4.7 Consideration on Flood Mitigation

4.7.1 Capacity of the Yaque del Sur River

On the basis of the interview survey on the floods and the actual river conditions, the capacity of Yaque del Sur River below Santana headworks (herein after referred to as "lower reach") can be estimated. The river on the upstream of Santana headworks has approximately one-kilometer-wide river course with meandering lower river bed of about 50 m wide, while the remaining sections are regarded as higher river beds. The total capacity of the river on the upstream of Santana is estimated at 20,000 m^3/sec or more. Beside the farmlands located in the river course, there is no controlling factor or obstacles against the river capacity in this stretch.

At Santana headworks, the river starts meandering according to changes of the topography. Depression between Tamayo and Vicente Noble is considered as a flood plain of the river, and several traces of previous river courses remain. From Canoa to the downstream reach, there exists few mountains or hills along the river, and all the flat area is regarded as flood plain. Thus the river capacity in this stretch is estimated by the lower river course, i.e., existing river course.

In order to grasp the river capacity and flood water levels by return period, water level analysis by using non-uniform flow calculation is conducted. For the purposes, leveling survey was conducted as follows:

- Longitudinal leveling survey for 53 km from the confluence of the Yaque del Sur River to Conuquitos (2 km upstream of Santana headworks) taking elevations of river bank and water surface in the river every 100 m on the average, and
- Leveling of river cross-sections at 41 locations.

The results of the non-uniform flow analysis are illustrated in Fig. 4.7.1 with water levels of discharges of 100 m^3/s and 200 m^3/s. From the results, it is very clear that the capacity of the river sections on the downstream of Canoa to the Carribean Sea is more or less 100 m^3/sec. It should be noted that the flood flow of 1 in 50 years, which is estimated at about 4,000 m^3/sec almost overflows before Canoa. The location of the cross sections is illustrated in Fig. 4.7.2.

4.7.2 Dam Operation

Emergency Dam Operation Committee (COEE) issued an instructive manual on operation of Sabaneta dam in August 1998[9] and Sabana Yegua Dam in July 1998[10]. It should be noted that Hurricane Georges passed only a few months after the issue of the manuals.

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[9] Instructivo de Operación de Emergencias ~ Presa de Sabaneta

[10] Instructivo de Operación de Emergencias ~ Presa de Sabana Yegua

It is mentioned in the manuals that all the instructions during emergency period are given by COEE. COEE receives hydrological and meteorological data from dams, then analyze them, and instruct necessary operation to each dam by radio or telephone communications. In case the communications between the dams and COEE are cut off, the authorized operators at the dams will operate the gates and valves according to the manual.

If the water levels in the reservoirs drastically rise, or abnormal situations happen to the facilities of dam, hydropower and other related facilities, the operators are obliged to inform COEE immediately. The operators should keep close contacts with local institutions to exchange information on local situations and to transfer all the instructions from COEE. While the emergency situation is growing by increase of water level, etc., COEE or the authorized operators will contact with Civil Defense and issue orders for evacuation to local residents.

The dam operations in emergency are mentioned separately for hurricane seasons and others. ***During non-hurricane seasons*** (from December to May), the hydropower turbines should be operated all the time below the maximum level operating for the turbines[11] unless any kind of troubles happens. Once the turbines are stopped, they should not be restarted without instructions from COEE. The operators should monitor the water level of the reservoirs every ten minutes and grasp the inflow volume. Immediately after the emergency period ends, all the facilities should be checked. In case some abnormal situations are found, those should be reported to COEE soon.

During the hurricane season, three levels of announcement will be issued on the basis of meteorological and/or hydrological information by ONAMET. They are;

- *Warning* contains information concerning a tropical storm or hurricanes that do not require the *Alert* or *Notice*. *Warning* is issued when hurricanes and tropical storms are expected to penetrate the Caribbean Sea,
- *Alert* will be issued when the tropical storms or hurricanes are expected to enter the territory of the Dominican Republic within 36 hours, and
- *Notice* will be announced when a hurricane (Category-1 or more) is expected to enter the territory within 24 hours.

Once the *Notice* is announced, the operators should take the following procedures;

- Contact with the Civil Defense and notify possibility of emergency discharges of the dams to the residents on the downstream,

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11 644 m AMSL for Sabaneta, and 396 m AMSL for Sabana Yegua for the non-hurricane season.

- As far as facilities related to the hydropower generation functions well, the turbine should be operated. If the turbine is stopped by some reasons, it should not be restarted without getting instructions from COEE,
- Before the spillways are used, the residents on the downstream should be evacuated, and the operators should move to a place, in which they can control the facilities safely.
- The operators should monitor the water level and calculate the inflow every 10 to 30 minutes,
- The operators always should try to keep contact with COEE, etc.

As for Sabana Yegua Dam, seasonal or daily maximum operation levels are set varying from 386 m to 396.4 m AMSL, while Sabaneta Dam has a constant operation level of 644 m AMSL after completion of the improvement of the emergency spillway.

4.7.3 Flood Warning System

As mentioned above, the flood disaster by Georges was not caused by the dam operation itself. Heavy rainfall in the uncontrolled basin without dams concentrated and inundated flood prone areas. It is also considered that sense of wariness against the floods was fainted among the people after a long "flood free" years since David, and that made the matters worse. The flood victims were seriously shocked by the sudden disaster, and they are requesting various flood mitigation works. But drastic measures such as flood control dams and/or river improvement works require huge costs and long time to realize. On the other hand, there is a high possibility of having hurricanes in the future, and urgent countermeasures are necessary. However, even by those measures, the flood disasters might not be avoided, if the people's cautiousness against the floods gets fainted. It is considered more important to fix the sense of "self-protection" in the people's mind to evacuate themselves quickly from the floods or other disasters. In this meaning, development of flood warning system will be a great help to establish a regional protection system against natural disasters. It is considered that the flood warning system should be implemented earlier while the people have clear memory on the flood. The development costs are small compared with the drastic measures, which will realize the implementation earlier.

The system will be developed by stage-wise and priority approach for the high-flood-risk areas, such as densely populated area, downstream of the dams, villages adjacent to the river course without proper access, etc. The flood warning system will utilize a telemetering system with control stations at the dams, warning stations, repeater stations, water level stations, warning vehicles, radio communication systems, etc. The following development plan is considered by priority:

(a) Priority-1

- Control station at Sabaneta and Sabana Yegua Dams,

- Repeater stations at San Juan and Quita Coraza,
- A hydrometric station on the upstream of San Juan,
- Warning stations at densely populated flood prone areas of over 2,000 households (San Juan, Tamayo, Vicente Noble),
- Warning stations at residential areas on the downstream of the dams (Sabaneta, Los Bancos)
- Warning vehicles with sirens, speakers and radio communication equipment (2 in San Juan river basin, 3 in Yaque del Sur river basin), and
- Other warning facilities and civil works (road closing gates, hand speakers, warning boards, rubber boats, etc)

(b) Priority-2

- Repeater station at the lower reach (near EL Peñon),
- Warning stations at residential areas of over 2,000 households near the river and high risk areas of inundation(El Jobo, Cabral, Jaquimeyes,),
- Warning vehicles (one for every 20 km of the river stretch), and
- Other warning facilities and civil works (road closing gates, hand speakers, warning boards, rubber boats, etc)

(c) Priority-3

- Warning stations at residential areas of over 500 households near the river (Hato Nuevo downstream of Sabaneta, Sabana Alta, Quita Coraza, Fondo Negro, El Peñon, Canoa),
- Warning stations at residential areas close to the river course with poor access (Boca de Mura, San Simon, Monte Grande, Vuelta Grande, Arroyo Grande)
- Warning vehicles (one for every 10 km of the river stretch), and
- Other warning facilities and civil works (road closing gates, hand speakers, warning boards, rubber boats, etc.)

4.7.4 Other Measures

As mentioned above, the floods of over 10,000 m^3/sec are assumed at Santana headworks during the hurricane season. The river capacity there is estimated be more than that, but most of the waters overflow from the river course on the downstream stretch. The flood water levels by return period will be estimated in the following study period[12]. The following works are considered possible alternatives for flood mitigation in the lower basin. It is necessary to carry out another master plan study on flood mitigation to

[12] Phase-2 study period in Japan (February to March 1999)

determine how to treat the flood waters. The design floods by return period will be distributed and discharged to proposed destinations, such as Rincon Lagoon, floodways, and the downstream, according to the mitigation plan and the necessary facilities will be discussed.

(1) Flood Protection Dike at Tamayo

Tamayo is located in front of the flow direction of the Yaque del Sur River on the downstream of Santana headworks. The previous flood protection dike on the right bank was almost flushed away by the flood by Georges. The floodwaters over the dike flowed into Tamayo, stagnated and brought huge amount of sediments in the city.

The previous dike was located very near the river course on the right bank without sufficient height and strength to control the flood. Taking into the proposed magnitude of floods (1 in 50 or 100 years), it is recommended to reconstruct the flood dike closer to Tamayo. The dike will be constructed on the right bank along the line which lies 70 to 80 % of the river width during Georges. Some structures or vegetation will also be proposed in front of the dike to control the force of floods to protect the dike itself.

Dimension of the dike will be determined in the following study period according to the water level analysis.

(2) Canoa Floodway

During the flood period of the hurricane, certain part of the flood waters overflowed to the natural levee on the left bank at Canoa, flushed away the national highway between the two road bridges and flowed to the Caribbean Sea. This phenomenon has rarely happen before. Normally, a part of flooding waters flows into Rincon Lagoon from Mena through Caño Trujillo – Dren Los Tomates. During the hurricane, the capacity of the drain was not sufficient to reduce the river water level, and the remaining waters overflowed the left bank at Canoa. The flood waters also flowed southward to Jaquimeyes which is sandwiched by the national highway and railway for CEA, and stagnated there.

