump repairing	300,000.00	350,343.50
Small work construction	1,600,400.00	1,547,340.00
Rehabilitation of hydraulic structure	500,000.00	670,340.00
Floodgate installation	200,000.00	240,350.00
Canal construction contracted in Santo Domingo (54.82 km)	4,429,623.21	3,430,347.80
Rehabilitation and/or construction of berm with equipment (152.25km)	2,100,736.90	2,550,600.00
Weed cut and sediment extraction (labor) (545 km)	3,035,966.90	2,500,340.00
Canals and/or drainage cleaning with equipment	3,205,486.40	3,400,000.00
Collection of water charge	500,000.00	600,000.00
GRAND TOTAL	22,620,788.11	23,005,024.84

Note : Year 1996 and 1997 are before the Irrigation District Lago Enriquillo was separated from I.D Yaque del Sur. Thus the figures above includes both Yaque del Sur and Lago Enriquillo.

(c) Water users and water charge

As shown in the following table, water users registered in INDRHI are about 4,126 in the Project area.

Table Number of Registered Water Users and Water Charge

Year 1997

Canal	Water users	W. users paid	Total W. charge (DR$)	Collected amount (DR$)	W.users paid (%)	Collected amount (%)
Vicente Noble	1,053	282	285,847	82,013	26.8	28.7
Santana	88	7	25,944	3,343	8.0	12.9
Los Habitantes	316	26	99,235	14,894	8.2	15.0
Charco Blanco	99	7	31,081	1,466	7.1	4.7
El Jobo	176	12	67,788	6,097	6.8	9.0
Palo Alto	182	32	48,189	7,933	17.6	16.5
Palo de Leche	277	94	58,705	18,646	33.9	31.8
La Isleta	467	193	62,749	31,389	41.3	50.0
La Hoya	147	25	27,989	8,760	17.0	31.3
Penon	248	78	45,860	17,338	31.5	37.8
Pescaderia	75	5	17,995	405	6.7	2.3
Jaquimeye	291	86	69,575	23,256	29.6	33.4
Fundación	206	50	47,351	9,993	24.3	21.1
Las Elenas	149	42	21,970	11,241	28.2	51.2
Bombita	19	6	5,158	2,687	31.6	52.1
Guaba de Mena	75	4	20,748	462	5.3	2.2
Habanero	52	3	35,221	9,779	5.8	27.8
Hato Viejo	156	77	24,908	12,073	49.4	48.5
Mena Penon	50	6	22,977	3,742	12.0	16.3
Total	4,126	1,035	1,019,290	265,517	25.1	26.0

Source : Division de usuarios, INDRHI

According to the General Regulation 555, the water charge is decided based on the expenses required for O&M of irrigation and drainage facilities including all the office expenses. Based on this Regulation, INDRHI estimates that about DR$ 600 / ha needs for the O&M in I.D. Yaque del Sur. The unit rate of the water charge is, however, set at very low rate as follows.

Yaque del Sur Irrigation District

-	Plantain and upland crops :	DR$ 160 / ha up to 10 ha
		DR$ 320 / ha for acreage over 10 ha
-	Paddy :	DR$ 320 / ha up to 10 ha
		DR$ 640 / ha for acreage over 10 ha

In case that water is taken by private pumps, the water charge is a half of the above values.

Lago Enriquillo District (former Neiba Irrigation Zone) DR$ 110 / ha

It is, however, a fact that only about 1,000 users or only 25 % of total registered users paid water charges in 1997. Its tendency did not change in 1998. Amount of water charge collected in 1997 was only DR$ 266 thousands or only DR$ 45/ha. Its amount is less than 10 % of total amount required for O&M works.

Collection of water charge is managed by one person in charge. Farmers have to go to the office to pay water charge. The reasons why farmers do not pay water charge are, farmers said (1) the water service is insufficient, we can not get water sufficiently and timely, (2) sometimes the person in charge of distribution gives water to farmers who do not pay water charge, and (3) the office is far from our houses.

(2) Water User's Organization

INDRHI has put the high priority on the formulation of water user's organization (WUO) for entire irrigation systems and strengthening existing organizations in order to execute operation and maintenance of irrigation and drainage systems by farmers themselves in line with the policy of the beneficiaries participatory approach.

I.D. Yaque del Sur newly started to guide farmers to make WUOs and got fruitful results that water users associations were founded in several pumping irrigation systems. The works to organizing farmers, however, have been obliged to suspend, since all the forces of I.D Yaque del Sur have been concentrated into emergency works to restore the irrigation systems damaged by Hurricane George.

According to the Organization and Training Unit of the I.D Yaque del Sur, WUOs were founded in Peñon and Fundación areas in early 1990s and the Unit newly started to be engaged in the organizing nucleus and association of water users in 1998. As of December 1998, following organizations were set up.