The two road bridges at Canoa have insufficient capacity with box culverts, of which capacity seems not sufficient to drain the flood water. It is recommended to replace the two bridges with one bridge which has sufficient capacity to accommodate the proposed flood waters. A floodway from the bridge to the sea should also be considered to discharge the proposed flood properly. The capacity of the floodway should be discussed integratedly with other flood control measures or strategies for the whole lower river basin from Santana headworks to the confluence. However, the floodway would be constructed with flood dike on the right bank of a few kilometers long to guide the flood waters to the certain location on the downstream. The flood way itself will not be excavated as a form of flood regulating basin. Further study on the floodway with protection dikes is recommended in the future.

(3) Rincon Lagoon

The water level of Rincon Lagoon rose up to the full capacity by getting flood waters by Georges. As the flood water entered from northeast (Caño Trujillo-Dren Tomates), the Lagoon expanded to the north of El Peñon. The water of the Lagoon flowed to Neiba through Cristobal Canal from the west end of the Lagoon, and also overflowed easterly across the main road near Cabral. The waters flowed into the Yaque del Sur River to the east.

The water level of Rincon Lagoon had increased by 3 m by George, and increased volume is estimated to be 150 MCM. Thus, certain flood control effect is expected to Rincon Lagoon. In order to realize sufficient and effective operation, following works are considered necessary:

- Bathometric survey of the Rincon Lagoon,
- Installation of water level monitoring station with telemetric facilities in the Lagoon,
- Investigation on reconstruction of Caño Trujillo – Dren Tomates
- Leveling survey of Cristobal Canal to Neiba

Locations of the flood protection dike at Tamayo, the Canoa floodway and Caño Trujillo – Dren Tomates are shown in Fig. 4.7.3.

4.8 Plan of Environmental Conservation

4.8.1 Green Belt Formation for Waterfront Conservation

(1) Basic Concept

The grater part of Tamayo town was affected by the flooding caused by the Hurricane George. The water current of the river after passing the Santana headwork, diverging from the river course, coursed to Tamayo town. For the topographical conditions, Tamayo town is apt to suffer the damage of floods. It is necessary to take countermeasures not to repeat the disaster such as the last year.

On the other hand, in the Project area, since Tamayo and Vicente Noble have relatively large population, some recreation areas are required. An open space of waterfront of Yaque del Sur River provides good environment to establish a recreation area.

(2) Objectives

The objectives of this Project are:

- In case of the flood, to reduce the force of water flash from the river, and as a consequence to diminish the damage by flood in Tamayo town;
- To protect the river margin where sometimes affected by water erosion; and

- To contribute a place of recreation for the town people of Tamayo and Vicente Noble.

(3) Project area

The green belt is formed in the right bank along the river as shown in Figure4.8.1. It is around 1.2 km long. A small recreation area is established in also the right bank near the bridge which is very accessible place from both Tamayo and Vicente Noble.

(4) Design of the Green Belt and the Other Facilities

(a) Selection of Plant Species

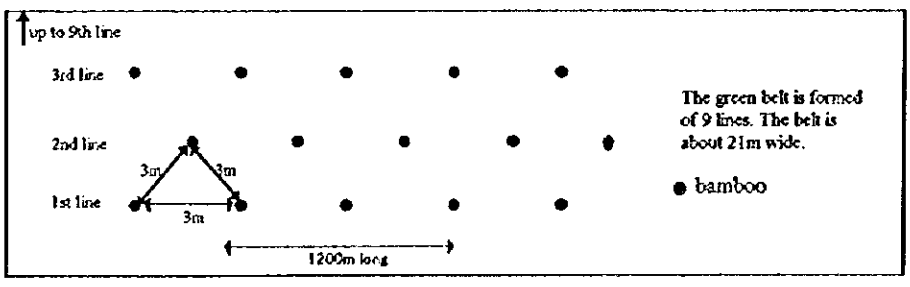
Selected plant to form up the green belt is mainly bamboo (Bambusa bambus). Since the bamboo grows rapid and stands in both dry and wet condition, it is adequate specie to plant in dry riverbed where drastic change of water condition sometime happens. The bamboo seedlings are supplied from the nursery of INDRHI at Barahona. The nursery has enough capacity of the seedling production, which is 30,000 seedlings per year, to provide them for this Project.

In a small recreation area, shade trees, such as Nin (Azadirachta indica), Roble (Catalpa longissima) and Caoba (Cedrela odorata) are planted. These species are endurable enough to dry condition of the Project area. The seedlings are provided from the nursery of the National Direction of Forestry (FORESTA) in Barahona or Cabral.

(b) Planting Design

The bamboo is planted as shown in the Figure below. The spacing between plants is 3 m. The green belt consists of 9 lines, so the belt is about 21m wide. A small open space, about 3000 m^2 large, is established near the bridge. Some species of shade trees mentioned above are planted randomly. The number of planted trees is about 50.

Planting Pattern of Bamboo



(c) Planting Method

Since there is no steep and rocky area in the Project area, land preparation for planting is just weeding. To plant a bamboo, first a hole with 30 cm depth is dug. A seedling is put there, and then the hole is filled up by soil. After that, water is thrown and

about 140g (5 ounce) of fertilizer is put around the seedling.

The shade trees to be planted are plants of 3 to 5 years old. To plant the trees, a hole with 50 cm depth is dug. After the planting, about 140g of fertilizer is provided to each trees.

(d) Other Facilities

A maintenance road along the green belt is constructed. The road is also used for taking a walk by local people. Some benches for local people to take a rest are collocated under shade trees in the recreation area and at some rest points along the maintenance road. Some steps to go down to or up from the dry riverbed are collocated.

(5) Project Works

The major work quantities required according to the above design are summarized as follows:

- Area of the green belt 1200 m long x 21m wide
- Recreation area 3000 m^2
- Maintenance road (gravel) 1200 m x 3 m wide
- Benches 20
- Steps 2 places

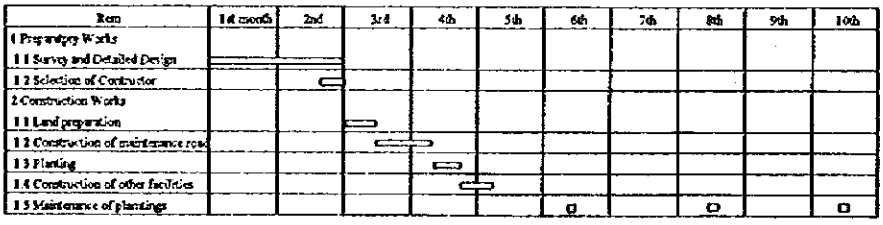
(6) Organization and Management

The Project is implemented by the Office of Watershed Management, INDRHI, with assistants from National Direction of Forestry.

(7) Schedule of the Project

The Project period, from the preparatory study up to maintenance, is 10 months as shown in the table below.

Figure Schedule of the Project



4.8.2 Environmental Monitoring Program in Rincon Lagoon

(1) Basic Concept

The water volume and water qualities in Rincon Lagoon drastically have changed in comparison with those of period before hurricane George. The water of the lake could be useful for agricultural purpose, and its feasibility should be studied.

On the other hand, the lagoon, which is designated as a national park, has a very important role for natural environmental conservation. Several important species of fauna and flora are reported. However, there is no sufficient data at the present to manage them. A monitoring study to understand their ecological habitat is necessary.

(2) Objectives

The objectives of this Project are:

- To collect basic data in long term on wildlife and its habitat and also on water use for agricultural purpose;
- On the basis of the monitoring result, to recommend the better water management of the lagoon, taking account of the importance of water for both agriculture and wildlife.

(3) Monitoring Program

(a) Period and Frequency of the Study

The total study period is 10 years. In the first half of the first year, a study to understand the general condition of the wildlife and water condition of the lagoon is conducted (General Study). After the study, from the second half of the first year until the tenth year, periodical studies focusing on some bio-indicator are carried out every two months (Periodical Study). In the 5th year and the 10 year, the studies with same content of the General Study are conducted.

(b) General Study

The general study on fauna and flora, and also on water condition is conducted. The object area of the study is whole area of the lagoon. The items of the study are:

- Description of Species of Fauna and Flora and their Quantity
- Drawing of Vegetation Map
- Condition of Ecosystem
- Measurement of Water Level and Topography of Bottom of Lagoon
- Measurement of Inflow and Outflow of Water

- Water Quality of the Lagoon (Temperature, pH, COD, DO, NH4-N, NO3-N, Total Phosphate, Number of Colon Bacillus, EC)

Considering the result of the study, the planing of the periodical study, concerning the selection of the focused areas and the livings as bio-indicators, items of water quality analysis, and the detailed study method, is made.

(c) Periodical Study

The periodical study is conducted every two months to monitor the condition of wildlife and water, and to understand the relation between the water fluctuation and its impact for livings in the lagoon. Since the study is conducted from the second half of the first year until the 10th year, but twice (in the 5th and the 10 year) of the periodical study are substituted for the 2nd and 3rd General Survey, so the periodical studies are finally carried out 55 times.

Concerning the monitoring of wildlife, some bio-indicators and areas selected from the result of the general study are focused in the survey. The study method will be established after the analysis of the result of the general study. Concerning the water condition, the measurement of water level, measurement of inflow and outflow of water, and water quality test are conducted.

(d) Implementation of Field Study, Analysis and Evaluation

The field study concerning fauna and flora of general study as well as the periodical study is conducted by academic researchers from the SURENA of the Ministry of Agriculture, the Botanical Garden, universities or NGOs. The field survey concerning on the water condition is conducted by consultants.

A committee consisted of representative from relevant organizations is formalized. Periodical meetings to understand the study progress and to coordinate monitoring plan are held by the committee members and survey staff. In each meeting, findings from the field and result of analysis are presented and discussed.

In the final stage when the all monitoring study is finished, on the basis of the monitoring result, the better water management of the lagoon, taking account of importance of water for both agriculture and wildlife, is recommended. Water introduction from Yaque del Sur River to the lagoon and the lagoon's water use for agricultural purpose may be topics of the recommendations.