Name of Community	No. of Association	No. of Nucleus	Inaugurated Year
Jaquimeyes	1	4	1998
Peñon	3	19	Around 1991
Peñon 1	1	5	
Peñon 2	1	6	
Palo de Leche	1	8	
Bombita	1	7	1998
Pescadería	1	11	1998
Fundación	1		Around 1991

Water users organizations being made by the INDRHI are managed by the following members:

Board of Directors in Association
- One - President
- One - Vice president
- One - Treasurer
- One - Secretary
- Three - Other Committee Member

The association is generally made in each of pumping stations. Under the association, several nucleuses are established in each of laterals. In each nucleus, a distributor, an assistant and a maintenance staff are to be nominated by the members. It is determined that the distributor and the assistant have to work for water distribution in their area. They are requested to record the date when water is distributed. The maintenance staff has to direct and supervise members to make the canals clean. Actually the formation of nucleuses differs a little bit from the original one as stated below.

In Fundación area, nucleuses have been organized under an Agricultural Association founded in 1982. In each nucleus one distributor and two maintenance staffs are nominated from the members. They are working on voluntary basis. According to the member of the Association of Palo de Leche, the Palo de Leche pump irrigation canal system has eight (8) laterals, in each of which a nucleus is organized. Water distribution is made by conference among nucleuses and between members in each nucleus.

WUO of Jaquimeyes is not actually working, because the pumping operation has been stopped since the suction pit was buried with sediment in September 23.

It has been recognized that merits of making organization are the decrease of water dispute between water users and decrease of unfair water distribution such that a person who has power and money gets more water than others. If unfair in the water distribution between nucleuses or among members is pointed out, it is corrected in the conference between nucleus or among members. They have not, however, experienced that water distribution is carried out in accordance with the water distribution schedule. They have not been making the water distribution schedule. They verbally confirm water distribution schedule in the meeting in the drought season. Regulations, water distribution rules, and operation and maintenance manuals have not been prepared yet. The collection of water charge by WUO was once tried, but it disappeared due to accounting problem such that

collected money was lost and disappeared.

3.5.3 Present Operation and Maintenance

(1) Operation

As already explained, water distribution rules, and operation and maintenance manuals have not been prepared in written forms in both I.D Office and WUOs. In the main canals to lateral canal levels, water diversion schedules are approximately fixed, for example, one lateral canal distributes water from Monday to Wednesday and the other lateral does from Thursday to Sunday. In each lateral canal, the irrigation inspector and the water distributor hired by INDRHI are distributing water by the requests of farmers. In the area where a nucleus is organized, a person nominated for water distribution works as a coordinator to request the INDRHI staff to distribute water. These processes are being carried out with no written water regulation rules and manuals.

(a) River water diversion at Santana intake, other intakes and pumping stations

The Santana irrigation canal system and the other systems located in the downstream of the Santana freely take water from the Yaque del Sur river during the period when water is abundant, but once river flow is insufficient, alternatively take water sharing a week in 4 days for the Santana intake (CEA) and 3 days for other systems. The Santana intake takes all water from Sunday 4:00 p.m. to Thursday 2:00 p.m. weekly, while other intakes and pumping stations can take water for other days.

(b) Operation of gravity irrigation canal systems

Vicente Noble irrigation canal system is operated by a person in charge of water distribution, a gate keeper and a few assistant employed by INDRHI. Usually turnout gates are operated simply on-off basis on a few days or weekly rotation by lateral canals. Then, water is distributed to fields in accordance with the request from farmers. During the drought period, most of river water is taken by the Vicente Noble intake. Discharge is not measured at any points.

As for the canals managed by CEA such as Lateral B and Lateral H of the Santana irrigation system, water is exclusively supplied to the sugarcane fields from early morning to P.M. 2 : 00 and then from 2 : 00 to early morning farmers can take water to their fields.

(c) Operation of pump irrigation systems

As for a pump irrigation system, a person in charge of water distribution and two pump operators (daytime and night time each) are usually engaged in one pumping station. The person in charge directs the pump operators to operate pumps in accordance with the requests from farmers or from the board of directors of WUO newly founded in 1998. Pump operators are not recording the operation such as electricity consumption, pump operation hours, and number of pumps operated. The most important points are reliability of electricity supply and availability of river water during the drought period. Electric

supply is erratic in these years. All the pumps are motor-driven pumps. Thus the operation is disturbed by the erratic stop of electric supply. The river water is very small during draught period, since all the water is diverted at the Santana and Vicente Noble intakes.