(4) Necessary Equipment and Facilities

Necessary equipment for the survey and analysis is 2 boats with motor, 2 four-wheeled vehicles, 2 motorbikes, 5 binoculars, 2 of 40 power telescope, and 2 computers.

(5) Organization and Management

The Sub-secretariat of Natural Resources (SURENA) and National Direction of Parks (PARQUE) are the main organizations of the plan. A committee is formed, which consists of representatives from SURENA, PARQUE, and INDRHY, and academic advisors from the Botanical Garden, universities and NGOs. The committee manages the study activities.

(6) Schedule of the Plan

In the first year, under the initiative of the SURENA and National Direction of Park, an assembly with participation of representative INDRHI and academic researchers from the Botanical Garden, universities or NGOs, is held. After the committee is set up, its members discuss about the detail method of the General Study. When the Study is finished, a meeting of committee is held again to discuss about detail design of the Periodical Study. The periodical study is held each 2 months up to 10th year.

4.9 Plan of Operation and Maintenance

4.9.1 Overall Water Management

In order to maintain the functions of the facilities, operation and maintenance works are indispensable. In particular, the equipment and facilities for the telemetry, flood/discharge warning, and voice communication facilities, are mostly imported and require intensive training and meticulous maintenance. The inspective works are conducted in three forms as follows;

(1) Daily inspection : minimum maintenance for daily operation

(2) Periodical inspection : periodical (monthly) check-up of equipment from outside

(3) Detailed inspection : checking of accuracy of measurement, function by suspending the operation; check the inside of the equipment, repair, changing of parts, adjustment, cleaning, etc; twice a year

Inspection manual will be prepared consisting of inspection items by equipment, methods, procedure, and check sheets for respective inspection form. As for periodical maintenance and detailed inspections, a chart of inspection schedule should be prepared for the implementation.

Inspection records on the structure and functions are very important for the following improvement and replacement. They should be kept in the Center indifinitely. The daily inspection should be done at the beginning of shifts of operaters. Some part of the periodical and detail inspections will be done by specialists on the system. It is recommended to make a contract for the detail inspection with the manufacturers concerned. The inspection wil be done as shown in the following table:

item	details	Daily inspection	Periodical inspection	Detail inspection
sensors		Ink for recorders, recording paper, etc	Visual inspection	Rust, condition, accuracy
Telemetry equipment		Visual inspection	Cable and wires, connector, condition of terminal, lamp, buzzer, display	INPUT terminal, fuction of analog and digital parts, accuracy OUTPUT Display, indictor TRANSMISSION Transmission signals, power supply, etc OTHERS Arrester, earth,etc
Radio equipment	Tranceiver Antenna, feeder, earth, Power supply	Noise, interference	Cable and wires, connector, condition of terminal, lamp, switch, display Visual inspection, specific gravity, voltage	Output power, reflection power, modulation and demodulation frequency, structure, feeder, coaxial arrester, liquid, charge, etc
Display/prin-ter		Visual inspection watch	Cable and wires, connector, condition of terminal, lamp, switch	Display sequence Alert sequence Control sequence
Processing devices	Processing unit	Visual inspection	Fan, filter, connector, terminal,	Memory test, auto restart
	Hard disk, printer, memory card, data logger, etc.	Visual inspection Paper, ink, etc	dust, switch, lamp, key	Test of actions
	CRT device	Visual inspection	Connector, terminal, data, figure, key light pen	Test of actions
Others	Consolepanel Ventilator Cable, Pit	Visual inspection, dew, eboking, leakage		
Warning vehicle	Radio system	Same as "radio equipment"		
	Speaker and sirens	Same as radio "warning station"		
	vehicles	Visual inspection, gasoline	Oil, battery, tire pressure, etc	Engine, frame, suspention, etc.
Warning station	Same as telemetry and radio equipment			
Other stations	Same as telemetry, radio equipment, etc.			

4.9.2 Irrigation and Drainage

(1) Operation

It is proposed to carry out the demand-oriented river water management as explained in the previous section 4.9.1. The Yaque del Sur Water Management Center will manage releasing amount of water stored in the Sabana Yegua reservoir in accordance with the water demands monitoring the river discharge and will control the diversion of water to both the Azua area and Yaque del Sur river downstream. Water is diverted at the Santana headworks and conveyed through the proposed main canal up to the night storage ponds on the 24-hour basis. Then, water stored in the ponds is distributed from the ponds through laterals and field canals usually during the daytime. In the pump irrigation system as well, water is principally delivered during the daytime.

The operation will be started from the estimation of the irrigation water demands based on the cropping program. Based on the irrigation water demands and the availability of water resources, an irrigation schedule will be contemplated. Then the irrigation system from the heads to the field level are operated in accordance with the irrigation schedule.

(a) Preparation of Seasonal Irrigation Schedule

Preparation process of seasonal irrigation schedule proposed in the Master Plan study is rather complicated with many processes. Considering the technical level of I. District Office and WUO, more simple procedure for the preparation of the irrigation schedule is proposed. The following procedure to prepare the irrigation schedule is one of the simple examples.

(i) Estimate of irrigation water requirements : Each of the Irrigation District Offices or the irrigation engineer of WUO estimates the irrigation water requirements at the sub-committees level based on typical cropping patterns prepared in accordance with the last patterns and compiles the irrigation water requirements up to the Santana intake level. The cropping pattern is not changed much every year, so the last cropping pattern is useful for estimate of irrigation water requirements. Typical cropping patterns will be simply composed of the combination of three kinds of crops such as perennial crops, short growing upland crops, and paddy

(ii) Water Balance : The Center evaluates the irrigation water demands through the water balance study between the demands and available amount of water estimated from actual storage in the reservoirs, rainfall and river discharge tendencies.

Then, if the irrigation water demands are expected to be smaller than the available water resources, the irrigation engineer will prepare an irrigation schedule to meet the irrigation water demands estimated above. If the irrigation water demands are larger than the available water resources, the irrigation engineer will revise the cropping patterns in accordance with the suggestion from the Center and the Board of Directors so that the irrigation water demands meet the available water resources.

(iii) WUO informs the irrigation schedule to all the farmers.

(b) Preparation of monthly or half-monthly irrigation water distribution schedule

Based on the irrigation schedule, a water distribution schedule, which mentions the time schedule and discharge of water delivery to every field is prepared in each of the distribution system or in each of the small irrigation systems by the irrigation inspectors and the irrigation operator.

During the cropping season at least once or twice, the operators should investigate the kind of crops and the cropping area in the field in collaboration of the executives of nucleuses. The inspectors should compile them at the sub-committee level and the Santana level. Based on these data, the irrigation engineer or the Irrigation District Office should estimate the irrigation water requirements and modify the seasonal irrigation

schedule, if necessary and inform to the Center. When a drought is expected, the Center should instruct the Irrigation District Office and WUO to modify the irrigation schedule and water distribution schedule in consideration of the decrease of the allocated amount of water. The crop sensitivity to the water shortage is also taken into account in the modification of the irrigation schedule.

(c) Operation of the irrigation system

(i) Santana headworks and the main canal

Water is continuously diverted from the river and conveyed through the proposed main canal to the night storage ponds. The intake gates should be operated to divert water in accordance with the irrigation schedule. When a flood comes, the intake gates should be fully closed. The check gates on the main canal, which control the diversion discharge to the night storage pond are carefully adjusted once or twice a month in accordance with the irrigation schedule. The turnout gates, which directly supply through small laterals to the fields will be operated daily usually opened in the morning and closed in the evening. During the off-season of water demands or during the severe drought period, rotational water supply should be made among the systems of the night storage ponds. The water distribution operator will operate the check gate and the turnout gate.

(ii) Night storage ponds and distribution systems

Usually at the morning time, the outlet gate of the pond is opened and water is distributed to fields through a distribution canal system. It is important that distribution and field canals convey water with their full capacity and rotation will be made in each of Nucleus blocks in order to keep high irrigation efficiency. Amount of water supply is mainly adjusted by irrigation supply hour and not by discharge. During the off-season of water demands or during the severe drought period, rotational water supply should be made among the Nucleus blocks. The water distribution operator employed by WUO will operate the outlet gates of the night storage ponds. The assistant operator operates check and turnout gates on the laterals. In the distribution system, farmers themselves distribute water in accordance with the predetermined water distribution schedule. During the irrigation application day, the farmer or his proxy shall always manage water in his fields.

(iii) Pump irrigation system

In case of the pump irrigation system, which will be improved with the provision of a regulation pond, water should be distributed from the regulation pond usually during the daytime only as well as a lateral system in the proposed main canal system. The outlet gate will be opened at the morning time and closed at the evening time. As for the pump operation, when the river water is abundant, the pumps can take water at any time. However, when the river water is nearly equal to the water demand, the pump operation hours should be adjusted so that pump

stations do not conflict with each other. Further when the river water is less than the demands, the pump operation hours should be adjusted each other so that the river water can be taken continuously on 24 hour basis. Also, during the drought season, a temporary weir across the river may be built to store the limited water and to prevent the tidal intrusion. An inspector will make the rotation schedule of pump operation and a pump operator and the assistant will make the operation.

(2) Maintenance

Field canals and drains will be maintained by farmers' themselves of every Nucleuses as a communal work. Nucleus chief and a person in charge of maintenance will prepare a maintenance schedule for the canals and the drains containing an allotment of works to every farmer and the date of the works. The maintenance staff of the work force of WUO will advise the Nucleus to prepare the schedule especially for adjusting the date among the distribution systems. Generally, the maintenance works are carried out twice to four times a year. Every farmer or their proxies should participate in the maintenance works of the distribution canals and the drains with hand tools. If he can not attend, he will pay to the nucleus some amount of money to employ labors for maintenance works. All the maintenance works except the repairing of concrete and metal works will be directly executed by farmers themselves. The repair of the concrete works and metal works will be carried out by maintenance staff employed by WUO or by a contractor supervised by WUO.