(d) On-Farm Level Operation

Plantain fields are irrigated by basin irrigation method about once a month. Fields planted with tomato are irrigated by furrow irrigation method at 10 to 12 days interval. In case of plantain, which is dominant perennial crop in this zone farmers prefer to supply water to the fields at night time since plantain falls down due to soil-softening with water and by strong wind prevailing at daytime. Women participation to farming practices are limited at the planting and harvesting times. Major farmers usually employ workers for water distribution. The employment fee is generally 80 pesos with meal to 100 pesos in daytime work and about 150 pesos in night time work.

(e) Transportation equipment for field operation

Some inspectors and water distributors have assigned motorcycles from INDRHI and others have their own motorcycles, but most of them don't have any. They receive three (3) gallons of gasoline every Monday. It is, therefore, difficult for a person who has not transportation means to visit the sites along the canals and it is supposed that water diverted to laterals is flowing with no control or where nucleuses are organized, is distributed by farmers.

(2) Maintenance

(a) Data availability in Irrigation District and Zone Office

It is the responsibility of the District and/or the Zone Conservation and Improvement Unit to make an inventory of all the irrigation and drainage canals and the related structures and keep all the data indicating their locations, dimensions, quality of materials and actual situations. In case of pumps, the Pump Operation and Maintenance Unit has responsibility for such works. These data, however, have not been kept by the Irrigation Office except general data such as length of major canals and list of pumps, although they are the most important as basic data to prepare the maintenance and repair programs and to carry out some necessary investigation and design for repairing works.

(b) Maintenance and repairing

Most of the canals and the related structures are maintained by Irrigation District Office. It generally looks that maintenance works are little executed in all the irrigation systems in the Area, although immediate after the flood of hurricane George, INDRHI is doing rehabilitation works with full swing to restore the damaged irrigation systems.

The water users' organizations and farmers carry out only a minor routine works such as canal cleaning on voluntary basis or temporally employed by INDRHI. When

repairing is needed, WUO or farmers ask to the Irrigation District office.

(c) Maintenance equipment

I.D. Yaque del Sur has heavy equipment such as trucks, bulldozers, excavators and a motor grader as listed below. Heavy equipment that can be employed is only one truck, one bulldozer and one excavator. In addition, after hurricane George the Irrigation District received two excavators, which are working at Vicente Noble area.

-	Truck,10 m^3		out of order
-	Truck, 6 m^3		good
-	Bulldozer	3 nos.	1 no. good
			2 nos. out of order
-	Excavator	8 nos. in total	1 no. good
			2 nos. under repairing
			5 nos. out of order
-	Motor grader	1 no.	under repairing

Also I.D. Lago Enriquillo has heavy equipment as listed below. Heavy equipment which can be employed is only one dump truck, two backhoes, one bulldozer and one motor grader.

-	Dump truck	1 no.	Good
-	Drag line	1 no.	Out of order
-	Back hoe	4 nos.	2 nos. good
			2 nos. out of order
-	Bulldozer	2 nos.	1 no. Good
			1 no. out of order
-	Motor grader	1 no.	Good

3.5.4 Geological Investigation of Foundation of Santana and Villarpando Intake Weirs

In order to obtain the geological conditions at the Villarpando and Santana intake weirs, the core-boring test including the following investigation items has been conducted on a sublet contract basis.

Locations of the core-boring sites were instructed by a member of the Study Team in consideration of the proposed rehabilitation plans for the each weir.

Item No.	Items	Q'ty	Remarks
1-1	Core-boring	100m in total	Villarpando HW ; 2 sites x 20m/hole Santana HW ; 3 sites x 20m/hole
1-2	Standard penetration test 'SPT'	90 nos.	For soil layer
1-3	Soil sampling (3 samples/hole)	15 nos.	In boring holes
1-4	Particle size analysis	15 nos.	
1-5	Permeability test of soil samples	15 nos.	

Locations of the core-boring sites are shown in Figure 3.5.2 and the obtained results of boring tests are summarized in Table 3.5.2.

3.5.5 Soil Mechanical Investigation of Embankment Materials for Canals and Dikes

It is very significant to identify the possibility of borrow pits of construction materials, (i.e. embankment material for canals, roads and dike), because it affects the construction cost of the Project extremely. Thus, the soil mechanical investigation has been performed in the Project area on a sublet contract basis during the study period. Items of the investigation are summarized in the table below.

Item No.	Items	Q'ty	Remarks
2-1	Test pitting and sampling (3 samples/site)	10 sites	Including soil profile descriptions
2-2	Particle size analysis	30 nos.	
2-3	Soil density test	30 nos.	
2-4	Compaction test	30 nos.	
2-5	Plastic limit/ liquid limit analysis	30 nos.	

Locations of the test pits are shown in the Figure 3.5.2 and the obtained results of the tests are summarized in Table 3.5.2.

3.5.6 Results of Farm Household Survey

A total of 59 farmers was interviewed. All the farmers take irrigation water from the Yaque del Sur river. According to what three main problems affecting agricultural production were asked, 73% of all firstly and 15 % of all secondly pointed out the difficulty on irrigation. Nearly 90 % of all feels insufficient water in the dry season. They think the insufficient water is caused by the reasons such as inadequate water diversion at Villarpando, inadequate diversion at their headworks, poor condition of canal systems, insufficient quantity of water in the river in dry season, difficulty of pumps in maintenance and frequent interruption of electric supply, poor water management in canal systems, powerful people taken water, etc. Nearly 90 % of farmers replied that they were willing to participate water users organization that is responsible for operation and maintenance of the irrigation systems.

3.5.7 Problems in Irrigation

A main problem in the irrigation sector pointed out by most of farmers and the staffs of INDRHI is water shortage in the dry season. It is mainly due to two main causes; one is insufficient river water and the other is inefficient use of water in the canal systems and the fields.

The insufficient river water is caused by the absolute shortage of the river water resources or man-caused problems. The absolute shortage of the river water resources rarely occurs except the drought season of an extreme drought year. Most of the causes of the insufficient river water is of man-caused, for example, improper diversion of water in Villarpando headworks and other intakes including Santana headworks and Vicente Noble intake, stop of pump operation due to the interruption of electric supply, etc.

Inefficient use of water in the fields is being caused by various causes like no care of water distribution due to shortage of operation staffs and no transportation means, difficulty of water distribution with no control structures, etc.

These problems are logically explained in Figure 3.5.3 (1/3 to 3/3).

3.6 Rural Infrastructure

3.6.1 Living Environment

In the Project area, most of the families are engaged in agriculture and live in the rural area. Their housing conditions are still poor comparing with the urban area. Their housing materials consist of wood, palm tree, soil with palm tree, or concrete/concrete block for the wall. Sanitary situation is also poor without water closet, sewerage system, and proper domestic rubbish disposal system. In many villages, they own jointly simple lavatory holes outside surrounded by wooden wall or other simple materials. Due to the lack of efficient system, they are dumping domestic rubbish in the river or other open spaces. Such poor sanitary environments affect health care and living condition in the Project area.

Water and electric power supply in the Project area have been developed by the respective ministries in national level. Their present condition is however not satisfactory acceptable and some areas area still awaiting the extending the services. For water supply, the systems do not cover whole Project area and the quantity is insufficient. In addition, some systems suffer the improper (salty) water quality. Electric power is available in almost area, however they are facing the low voltage condition and frequent power cut-off. The problem tree of rural infrastructure is illustrated on Figure 3.6.1.

3.6.2 Roads

(1) National Road Network

The Project area has a good accessibility traversed by the national road network. Three secondary national roads, namely routes 44, 46, and 48 and three tertiary national roads namely routes 514, 529, and 531 run in the Project area in relatively good condition. Route 44 is branched off from the primary national road route 2 at Cruce de San Juan, and runs along the eastern boundary of the Project area linking Barahona City in south. The route 46 and 48 are branched off from the route 44 at Cruce de Cabral and Cruce de Palo Alto, reaching Mella and Neyba respectively. Their inventory and the routes are presented in Table 3.6.1 and Figure 3.6.2, and summarized as below.

Route No.	Route	Length	
Route 44	El Higuito – Barahona – Cabo Rojo	151.7 km	(19.2 km)
Route 46	Cruce de Cabral – Cabral – Jimani	85.8 km	(10.8 km)
Route 48	Cruce de Palo Alto – Cruce Mena – Neyba - Descubierta	75.6 km	(8.2 km)
Route 514	Cruce de Vicente Noble – Vicente Noble - Tamayo	10.5 km	(4.6 km)
Route 529	Tamayo – Cruce Mena	6.2 km	(6.2 km)
Route 531	Cabral – El Peñon – (Route 48)	10.2 km	(10.2 km)

Note : Figureures in parentheses show the length in the Project area

These roads are relatively well maintained periodically and occasionally in good condition by the Ministry of Public Works and Communications (SEOPC, *Secretaría de Estado de Obras Públicas y Comunicaciones*) through the responsibility of the Barahona district office in Barahona province and the Neyba district office in Bahoruco province. The annual maintenance programme is planned by the SEOPC, of which mainly executed by SEOPC under the direct management and partly carried out by the local contractor.

(2) Rural Road

Rural roads called "*caminos vecinales*" and a lot of farm road / footpaths are identified in the Project area. The rural roads registered on the list of SEOPC in and around the Project area are as below.