Major irrigation facilities such as the main and lateral canals, the related structures, night storage ponds, and major drainage canals will be maintained by the staff employed by WUO with light equipment. WUO will employ maintenance staff on a permanent basis and labor and routine maintenance workers on a part time basis. The irrigation engineer and the inspectors will prepare the annual maintenance program in consultation with the Irrigation District Office containing the date, the location, the kind of works, number of staff and labors, equipment and tools to be mobilized, and the expenses. In accordance with this schedule, the maintenance staff will manage maintenance works mobilizing laborers with light equipment and tools. In case that the emergency repairing or a large-scale maintenance and repairing is required, the Irrigation District Office will assist WUO to repair the damaged portion or to carry out the large-scale maintenance works mobilizing construction equipment owned by the Irrigation District office.

4.9.3 Rural Infrastructure

Proposed rural water supply systems will be implemented under the management of INAPA technically and administratively from the detailed design stage. Their operation and maintenance will also be under its responsibility as same as the other water supply systems. Their operation includes 1) pump operation, 2) management of settling pond, filtration gallery, and elevated water tank, and 3) operation and replacement of chlorination plant, etc. Since the water supply system will be established on the INDRHI's irrigation canal system, water will be reserved in the night storage pond during the canal maintenance period. Water charge to INDRHI will be paid following the agreement between INDRHI

and INAPA. Collection of water charge from the beneficiaries will be made by the INAPA district offices according to its tariff, while maintenance works of the water supply system will also be carried out by its district offices.

Community center will be managed under the responsibility of the WUO itself. It will be operated to actively receive the villagers' level communication meeting and recreation activities through the organization of the local government or villagers' groups.

4.9.4 Environmental Conservation

The Project, which requires maintenance, is "Green Belt Formation for Waterfront Conservation".For the planted bamboo and shade trees, the maintenance for 6 months is required. The maintenance consists of weeding and fertilizing (5 oz. (140g) per seedling) once a 2 months, or 3 times in the 6 months. In case some seedlings die, a supplement planting is required. It is estimated that the number of seedlings for the supplement planting is 360 of bamboo and 5 of shade trees (10 % of the number of total plantings). After the 6 months, since the bamboo is tall enough to win competition with weeds, any more cares are not required.

5. IMPLEMENTATION PROGRAM

5.1 Implementation

5.1.1 Approach to the Project Implementation

The Project will be implemented comprehensively for the agricultural development in the Yaque del Sur river lower reaches area aiming at the improvement of living standard of farm households and the living environment of the rural area. The Project will consist of several sub-Projects as follows:

(i) Agriculture and Agricultural Support Services Project

- Project for strengthening research and extension services
- Project for Strengthening Credit Services
- Agricultural Cooperative Model Project and Market Information System Project

(ii) Overall Water Management Project

- Yaque del sur river Water Mangement Center Project
- System Project for Water Management
- Training Program for Water Management Staff

(iii) Irrigation Development and Water Management in the field Improvement Project

- Improvement Project of Villarpando Intake Weir
- Improvement Project for Irrigation Facilities including Santan Intake Weir
- Project of Strengthening Water User's Organization

(iv) Rural Infrastructure Improvement Project

- Rural Water Supply Project
- Project for Community Center

(v) Environmental Conservation Project

- Green Belt Formation Project for Waterfront Conservation
- Environmental Monitoring Program in Rincon Lagoon

In order to comprehensively and efficiently implement these sub-Projects, it is proposed to establish an advisory committee composed of representatives from both public and private sectors relevant to the Project and an unified executing organization composed of the qualified staff assigned from the relevant ministry, local governments, and agencies. These organizations are explained in Section 5.2. A farmer's participatory approach t the Project is firstly planned for the implementation of the Project. The Project implementation office shall be in operation from the preparation stage and the detail stage not only for survey and design but also for land acquisition, arranging beneficiary's participation for construction and operation and maintenance.

(1) Agriculture and Agricultural Support Services

Agriculture and agricultural support services Projects will be done by assistance from the private sector as much as possible. A research program of adaptive and applied on – farm research will be carried out by sub-let contract with Universities and/or private sector. Agricultural cooperative reinforcement Project will be performed under guidance of the market specialist who has a long experience of commercial business. Agricultural information centers will be formed under JAD. The Project for Strengthening Credit Services contains preparation of the cadastral maps and provision of legal procedure services that farmers should obtain definite land titles in order to get loans from the agricultural bank. The cadastral survey will be made by sub-let basis to private firms.

(2) Overall Water Management Project

A key structure of the overall water management or Yaque del Sur Water Management Center is Villarpando headworks. Some devices and equipment for the telemetric system will be installed at intake gates or around the headworks, therefore the improvement works should be completed beforehand. The telemetric system will be constructed according to the priority in the sequence. Survey and basic design works for the network will be done for the whole Project area at the initial stage of the Project. According to the estimated costs, development stages will be set, then detailed design will be conducted for the whole stages.

In order to implement the Project smoothly and realize quick yielding of the Project, the components of the Priority-1 will be divided for two phases as follows:

(a) Phase-1

Phase-1 will consist of minimum components which are indispensable for performing the functions of the overall management. The hydrometric stations of Los Guiros and Sabana Alta, which will be established at remote places without permanent staffs, should be facilitated with a telemetric system included in the Priority-1. Yaque del Sur Water Management Center will also have the telemetric facilities as proposed. The display panel for the whole system will be allocated to the phase-2. As for dam stations at Sabana Yegua and Sabaneta, telemeter facilities will not be installed. The water level in the reservoir will be reported by voice communication system to the Center. At Villarpando headworks, a water level gauge will be installed at the beginning point of the Ysura Head Race Canal. The data will be sent by wired transmission to the Center. Repeater stations for voice communication will be constructed at San Juan and Los Guiros. A repeater station for telemeter system will be established at Los Guiros.

(b) Phase-2

Phase-2 will facilitate the remaining items for completing of the Priority-1, namely, telemeter system for the dam stations, two water level gauges at Villarpando headworks, and repeater stations at San Juan for telemeter system will be constructed.

(3) Irrigation Development and Water Management in the field Improvement Project

The construction and improvement works of the major facilities should be carried out by a qualified general contractor. The contractor should be requested to employ local people as much as possible for labor works such as small earth works and canal lining. Small earth canals like field ditches should be improved and constructed by farmers themselves. In parallel with the construction works, farmers should organize WUO under the strong assistance from INDRHI and the operation and maintenance of improved irrigation facilities should be committed from INDRHI to WUO whenever an irrigation system commanded by a night storage pond is completed.

Consulting engineers should be employed to assist the Project executing body in the preparation of the tender documents, the tendering and supervision of construction and procurement works, setting-up and reinforcement of WUO. Experts required for these works are at least a construction management engineer, a irrigation design engineer, a construction engineer, an irrigation water management expert, an institutional expert, and a specification writer for construction works and procurement of facilities.

(4) Rural Infrastructure Improvement Project

Rural water supply Project will be implemented under the management of INAPA technically and administratively from the detailed design stage. Since two of the water supply systems, Bombita and Altagracia, will be established on the proposed INDRHI's main irrigation canal, the implementation schedule should be discussed and well managed according to the agreement between INDRHI and INAPA. Implementation of the community center Project will be linked with the construction of the proposed irrigation system and establishment of the WUOs. INDRHI will be the executive body for the implementation of the community center Project as well as the other irrigation facilities.

5.1.2 Implementation Schedule

The implementation schedule is shown in Fig. 5.1.1. The total period is scheduled to be five (5) years taking into account of content of works, scale of works, available working days, etc for the sub-Projects. The implementation is divided into first phase and second phase.

(1) Agriculture and Agricultural Support Services Project

A research program of adaptive and applied on-farm research and training for extension workers/leaders of nucleus of water users will be carried out for 2 years. These Projects should start at the time when nucleus of water users is formulated. Since the Project for Strengthening Credit Services contains preparation of the cadastral maps and provision of legal procedure services that farmers should obtain definite land titles in order to get loans from the agricultural bank, these works should be done at first phase and completed for 5 years. Also the Project of agricultural information centers that provide weekly marketing information to farmers should be commenced at first phase before the irrigation benefit by the implementation of the irrigation Project will occur. Agricultural

cooperative reinforcement Project should be started at the late of the implementation schedule

(2) Yaque del Sur Water Management Center Project

The construction works of the first stage (Phase-1 of Priority-1) will be completed within one year. At the end months of the first stage, preparation for the second stage will be started. The building of Yaque del Sur Water Management Center will be completed at the first half of the stage-1 and the telemetric facilities will be equipped during the second half. Since the fundamental facilities for the telemetric system, such as repeater stations and the Center will be constructed at the stage-1, the second and the third stages (stage-2 & stage-3) will be similar or shorter than the first stage. Training for the Center staffs will be started during stage-2, as a part of stage-3 components. The implementation schedule of the Project is proposed in Fig. 5.1.1.

(3) Implementation of the Irrigation and Water Management in the Field Improvement Project

The improvement works of the Villarpando headworks and establishment of water management office should be put in the first phase, since the accurate water diversion between the Azua and the Yaque del Sur area is prerequisite to improve the irrigation water management system especially for the Yaque del Sur lower reaches area. The construction works of the Project facilities will be implemented in the sequence of survey, design, tendering, construction, and operation test. In parallel to the construction works, works for setting-up and reinforcement of WUO are proceeded. It is recommended that WUO is organized at the sub-committee level in the Tamayo area in the first phase.