43-03-05-01-28	Tamayo – San Ramon	5.0 km
43-03-05-01-19	Monserrate – El Palmar	4.0 km
44-01-07-00-36	Canoa – Vicente Noble	3.9 km
44-01-07-02-40	Vicente Noble – La Fajita – Arroyo Grande	12.5 km
44-01-09-01-33	Fundación – Pasos de Las Elenas	4.2 km
44-01-09-04-32	Habanero – Fundación	7.6 km

Rural roads running among the villages and farms and linking the other roads are normally gravel or earth surface with a width of 4 ~ 6m. The roads are mainly utilized by the farmers for their daily farming activities manually or with small vehicles, tractors, motorbikes and cattle etc. Though the maintenance is also to be carried out by the responsibility of SEOPC district office, and partly conducted by the farmers or community according to necessity. Their activities is quite limited, therefore the condition is recognized to be poor especially with the muddy surface in the rainy seasons and raising of dust. Data and maps on these farm roads are however not sufficiently managed, hence information is collected through existing 1/5,000 topo-map and field investigation during the survey period. These total lengths of these roads in the Project area are summarized below. Road density is very low, varying 1.4 to 1.9 km/km^2 and 1.7 km/km^2 on average in whole the Project area.

Area	Gross Area (ha)	Rural Road (km)	Density (km/km^2)
Tamayo Area	1,044	20	1.9
Vicente Noble Area	1,548	30	1.9
Palo Alto - El Peñon Area	906	13	1.4
Fundación Area	3,041	47	1.5

(3) Irrigation Road and Sugarcane Road

In addition to the above, canal inspection roads along the irrigation or drainage canals and sugarcane feeder roads within the sugar corporation area found in and around the Project area. These roads are also playing an important role for traveling of the farmers and transportation of the farm products and commodities. The canal inspection roads constructed and maintained by INDRHI run along the major canals, such as the Santana canal, the Vicente Noble canal and some of lateral canals, while no road are attached to the minor canals.

Area	Gross Area (ha)	Canal Inspection Road (km)
Tamayo Area (Santana Canal)	1,014	4.5 km
Vicente Noble Area	1,548	9.0 km
Palo Alto - El Peñon Area	906	-
Fundación Area	3,041	1.0 km

Sugarcane feeder roads are under the responsibility of the CEA and their improvement is to be excluded from the Project.

(4) Damages to the Roads by the Hurricane George

The roads and related facilities that were damaged by the hurricane in 1998, mainly which are found along the flood route of the Yaque del Sur river as mentioned in section 3.9. The rehabilitation on the roads and the structures are being executed by SEOPC according to their rehabilitation programme, some of which are only temporary measures awaiting the permanent works. In and around the Project area, since most damages have been rehabilitated permanently or tentatively, no serious affect to the transportation is observed. Summary of major damages and progress of rehabilitation as of end December 1998 are summarized below.

Facility	Road	Location	Damage	Measure
Road	Route 44 &429	near Tamayo, Canoa, & Jaquimeyes	Sand deposit	Removed
Road	Route 48	Near Mena	A part of road surface was cut	Temporary measure
Road	Rural road	from El Peñon	Road surface was totally damaged	No measures
Culvert	Route 44	near Canoa	Road was breached and side walls were flushed away	Temporary embankment
Culvert	Route 44	near Bombita	Road was breached	Temporary embankment and reconstruction underway
Culvert	Route 48	Tomate Mena	Side walls were flushed away	No measures

3.6.3 Rural Water Supply

(1) INAPA Water Supply System

Almost towns and villages in the Project area are included in multiple water supply systems (called "*acueducto multiple*") established by National Institute of Potable Water and Sewerage (INAPA, *Instituto Nacional de Aguas Potables y Alcantarillados*). There exist 6 multiple water supply systems in the Project area, which are; 1) Vicente Noble system, 2) Tamayo system, 3) La Uvilla - El Jobo system, 4) Mena system, 5) Cabral system, and 6) Pescaderia system. These systems were constructed in the 1970s by INAPA and have extended and rehabilitated from time to time, some of which are however not satisfactory operated these years and their beneficiaries are facing shortage of water both amount and quality because of system deterioration and pressure by the increasing village population.

INAPA water supply systems are designed based on a 20 years target population and their source rely on groundwater or river surface water. These systems consist of intake facility or pump, simple treatment system, tank and pipe line network. Their inventory of each water supply system are presented in Table 3.6.2 and briefly described as below.

(a) Vicente Noble System

Vicente Noble system had been supplying water to the communities of Vicente Noble and Canoa, of which the source were three wells located in the left side of the Yaque del Sur river. In parallel with existing working system, a new intake pump station have been constructed with a filtration gallery, a storage tank and a chlorination treatment facility at about 500 m upstream from the Santana headworks.