The construction works of the irrigation canals are carried out from the main canal from the upstream to the downstream. In accordance with the progress, the night storage ponds and lateral canal systems are constructed from the upstream to the downstream. Nucleus is to be formulated one by one tertiary block in parallel to the construction works of the laterals. Upon the completion of or in parallel to the construction works of a lateral, existing small canals, which receive water from the lateral are improved by the newly founded nucleus. Then training will be made by INDRHI staff for water management in the tertiary block. When all the nucleuses are established in one night storage pond irrigation area, sub-committee will be organized and the representatives will be elected under the attendance of the chiefs of all the nucleuses. Prior to the foundation, bylaw of the sub-committee will be drafted up by a team consisting of leading farmers, nucleus chiefs, INDRHI representative, and consultants. The rate of water charge will be determined as well by the chiefs of all the nucleuses in accordance with the advice from INDRHI. Training for the institutional management and water management in the lateral block including the night storage pond will be made for the representatives, leading farmers, and INDRHI site staff, who are expected to be employed by WUO to form a work force for operation and maintenance of irrigation facilities (refer to Section 4.5.6). After the training, the sub-committee will collect water charge from the member farmers through the chiefs of nucleuses, and employ the INDRHI staff for the operation of the check gate on

the main canal, the outlet gates of the night storage pond, and gates on the lateral canals and routine minor maintenance works for the lateral systems. When a few sub-committees are established in each of the main canal system and pump irrigation systems, an irrigation association will be formulated in the main canal system and pump irrigation systems, respectively. The association will work as an Irrigation Committee until the Irrigation Committee is officially formulated.

(4) Rural Infrastructure Project

Each water supply Project requires one year construction period excluding its detailed design works. Since water supply Projects at Bombita and Altagracia rely their water sources upon the proposed main irrigation canal, construction of the systems will commence in line with the construction schedule for the proposed main canal. The construction of the Bombita and the Los Robres systems will be commenced in 2nd year of phase-2, and the Altagracia system will be completed in the last year of phase-2.

Construction of the community center will also be done according to the progress of the proposed irrigation facilities and establishment of the proposed WUOs in each area. Thus all communication centers will be constructed in the last year of the period of phase-2.

5.2 Organization and Management

5.2.1 Advisory Committee

The advisory committee will have roles:

(1) to recommend and coordinate the Project policies and actions which will help to achieve the Project's goals.
(2) to review and recommend the Project annual plans to be prepared by the executing organization.
(3) to assess the degree of accomplishment of annual plan and suggest corrective measures if necessary;
(4) to review the by-annual (or quarterly) progress report submitted by the executing organization.

The advisory committee will be composed of representatives from both the public and the private sectors related to the Project such as:

- The Head of Yaque del Sur Irrigation District, Barahona,
- The Head of Lago Enriquillo Irrigation District,
- The Director of SEA South Regional Office, Barahona,
- The Manager of IAD Regional Office, Barahona,
- The Director of National Cadastral Office, Barahona and Bahoruco provinces
- The Director of INAPA, Barahona,
- The Governor of Barahona and Bahoruco Provinces,
- A Representative from Barahona Sugar Mill,

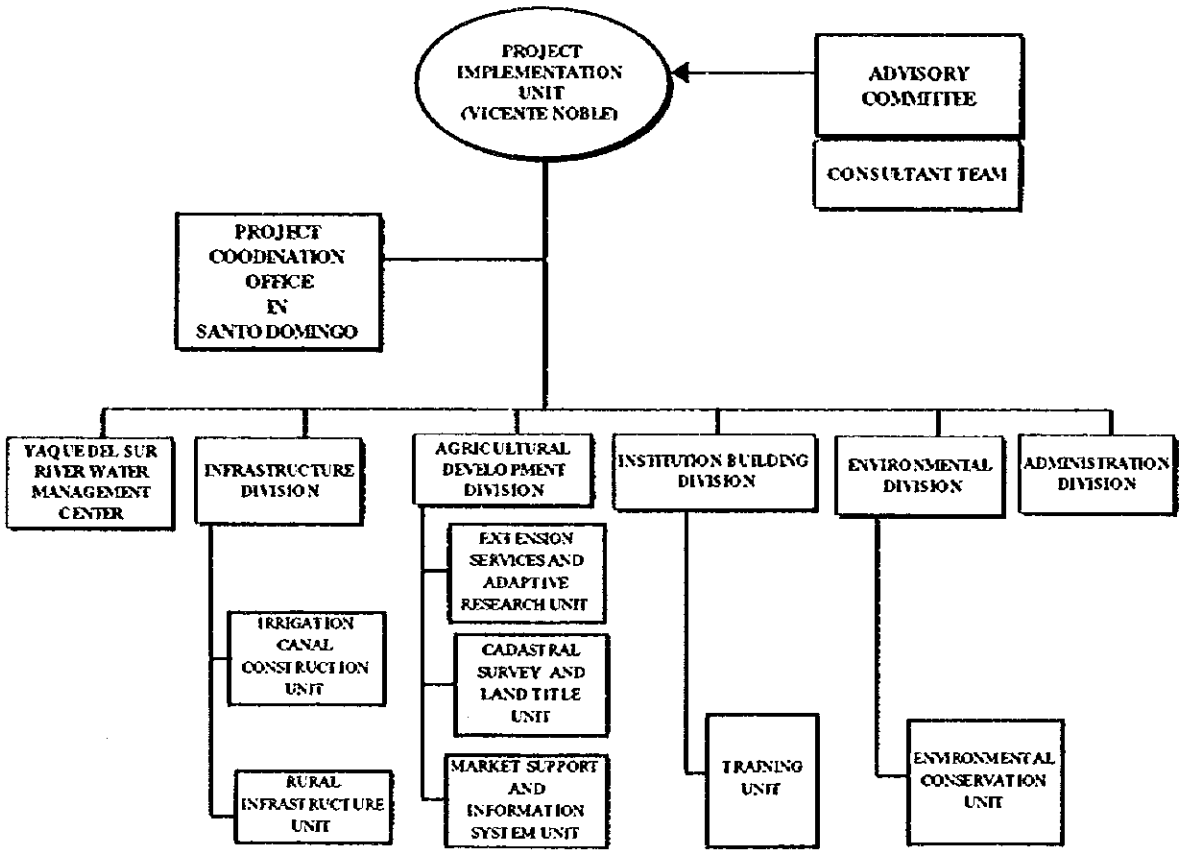
- A Representative from the Barahona Dioceses,
- A few leading farmers from the Project area,
- A Representative from the private sector, especially from the financial sector.

The committee will hold a regular meeting every half a year or quaternary or in accordance with the request of the executing organization. In this meeting, the executives of the executing organization will attend.

5.2.2 Executing Organization and Staffing

The executing body will be located in Vicente Noble or Barahona city and the Project office which acts as a coordinator among the Ministry and agencies dispatching staff to the body will be established in Santo Domingo.

The executing organization will consist of five divisions such as administration division, infrastructure division, agricultural development division, institution building division, and environmental division. Further every division will have sub-divisions such that the infrastructure division is further divided into irrigation sub-division and rural infrastructure sub-division and several units as shown in the following Figure.



The executing organization will generally undertake the following works:

i) Coordinating, supervising and monitoring the Project;

ii) Planing and conducting internal audits, and financial requirements for the Project components;

iii) Establishing implementation schedules for the Project; and managing the implementation of the Project.

(1) Yaque del Sur Water Management Center

Yaque del Sur Water management Center will be constructed at Villarpando aiming at distributing the available waters evenly to Azua and Barahona/Neiba areas. Basically, the functions should not be independent and will not be affected by any self-centered intentions by the Irrigation Districts. Thus, the implementation of the Center Project should also be conducted by a division for the Center itself. The Center Project will have a component of establishment of the telemetric system, which consists of imported materials and equipment. Intensive training programs are included in the Project cost to train the staffs who will work for the Center. However, it is recommended to fix an executive organization which will handle the implementation and shift to the Water Management Center itself after the completion, because some core staffs should know not only the equipment itself but also how to install, set up, calibrate and maintain the equipment and facilities. Hence, Yaque del Sur Water Management Center will be established in the executive organization of which main office will be set up at Vicente Noble. The chief of the division (Center), who is supposed to be a staff engineer of the Center after completion will be the be appointed by the headquarters of INDRHI.

(2) Infrastructure Division

Infrastructure Division will take charge of survey, design, preparation of tendering documents, and construction supervision. The Division will provide technical assistance to WUO to improve small canals as well. Tendering works will be done in collaboration with the Administration Division. Operation and maintenance manuals of irrigation facilities are also prepared in this Division. Training of farmers for the irrigation water management will be carried out in collaboration with the Institution Building Division. For these works, the Division will be mainly composed of a construction management engineer, a few construction supervisors, a few design engineers, a metal work engineer and an electric engineer, a few topographic surveyors mostly coming from INDRHI and INAPA.

When the improvement of the Villarpando headworks and the construction of the Water management center are started, a sub-office which may consist of a few staffs such as a construction engineer and an architect will be assigned.

(3) Agricultural Development Division

Agricultural Development Division will take charge of design, preparation of

tendering documents, and Project supervision. The Division will supervise 3 Projects such as Project for strengthening research and extension services, Project for Strengthening Credit Services and Agricultural Cooperative Model Project and Market Information System Project. Moreover, the division is responsible for the coordination among the related ministries i) arrangement of scheduling of land preparation, ii) arrangement of supply of farm inputs to farmers, iii) monitoring of agricultural information, iv) technical guidance on farm practices and management.

(4) Institutional Building Division

Institutional Building Division will work mainly for establishing and reinforcing WUO who operates and maintains the irrigation facilities improved by the Project and acts as a communication system and coordination body for farm inputs and marketing. The Division will also coordinate to establish and reinforce the Water management center to be located in the Villarpando. The Division will make a training program, lead farmers to organize and reinforce WUO through guidance and training, assist and advise WUO to make bylaw and water distribution rules and to manage the organizations in various administration and technical fields. In order to fulfil the institutional works, the Division will be composed of an institutional expert, operation and maintenance experts of irrigation facilities, local government staff, a financial assistant, and leading farmers and also tentatively hire a layer, a water management expert and a telemetering communication expert.

(5) Environmental Division

The environmental division is in charge of supervision of the Projects such as Green Belt Formation Project for Waterfront Conservation and Environmental Monitoring Program in Rincon Lagoon.

(6) Administration Division

Administration division undertakes non-technical functions such as purchasing and supply, transportation control, security control, public relation, office supply, fuel control for vehicles, personnel control, clinic services, housing services, medical services and payroll. And the division is responsible for controlling all the accounting and financial transaction.

(7) Consultant

In addition to the government staff and farmers, it is necessary to assign consultant experts in order to train key personnel to enhance sustainable agricultural activities to advise the executing organization to smoothly implement the Project. The experts required for this purpose are listed below.

- Construction management expert
- Design engineer
- Institutional expert

- O&M expert
- River water management expert (Hydrologist)
- Mechanical engineer
- Agricultural extension expert
- Agronomist
- Economist

After the implementation of the Project, the Project implementation office will be phased out except Yaque del sur river water management center. The Yaque del sur river water management center, which should function to deliver fairly river water to Azua irrigation district area and Yaque del sur/Lago Enriquillo irrigation district area, will continue its function not under Azua irrigation district office but under supervision the headquarters of INDRHI at Santo Domingo.

After the implementation of the Project, operation and management for Villarpando intake weir and Yaque del sur river water management office will be made by the control of the headquarters of INDRHI. All irrigation systems except Santana intake weir are in principle managed by water user's organizations but INDRHI has ownership of all the irrigation systems. Yaque del sur irrigation district office and Barahona Sugar corperation will do operation and management of Santana intake weir. INDRHI will take the rural water supply systems over INAPA that should manage. Community centers will be managed by water user's organizations.

6. COST ESTIMATE

6.1 Conditions of the Cost Estimate

The Project cost is estimated on the basis of preliminary design of the Project facilities with the following assumptions.

(1) The exchange rate used in the estimation is as follows;

US$1.00=DR$15.5=112 Japanese yen

(2) Construction works will be executed by the contractors, which will be selected through the international competitive bidding. The contractors will provide the construction machinery and equipment required for the construction. Therefore, depreciation costs of machinery and equipment are considered in the estimate of construction cost.

(3) The unit prices are analyzed on the basis of basic unit cost and working rate of labor and materials are basically quoted from the unit cost officially used by INDRHI in January 1999. The unit prices of the works were divided into the foreign currency (F/C) and the local currency (L/C) portion. Proportion of the foreign and local currencies for the construction materials and equipment was applied as shown in the following table.

Proportion of F/C and L/C

Descriptions	Foreign currency [%]	Local currency [%]
Cement	80	20
Steel bar	80	20
Lumber	80	20
Construction equipment	100	0
Fuel and Oil	100	0
Labor and Operator	0	100

(4) Engineering service and administration cost are estimated at 15% and 5% of direct construction costs, respectively. Physical contingency is estimated at 10% of the direct construction costs.

(5) The price contingency is taken into account at annual escalation rate of 15% for local currency portion and 2.0% for foreign currency portion.

6.2 Cost Estimate for the Projects

6.2.1 Estimate of Construction Cost

The Project cost comprises the construction cost, procurement cost of equipment and machinery, engineering services cost, administration cost and contingencies. The total cost of the proposed Project in the Project area is summarized in the following table and the details are described in Table 6.2.1.

Summary of Project Cost

[DR$ million]

Project	Foreign Currency	Local	Total
1) Agriculture and Agricultural Support Services Plan			
Direct cost	6.56	48.61	55.16
Indirect cost	2.09	15.56	17.65
Total of 1)	8.65	64.17	72.82
2) Overall water management plan			
Direct cost	160.44	40.11	200.56
Indirect cost	24.87	6.22	31.09
Total of 2)	185.31	46.33	231.64
3) Irrigation development and water management in the field improvement plan			
Direct cost	377.41	138.83	516.24
Indirect cost	121.76	65.49	187.24
Total of 3)	499.17	204.31	703.48
4) Rural infrastructure improvement plan			
Direct cost	18.02	7.94	25.96
Indirect cost	5.77	2.54	8.31
Total of 4)	23.79	10.48	34.27
5) Environmental conservation plan			
Direct cost	1.39	1.49	2.88
Indirect cost	0.45	0.48	0.92
Total of 5)	1.84	1.97	3.80
Total			1,046

(1) Agricultural Support Services

The direct costs for agriculture and agricultural support services plan are summarized below. The required man-power, materials, equipment and other expenditures are shown in Table. 6.2.2 ~ Table 6.2.6

Summary of cost for Agriculture and Agricultural Support Services Plan

(Unit: DR$1000)

Projects	Cost		Total
	F/C	L/C	
1) Strengthening reserch and extension services			
Adaptive Research Program	585	11,862	12,447
Extension and Training Programs	1,621	11,296	12,918
sub-total	2,206	23,158	25,365
2) Strengthening credit services	-	-	
Credit Support Program	1,014	18,410	19,425
sub-total	1,014	18,410	19,425
3) Agricultural cooperatice model project and market support system		-	
Market support	2,091	3,306	5,397
Market Information Systems	- 1,244	3,729	4,973
sub-total	- 3,335	7,035	10,371
	-	-	
Total	6,556	48,605	55,165

(2) Overall Water Management

Overall water management includes the costs for the telemetry system (water management and flood control), Yaque del Sur Water Management Center, Santana Branch Office, training of WUOs and staff for the water management.

(a) Telemetry System

The telemetry system has two purposes for the water management and flood and/or discharge warning. Dimensions of the telemetry system depends on quantity of data to be processed, intervals of processing, etc. For the proposed system of the Project for all (priority 1 to 3) will require three transmission channels for i) telemetry system (water management), ii) flood/discharge warning system and iii) voice communication system. Stations such as repeater stations will be used with three channels of similar equipment for the transmission. ITV signals will be sent in-between those of telemetry system.

The transmission systems are given in Fig. 6.2.1 ~ Fig. 6.2.3 for the three systems. Since most of the equipment and facilities will be imported, the foreign currency portion will account for about 80 % of the total cost.

(b) Yaque del Sur Water Management Center and Santana Branch Office

Yaque del Sur Water Management Center will built of reinforced concrete or concrete blocks with two floors. The total floor area amounts to 400 m^2, with necessary office and household appliances, furniture, etc. The cost for the Center building is estimated by unit cost per square meter which includes facilities for such as water distribution, sanitary, electricity, etc. The unit cost is estimated at 8,000 DR$/$m^2$ or 516 US$/$m^2$, out of which 30 % is regarded as the foreign currency portion and 70 % for the local.

(c) Training Cost

Training cost consists of equipment for training and operation cost.

The cost for the overall water management are shown in Table 6.2.7 and summarized as follows.

No.	Item	Cost (RD$)				Total
		Priority-I		Priority-II	Priority-III	
		Phase-1	Phase-2			
Telemetric Water Management System						
1	Yaque del Sur Water Management Center	16,324,000	8,008,000	1,305,000	8,116,000	33,753,000
2	Villarpando Headworks Control	4,371,333	9,709,667	0	5,976,000	20,057,000
3	Sabana Yegua Dam Station & Sabana Yegua Upstream Raingauge Station	1,889,000	6,735,000	1,132,000	2,393,000	12,149,000
4	Sabaneta Dam Station & Sabaneta Upstream Raingauge Station	936,000	7,924,000	1,132,000	2,393,000	12,385,000
5	Sabana Alta Hydrometric Station	5,408,000	0	96,000	220,000	5,724,000
6	Los Guiros Hydrometric and Raingauge Station	5,408,000	0	96,000	220,000	5,724,000
7	Santana Branch Office & Headworks Control	0	0	13,615,000	8,964,000	22,579,000
8	Rincon Lagoon Hydrometric Station	0	0	11,064,000	12,192,000	23,256,000
9	Palo Alto Hydrometric and Raingauge Station	0	0	0	5,752,000	5,752,000
10	San Juan Hydrometric Station	0	5,532,000	0	2,809,000	8,341,000
	Documentation (manual, etc)	138,000	138,000	276,000	276,000	828,000
	Spare parts	304,000	304,000	3,376,000	1,314,000	5,298,000
	Measuring instruments	719,000	719,000			1,438,000
	Training	186,000	186,000	373,000	373,000	1,118,000
	Site survey and installation	13,756,000	13,742,000	9,037,000	5,618,000	42,153,000
	TOTAL	49,439,333	52,997,667	41,502,000	56,616,000	200,555,000

(3) Irrigation and Drainage

Irrigation and drainage sector comprises 1) Improvement Project of Villarpando intake weir, 2) Improvement Project for irrigation facilities including Santana intake Weir and 3) Project of strengthening water user's organization. The total work quantity is summarized in Table 6.2.8.

The unit cost for estimating the direct construction cost was determined based on labor wage, material cost and equipment cost (Table 6.2.8~Table 6.2.10).

The summary of the direct construction cost is shown in the following table and the detail breakdowns are mentioned in Table 6.2.11

Direct Construction Cost of Improvement of Irrigation and Drainage Facilities [DR$ 1000]

	F/C	L/C	Total
- Preparatory Works	17,972	6,610	24,582
- Villarpando HW	11,472	4,389	15,861
- Main Canal System (canal work)	62,731	24,410	87,141
- Main Canal structures	17,427	5,791	23,218
- Regulation Ponds	53,374	12,886	66,260
- Lateral Canal	174,077	65,026	239,103
- Siphon	24,400	12,395	36,795
- Santana Headworks	11,607	6,655	18,262
- Drainage (lateral level, total 7 km)	4,348	665	5,013
Total	377,408	138,827	516,235

(4) Rural Infrastructure

Estimated direct construction cost of rural infrastructure is shown in Table 6.2.12 and summarized below.

Unit; DR10^3

	Direct Construction Cost	
	Foreign Currency	Local Currency
Water Supply Project		
- Bombita System	3,473	2,425
- Los Robres System	2,436	1,205
- Altagracia System	3,281	2,100
Community Center		
- Vicente Nobre Center	3,456	864
- Fundación Center	2,688	672
- El Peñon Center	2,688	672

(5) Environmental Conservation

(a) Green Belt Formation for Waterfront Conservation

The total cost for the Project is estimated as DR$ 609,000 as shown in table below and detail calculations is shown in Table 6.2.13.