However, just after the test-run for the new pumping station, the hurricane damaged the system, for which the flood flushed away the buried pipeline and power supply cable of about 50 m between the pumping station and the storage tank. After the hurricane damage, INAPA has then put efforts to rehabilitate the old system by reinstalling the 3 wells system (old aqueduct) with diesel engine driven pumps which is at moment supplying water to a part of Vicente Noble town, but not reaching to Canoa.

(b) Tamayo System

Tamayo system was also working with same intake with the Vicente Noble system and supplying water to Tamayo community including surrounding villages of Monserrate, Rincon de Aji, and La Cuaba. New system was constructed utilizing the same intake pump with the Vicente Noble System. The new system was however damaged by the hurricane as described in a paragraph for Vicente Noble. INAPA therefore reinstalled 2 wells with pump same as for Vicente Noble just opposite site of the Vicente Noble wells. The old system is at moment working for supplying water to a part of Tamayo town but not for Monserrate village.

(c) La Uvilla System

La Uvilla system was supplying water to the communities of La Uvilla and El Jobo, working with two tube wells by groundwater pumping. Though this system was working in good condition before hurricane in 1998, the wells have been totally destroyed by the hurricane and hence water supply has been completely stopped. The villagers therefore rely their drinking water upon the water tanker suppliers. INAPA is then trying to rehabilitate tentatively the old wells but the result was negative at moment.

(d) Mena System

Mena system was serving to Mena town consisting of Mena Arriba and Mena Abajo with two tube wells by groundwater pumping. However, the system was partially damaged by the floodwater during the hurricane period, especially to the pipeline to Mena Abajo that was crossing the Caño Trujillo.

(e) Cabral System

Cabral system is located in the southwestern part of the Project area and has been supplying water to the communities of Cabral, Cachón, El Peñon, Fundación, Palo Alto and Jaquimeyes. The system has no serious damage to its facilities by the Hurricane. The

system is composing of two sub-systems, one for Cachón town independently from the source of spring that was originally used for whole Cabral system, and the other for the rest by pumping groundwater from new wells. The pipeline from Cabral tank to El Peñon has a problem of sand deposit in the pipe and difficulty to supply full water to the end of system. Jaquimeyes town is hence always facing shortage of water.

(f) Pescaderia System

Pescaderia system is situated in the southeastern corner of the Project area and supplying water to the communities of La Hoya, Hato Viejo and Pescaderia. The system relies its source on the groundwater along the national road route 46. This system also doesn't have serious affect by the hurricane, however the beneficiaries suffer improper water quality.

Operation and maintenance activities on the INAPA water supply systems in the Project area are executed through the responsibilities of the Barahona district office, especially for the replacement of the distribution pipe and minor repairing.

(2) Water Charge of INAPA Water Supply System

Water charge to the beneficiaries is collected in monthly basis through the district commercial office. The water supply to the houses are not equipped with the volume counter, and the rate of water supply depends on their type and number of the water outflows, not depending on the quantity for the housing use. The tariff is tabulated in Table 3.6.3. The collection ratio is about 80 % for the domestic use according to the data in the district office.

(3) Present Condition of Rural Water Supply

Though existing INAPA water supply systems cover almost communities in the Project area as described in above section, the systems are not satisfactorily operated and villagers are suffering the water shortage in case. According to the information (including the water collection rate) from INAPA district office and interview to the local peoples, actual status of rural water supply condition is estimated as shown on Figure 3.6.3 and summarized below.

INAPA system	Condition	Villages	Remarks
With INAPA system	Quantity & Quality acceptable	Cabral, Cachón, Palo Alto, El Peñon	
	Quantity acceptable but salty	La Hoya, Hato Viejo, Pescaderia	Buying drinking water from supplier
	Quantity not enough or partially supplied	Fundación	Buying drinking water from supplier
	System damaged by hurricane and no water supplied	Canoa, Uvilla, El Jobo	Buying drinking water from supplier
	System damaged by hurricane and partially supplied	Viceate Noble, Tamayo, Mena	Buying drinking water from supplier
	No water available for long time	Jaquimeyes	Buying drinking water from supplier
Without INAPA system	-	Altagracia	Taking water from Fundación System
	-	Los Robles	Taking water from Yaque del Sur river
	-	Bombita	

In the Project area, there are still some villages suffering the lack of INAPA's water supply system, i.e. Bombita, Los Robres, and Altagracia. The villagers in these villages are mainly depending on some point source, such as river, irrigation canals, etc, taking water in the neighboring systems or purchasing water from water supplier by tanker. Even in the area with INAPA system, some villagers, who suffer the improper water quality, purchase water from the supplier for drinking and cooking purpose, while other domestic use are rely on INAPA system. Water rate of water supplier varies from DR$10 to DR$30 per tank (55 gallons).