Summary of Direct Cost for Green Belt formulation

(unit;DR$)

Work Item	Cost
Personnel expenditure for planting	41,682
Seedling production	36,500
Fertilizer	2,281
Construction of the maintenance road	450,000
Construction of steps	28,000
Bench	50,000
Total	608,463

(b) Environmental Monitoring Program in Rincon Lagoon

The total cost for the Project is estimated as DR$3,153,000 as shown in table below and the detail breakdowns are described in Table 6.2.13.

Summary of Direct Cost for Environmental Monitoring Program

DR$

Item	Cost
Personnel expenditure	1,391,442
Water Quality Analysis	371,100
Equipment	1,390,200
Total	3,152,742

6.2.2 Annual Disbursement Schedule

The proposed Projects will be executed for 5 years, which include basic design, detailed design, competitive bidding and construction or Project implementation. Annual disbursement schedule is shown in Table 6.2.14.

6.3 Operation and Management Cost

The O&M cost comprises the administration cost, equipment cost, and O&M cost of the Projects. The annual O&M cost in the full operation stage for all the Project facilities is estimated about DR$ 14.3 million and the respective O & M costs are summarized in Table 6.3.1.

6.4 Replacement Cost

The metal works of irrigation facilities and equipment will be replaced periodically. The O&M equipment and gates should be replaced every 5-10 year and 20years after commencement of the Project. The replacement cost for the respective component in the Projects is summarized in Table 6.4.1

7. PROJECT EVALUATION

The Project evaluation includes an assessment of Project feasibility regarding economic, financial, environmental, socio-economic aspects. The economic feasibility is first evaluated by calculating the Internal Rate of Return (IRR). Sensitivity analysis is also performed in order to evaluate the soundness of economic viability of the Project against changes in benefits, the construction period, and construction costs.

Financial evaluation is carried out by analyzing the effect of the Project on the farm economy for typical type of farmers.

The socio-economic and environmental impacts to the Project are also evaluated.

7.1 Economic Evaluation

7.1.1 Assumptions

(1) Basic Assumption

The economic evaluation is made on the following basic assumptions:

(a) The economic life of the Project is 50 years

(b) All prices are expressed 1998 prices

(c) The exchange rate of US$1.00=DR$15.5 is applied

(d) Transfer payment such as interests and taxes excluded

(e) Standard conversion factor of 0.87 is applied to the price of non-tradable goods and services

(f) Shadow price factor of 0.44 is applied to unskilled labor

(g) The Project costs for the sub-Projects such as extension/research Project, credit Project, agricultural cooperative and information system Project and environmental conservation Project is excluded in economic evaluation.

In order to evaluate the Project costs and benefits with respect to world market prices, a standard conversion factor (SCF) is applied to the price of non-traded goods and services. The SCF in the years 1990 to 1997 is calculated at 0.87 as shown in Table 7.1.1. So the SCF of 0.87 is applied

From the viewpoint of the international economy, the transfer payment such as contract tax, duty, subsidy and interest are considered as a domestic monetary movement without any direct productivity. These transfer payments are, therefore, excluded from the Project cost for the economic analysis.

The shadow prices used for converting market prices into economic prices together with the discount rate applied for calculating the net present value are based on the

Guidelines prepared by the Central Bank known as "Guía Metodológica para la Preparación y Presentación de Proyectos Agroindustriales"

Economic prices of agricultural outputs (plantain, banana, cassava, pepper, melon, corn, and papaya) and farm inputs (urea, triplesuper phosphate) are estimated on the basis of the data used by the Central Bank and SEA. The domestic cost elements such as transport, handling and processing down to the farm gate level are multiplied by the SCF 0.87.

Farm labor is priced at DR$100 per man-day. For unskilled labor factor has been estimated by the Central Bank at 0.44 to make the adjustment necessary to reflect the border price of labor (shadow price) for The Dominican Republic.

7.1.2 Economic Project Costs

(1) Capital Cost

The economic construction cost is estimated by applying construction conversion factor to the financial construction cost as shown below: Since the overall water management Project covers the whole basin, improvement Project of Villarpando intake weir covers the areas including Azua, Lago/Enriquyo irrigation district areas, and Improvement projct of irrigation shares function of Santana intake weir and main canal with CEA sugar cane farms, capital cost is allocated to the Project as follows:

Project	The Project without consideration of cost allocation			The Project with consideration of cost allocation	
	Financial cost (1,000 DR$)	Construction conversion factor(%)	Economic cost (1,000 DR$)	Allocated rate (%)	Economic cost (1,000 DR$)
Overall water management Project(Yaque del sur water management center Project)	231,641	97.1	225,448	15.2	34,268
Improvement Project of Villarpando intake weir	20,937	88.8	18,582	16.5	3,066
Improvement Project of irrigation facilities and Irrigation water management Project	682,541	81.6	558,692	81.8	558,692
Rural infrastructure	34,266	88.9	30,431	100	30,431
Total	969,385		833,153		626,457

(2) Annual Operation and Maintenance Cost

Economic annual operation and maintenance cost is estimated by applying financial O&M cost to construction conversion factor. The depreciation cost of O&M equipment and gate is taken as the replacement cost. Economic annual O&M cost is estimated as follows: The annual operation and maintenance cost of the Project with consideration of cost allocation is calculated as same as methods mentioned item (1) Capital Cost.

Project	The Project without consideration of cost allocation			The Project with consideration of cost allocation	
	Financial O&M cost (1,000 DR$)	Construction conversion factor(%)	Economic O&M cost (1,000 DR$)	Allocated rate (%)	Economic O&M cost (1,000 DR$)
Overall water management Project(Yaque del sur water management center Project)	6,923	82.3	5,697	15.2	866
Improvement Project of Villarpando intake weir	16	62.5	10	16.5	2
Improvement Project of irrigation facilities and Irrigation water management Project	6,656	55.6	3,699	81.8	3,025
Rural infrastructure	713	68.6	489	100	489
Total	14,308		9,895		4,382

(3) Replacement Cost

It is assumed that O&M equipment and gates are replaced in every 5 to 10 years and 20 years. Economic replacement cost is estimated by applying financial cost of O&M equipment and gates to construction conversion factor is as follows:

Project	Metal & Equipment	Durability (year)	Total Economic Replacement cost (1,000DR&)
Overall water management Project(Yaque del sur water management center Project)	Outside of house	10	2,830
	indoor	25	3,538
Improvement Project of Villarpando intake weir*	gates	20	336
Improvement Project of the irrigation facilities and Water managent Project *	Gates and pumps	20	3,087
Rural infrastructure Project	Gates and pumps	20	2,575

*: Irrigation Project

7.1.3 Economic Project Benefits

The Project benefit consists of irrigation benefit and municipal water supply benefit in the Project.

The irrigation benefit is defined as the difference in primary profit from crops between the future with Project and without Project conditions. On the basis of production cost and gross income, the primary profit from crops per ha was estimated for both with and without Project conditions. In this study the primary profit from crops under the without Project condition was considered as the profit at present. The primary profits from crops under both the without Project and with Project conditions are shown in Table 7.1.2. The target yield of crops is assumed to reach for 5 years. And the irrigation benefit is estimated under the assumption that irrigation Projects formulated in the master plan are compeleted during 10 years. Irrigation benefit at the full stage is shown in Table 7.1.3.

The municipal water supply benefit is defined as substitution cost of the present water fee of 0.048 DR$/litter that water tank lorry carries water to the Project sites. The municipal water supply benefit is generated after the 5th implementation year. Total rural municipal water supply benefit is estimated at Table 7.1.4.

7.1.4 Economic Evaluation

The economic internal rate of return is calculated on the basis of cost and benefit flow as shown in Table 7.1.5. The internal rate of return is estimated at 23%. In the economic evaluation, agricultural support Projects such as research/extension Projects, credit Project and agricultural cooperative/information center Project are not taken into consideration.

7.1.5 Sensitivity Analysis

Sensitivity analysis is carried out to evaluate the soundness of the Project against possible adverse changes in the future in the following cases:

(i) Cost overrun by 20%

(ii) Reduction of irrigation benefit by 20% due to decrease of crop yields and prices

(iii) Combined effect of case (i) and (ii).

The results are summarized below.

Case	Internal rate of Return(%)
(i)	20.1
(ii)	19.5
(iii)	16.9

7.2 Financial Analysis

In order to evaluate the Project from the financial aspect of the farmers, the farm budget analysis on different sizes of farmers is made under both futures with Project conditions. After the implementation of the Project, the Project will provide bases for introduction of improve irrigation farming. As a result, increase of unit yield of crops and cropping intensity will be much expected. A farmer's income will increase and farmer's economic situation is much improved, which will offer incentive to the farmers in the Project area.

Crop yields are expected to be the following:

- Plantain 24 tons/hectare
- Banana 36 tons/hectare
- Papaya 52 tons/hectare
- Corn 2.8 tons/hectare
- Cassava 12 tons/hectare
- Red beans 1.5 tons/hectare
- Melon 40 tons/hectare
- Tomato 30 tons/hectare
- Pepper 18 tons/hectare
- Eggplant 20 tons/hectare

- Sweet potato 17 tons/hectare
- Pigeon peas 3 tons/hectare
- Rice 4.5 tons/hectare

Cropping intensity would increase up to 113 % from previous 75 %. Under these conditions, it is expected a significant increase on farm income in the future under Project conditions. On the other hand, substantial increase on farm income would not be expected in the future without Project conditions

The results of farm budgets for the farmers in the Project area are summarized below and Details are shown in Table 7.1.6.

Item	Small farmer	Medium farmer	Large farmer
Farm size(ha)	0.61	1.3	4.3
Family size (person)	5	5	4
Agricultural income (DR$)	64,013	136,422	451,243
Non-farm income(DR$)	11,500	11,500	0
Total income (DR$)	75,513	147,922	451,243
Production cost (DR$)	8,997	25,147	96,030
Living expenditure (DR$)	44,616	74,035	145,275
Total expenditure	53,613	99,182	241,305
Surplus (capacity to pay) (DR$)	21,900	48,740	209,940

As shown in the above table, net reserve or the capacity to pay is expected to be 21,900 DR$ for small farmer, 48,740 DR$ for medium farmer and 209,940 DR$ for large farmer, respectively. On the other hand, operation and maintenance cost of irrigation systems with Project condition is estimated at about DR$ 1,100/ha and the farmers in the Project area will be able to afford to pay for O/M cost.