(4) On-going and Planned Projects

In the Project area, various water supply Project are on-going, under design or under study. The progress of the new construction, rehabilitation and extension Projects are summarized below. The definite programme and possibility for these Projects are however not realized at moment, and detailed information is not available to the present Study.

1)	Barahona water supply Project	Development of wide water supply system including a part of Barahona and Baboruco with the source of Yaque del Sur and San Rafael spring	under the detailed design by private consulting company supervised by INAPA
2)	El Jobo Project	Two tube well development	under study by INAPA
3)	Mena Project	Development of wells and extension to Jaquimeyes and Palo Alto	under study by INAPA

3.6.4 Rural Electrification

(1) National Power Supply System

The source of electric power supply in the Project area comes from Dominican Electricity Corporation (CDE, *Corporación Dominicana de Electricidad*) through its transmission line network. The Project area is located in the south zone of CDE grid and one 138 kV transmission line, which is branched off at Cruce de San Juan, runs along the eastern border of the Project area connecting the Barahona thermal power station. One 69 kV transmission line is also branched of at the same sub-station and connects the Cruce de Cabral, which branches off another 69 kV lines, linking the Neyba area and the Las Damas hydropower station and the Barahona thermal power station.

In and around the Project area, 12 kV transmission lines are traversed to supply electricity to each community, one to Canoa area including Fundación, El Peñon, and the other to Cabral through Cachón. The Vicente Noble line supplies power to the municipalities of Vicente Noble, Tamayo, La Uvilla and El Jobo. These lines are also connected to the INDRHI's and INAPA's pump stations in the Project area. The transmission network including the distribution lines to the pump stations are illustrated on Figure 3.6.4. Maintenance on the transmission line is being carried out by each district office mainly for the repair and/or replacement of lines including poles and transformers. The charges for power supply are collected by each district office on a monthly basis. The power rates are varying based on its type and consumption by category.

(2) Hurricane Damages to the Electricity Supply System

The hurricane George damaged some parts of the transmission line in the Project area, out of which most serious damage is observed on the 69 kV line between Fondo Negro and Vicente Noble. At present, CDE took temporary measures to connect the 69 kV line directly from 138 kV line running near Cruce de Cabral in order to supply power mainly to the Vicente Noble area. In addition, many poles were fallen down and distribution lines were cut down, which are under rehabilitation by CDE.

(3) Rural Electrification

Most of the energized communities are facing shortage of power, low voltage, power cut-off due to the lack of total power generation, increasing loss caused by deterioration of transmission line or illegal connection. Meanwhile, existing pumping stations of INAPA and INDRHI are also facing the shortage of electricity affecting their operation of rural water supply and irrigation. According to the interview to the villagers, present condition is summarized as follows.

CDE system	Condition	Villages
With CDE system	Acceptable	Vicente Noble, Tamayo, Uvilla, El Jobo, Cabral, Cachón, Meno,
	Low Voltage or frequent power cut-off	La Hoya, Hato Viejo, Pescaderia, Palo Alto, El Peñon, Fundación, Canoa, Altagracia, Jaquimeyes
Without CDE System	No Electricity (CDE system was out of order)	Los Robles,

3.6.5 Other Social Infrastructures

(1) Hospital

There exist 11 health care centers in the Project area consisting of 3 sub-centers, and 8 rural clinics, of which provision is the responsibility of the Secretary of State Public Health and Social Assistance (SESPAS, *Secretaria de Estad de Salud Publica y Asistensia Social*). The summary is given below

	Sub-center	Rural Clinic
Cachón	-	-
Vicente Noble	1	-
Canoa		1
Cabral	1	1
El Peñon		1
Jaquimeyes	-	1
Palo Alto	-	-
Fundación	-	1
Altagracia	-	-
La Hoya	-	-
Pescaderia	-	-
Tamayo	1	1
Uvilla	-	2
El Jobo	-	-
Mena	-	-

Note ; In Bombita and La Hoya, there are health services provided by English Gov. and Catholic church

Sub-center located in major towns are providing health care services including general consultation, prenatal and baby clinic, examination, treatment, operation, immunization and dental service, while rural clinics are providing the general medical services. However, most of rural clinics are actually poorly operated due to lack of budget, vehicles, equipment, medical supplies and drugs.

(2) School

In the Project area, there exist 60 schools consisting of 45 elementary school, 3 middle school, and 12 other schools, of which provision is the responsibility of the Secretary of State Education and Culture (SEEC, Secretaria de Estado de Educación y Cultos). Their inventories are tabulated in Table 3.6.4 and summary is given below.

	Initial / Basic education	Intermediate education	Adult education	Technician / Professional education
Cachón	3	-	-	1
Vicente Noble	11	-	-	-
Canoa	4	-	1	-
Cabral	5	1	2	1
El Peñon	1	1		-
Jaquimeyes	2	-	2	1
Palo Alto	2	1		
Fundación	2	-	1	-
Altagracia	1	-	-	-
La Hoya	1		1	
Pescaderia	3		1	
Tamayo	1			1
Uvilla	3	-	-	-
El Jobo	2	-	-	-
Mena	4	-	-	-

(3) Transportation

Public transportation services are operated by only private individual transporters in the Project area under the administrative supervision of OTTT (*Oficina Técnica de Transporte Terrestre*). Transportation services by bus including mini-bus are available

connecting major towns and villages in the Project. The route map of the public transportation is illustraited in Figure 3.6.5. Pick-up truck and motor bike are commonly used for the passengers' transportation in the rural area within some short distances (called moto-concho). The farmers travel from their house to the farm on foot or by vehicles, motorbikes, bicycles, horses or donkeys according to the topographic and road conditions and the farmers' economic means. Transportation of farm products from farm to the villages is also made by above means or tractors with trailers. The transportation of the farm products and commodities between the villages and Santo Domingo or other major cities are also rely on the land transportation, and other means are not available, except one railway system for the sugarcane transportation within the sugar corporation farm. Though there is an international airport in Barahona, it is used for special charter flight and some domestic fright only.

(4) Postal Services and Communication Systems

Postal services are provided by the INPOSDOM (*Institute Postal Dominicano*) through the post offices established in the major municipalities. Telephone services are available in most villages, which are provided by two private companies, CODETEL and TRICOM, under the administrative control by the SEOPC. Though the almost villagers do not have telephone set in their house, they are able to access to either the telephone offices or public telephone booths provided in most of the villages.

(5) Community Center

In the Project area, only major cities have community centers that are providing spaces for the villagers' social activities such as various meetings and village level communications. Generally, they are just simple buildings made of concrete block wall with a wide room and are not furnished with special facilities and amenities. In the other villages in the rural area, community halls are not found but some other place are utilized for this purpose, for example schools, churches, villagers' residences and some open spaces.

3.7. Agricultural Support Services

3.7.1. Extension and Research

(1) General

Agricultural research is carried out in the country by the Government through Research centers, Universities and private organization. Agricultural research and extension services policies are determined by the Ministry of Agriculture through the Vice-ministry of Research and extension. Extension services are offered by the Government through the national extension services system using regional offices and agricultural zones and area. The research and extension service systems is shown in Figure 3.7.1.

There exist nine agricultural research centers in the country with specific research objectives and regional coverage. Private institutions engaged in agricultural research include the Institute Superior de Agricultura (ISA), Politecnico Loyola, Universidad

Autonoma de Santo Domingo (UASD) and Universidad Pedro Henriquez Urena (UNPHU). The Foundation for Agricultural Development (FDA) provides funding for research.

Resources allocated by the Ministry of Agriculture for Research and extension activities in 1997 amounted DR$53.72 millions representing 7.2% of the total SEA budget for that year.

(2) Offices and Activities in the Project area

The Project area is located within the South regional office of SEA in the Barahona zone. The Project area is comprised of 3 agricultural sub-zones and 23 agricultural areas. One extension agent (see Figure 3.7.2) covers each area. In addition to SEA, there is some extension being done for the Agrarian Institute to the Land Reform Beneficiaries in the Project area. Recently SEA provided motorcycle to all extension workers who operate in the Project area.

SEA has a training center in Barahona consisting of two rooms with capacity for 44 people each as well as dormitories to accommodate 45 people. In addition, the center has a kitchen/cafeteria with a capacity for 50 people. The training center has a 16 tareas (1 hectare) plot in Neyba devoted to grape production. The dormitories are not in good condition and need some refurbishing. Likewise, there is a lack of furniture (chairs, tables, blackboard, beds) and teaching aids (overhead projectors, data show, and the like) as well as computerized system.

The training center is being used by other public and non Government institution for training activities.

(3) Research Centers in the Project area

In the Project area there is a research center and an experimental Station. The Barahona experimental farm, located in Palo Alto, has about 300 tareas (18.8 ha) and it is being used to grow cassava and plantain. In the area also operate a nursery to produce coconut and fruit trees. In the past this experimental station was part of the research center system but now is under the jurisdiction of the Barahona Regional office. At present there is not any research experiment in place.

The Center for Agricultural Research in Arid Zones is located in Azua. (Approximately 20 miles from the Project area). There is not researcher with higher degree and only 10 Agricultural engineers. The CIAZA center shows insufficient infrastructure and equipment to carry out the necessary research for crop diversification and generate basic information on appropriate cropping pattern and water usage.

The budget allocation has been very limited and there is a lack of appropriate lab equipment. This in turn has affected the capacity to generate useful research finding for the Project area.