7.3 Environmental Assessment

7.3.1 Basic Concept

The result of the Initial Environmental Examination (IEE) (see annex 1, section 4.10) points out some possible negative impacts by the implementation of the Yaque del Sur Lower Reaches Irrigation and Drainage Project, and stresses the necessity of conducting the Environmental Impact Assessment (EIA) in the stage of the feasibility study.

In agricultural development Projects, however, negative impacts do not always happen. On the contrary, the Projects without large-scale constructions are enough friendly for environment, and bring many positive environmental impacts. Since large-scale Projects are not proposed in this feasibility study, many positive impacts are expected. Therefore in this section, not only the negative impacts but also the positive impacts are foreseen and evaluated.

In this feasibility study, the Projects shown below are proposed. The EIA is conducted for the all proposed Projects.

- Irrigation Water Management Improvement Project,
- Irrigation Facilities Improvement Project,

- Villarpando headworks Improvement Project,
- River Water Management Reinforcement Project,
- Project of Overall Water Management in Yaque del Sur River Basin,
- Project for Strengthening Agriculture Support Service,
- Rural Water Supply Project,
- Community Hall Construction Project,
- Green Belt Formation for Waterfront Conservation, and
- Environmental Monitoring Program in Rincon Lagoon.

7.3.2 Environmental Impact Assessment (EIA)

(1) Environmental Items to be considered

Considering the condition of the Project area (see section 3.8) and characteristics of the proposed Projects, the environmental items to be studied in this section are determined as shown below:

(a) Socio-economic Issues

- Substantial change in way of life,
- Change in economic activities of local people,
- Change in water use condition,
- Change in social and institutional structures,

(b) Health and Sanitary Issues

- Increase of agrochemical use,
- Increase of water born diseases,

(c) Natural Environmental Issues

- Hange in vegetation and land use,
- Soil salinization,
- Water contamination and deterioration of water quality

(2) Result of Environmental Impact Assessment (EIA)

(a) Result of the Study

The result of the environmental impact study is summarized in the figure below. The contents of the positive and negative impacts foreseen by the Project implementation are explained in Table 7.3.1.

Figure Result of EIA

		Irrigation Water Management Improvement Project	Irrigation Facility Improvement Project	Villaprendo Headworks Improvement Project	River Water Management Reinforcement Project	Project of Overall Water Management in Yaque del Sur River Basin	Project for Strengthening Agriculture Support Service	Rural Water Supply Project	Community Hall Construction Project	Green Belt Formation for Waterfront Conservation	Environmental Monitoring Program in Rincon Lagoon
Socio-economic issue	Substantial change in way of life	◎	○	—	—	—	◎	○	○	○	—
	Change in economic activities of local people	○	◎	○	○	○	◎	○	—	—	—
	Change in water use condition	◎	◎	◎	◎	◎	—	◎	—	—	—
	Change in social and institutional structures	○	—	—	—	—	—	—	○	—	—
Health and sanitary	Increase of agrochemical use	—	—	—	—	—	○	—	—	—	—
	Increase of water born diseases	—	△	—	—	—	—	◎	—	—	—
Natural environmental issue	Change in vegetation and land use	—	△	—	—	△	—	—	△	◎ △	◎
	Soil salinization	—	△	—	—	—	—	—	—	—	—
	Water contamination and deterioration of water quality	—	—	×	—	—	○ ×	—	—	—	○

Note: ◎Grate positive environmental impacts are foreseen; ○Positive environmental impacts are foreseen; △Although some negative impacts are foreseen, they will be reduced by countermesures; ×Small negative impacts or temporaly impacts are foreseen; —No change.

(b) Countermeasures to alleviate the Foreseen Negative Impacts

Some foreseen negative impacts are reduced by taking proper countermeasures as described in table below.

Countermeasures Taken for Foreseen Negative Impacts

Foreseen Negative Impact	Causes of the Impact	Countermeasures
Increase of water born diseases	Creation of new water body by construction of regulation ponds.	The ponds have to be periodically kept empty to restrain the propagation and get rid of mosquito and snails which causes malaria and schistosomiasis. Fish breeding is also effective.
Change in vegetation and land use	Change in farm and residential area by the construction of new canal, community hall, and creation of green belt	Appropriate compensation to the land owners and farmers.
	Slash of secondary forest by construction of the water management center	Creation of green area around the center by tree planting.
Increase of agrochemical use	A result of intensified agriculture	Research, extension and education for farmers on efficient way of agrochemical use
Soil Salinization	Backwater from sea, in the southern part of the Project area, where the altitude is low	Collocation of gates to prevent backwater from sea.

7.3.3 Assessment on Social Changes

(1) Social Change

As a result of the environmental impact study, the positive impacts to socio-economic condition caused by the improvement and construction of irrigation facilities and the formation of the WUO are mainly foreseen. This does not simply mean that, after the Project implementation, more agricultural production and higher income are brought to local farmers as a consequence of better water supply, but also mean that changes of essential structure or characteristics of the rural society are brought.

In this section, the essential changes of social structure or characteristics are studied, based on the case studies of San Juan and Azua where the similar Projects to the proposed Projects already has been implemented.

(a) Problems in the Rural Area

In the Project area, the problems concerning agriculture are analyzed as shown in chapter 3 of this report. Those are problems of infrastructure of irrigation, water management, marketing, extension and research, agricultural credit, and so on.

However, there is a more essential problem behind them. The problem is that the rural society is not enough democratic. The problem consists of 2 factors, which are: first, lack of force among small farmers to organize or combine by themselves; and second, the centralization of power, for example, to control water distribution. These 2 factors interfere farmer's thinking and activities to resolve the problems and to improve their life by themselves.

According to the interview with the staff of the Unit of Organization and Training, INDRHI (Barahona), whose task is to organize water user's organizations and to manage them, the most difficult process in the work is to motivate farmers to organize a nuclear by themselves. Also, if once a nucleus is set up, without continuous motivation from the

government staff, the nuclear is easily broken up. This phenomenon is caused by the weak united power in farmer's society.

On the other hand, in the most of the Project area where WUO has not yet established, a power, for example distributor of water, is in many cases nominated by political power. Since the united power among small farmers is quite weak, a problem of water is resolved between each farmer and the power, in individual level. In this case, economically or politically stronger farmers usually take advantage to receive the water. In the case that a power could not resolve the problem, a disturbance with violence between farmers happens. Under these conditions, an unfair, inefficient and unstable society has been built up.

(b) Result of Case Study in San Juan and Azua

The result of case study in the areas where irrigation Project already has been implemented in San Juan and Azua is shown in the Table7.3.2. Although the systems of the management of the WUO are slightly different between 2 areas, some common systems are observed. For example, there is election system when representatives are elected; meetings are always held in the process of decision making and problem resolution. As a result, the case of bribe use and political influence in the water distribution process were reduced; the case of robbery of water and the conflict with violence between users were also reduced; water management has been done more efficiently because of the increase of water distributors.

(c) Expected Social Change in the Project area

From the result of the case studies, several changes in system of water distribution process are observed. What is even more important, the Project impacts have extended to the rural social system. Also in the Project area, it is expected that same kind of changes will occur, which are concretely:

- Leaders, such water distributor of organization are elected by all users. As a result, more democratic rural society will be built.
- Organization with stratum structure, consisting of nucleus, committee and association, is built. As a result, the power will be decentralized and the water management could be done more efficiently and democratically.
- In every level of the organization, the decisions are made through discussion among water users. As a result, the decision process has become more democratic, and user's consciousness of social participation has become higher.
- Collaborated works for the irrigation facility management are done by all users. As a result, user's consciousness on social participation has increased.

- A strong rural society based on the WUO is able to become a powerful party against powers of outside area

Through the process of organization building and decentralization of the power, the society will become more democratic. In the process of the democratic society building, the local people will be empowered and at the same time the society to which they belong will be also empowered. With the empowered people, a society, which can do self-development, will be built up.

A condition is required, however, to realize such democratic society. The farmer's motivation to develop the society is required for such social change. To maintain the high motivation, it is required to raise agricultural production and their income with the implementation of the Projects. Therefore, some supporting systems for farmers, such as marketing, credit, extension and research, etc. are very important to make sure the successful and continuous achievement.

(2) Increase in employment opportunity and technical transfer

It is estimated that the Project will generate employment opportunities totaling about 0.31 million man-days of unskilled labors during the construction period. Furthermore, the employees will gain more work experience and technical skillfulness not only in the irrigation sector but also in the commercial sectors. The opportunity for self-employment in and around the Project area will be increased through the Project and this will activate monetary movement in the regional economy. The increased crop production will generate commercial activities.

(3) Improvement of farm products

The quality of plantain and other crops will be much improved by the sufficient water supply, which minimizes crop damage and assures uniform maturing of plantain. Such improved quality would increase the marketability of the products.

(4) Improvement of the nutritional status of the rural population

The Project will contribute to the improvement of the nutritional status of the rural population by supplying more staple foods (plantain).

(5) Improvement of the present water supply condition

The irrigation canals to be constructed for distributing water to the fields are water sources for the everyday use of the inhabitant and the rural water supply system will imporve health condition for the local peoples.

(6) Improvement of local transportation

The local transportation system will be improved by the construction of the O&M

road along the irrigation canals. The road extension will not only enhance the economic activities, but will also contribute to accessibility and communication.

(7) Energy aspect

The proposed irrigation Project will change the part of the existing pump systems to gravity systems of which irrigation water is direct supplied through the new main canals by Santana intake weir. The operation cost of energy is much decreased.

7.3.4 Environmental Evaluation

Almost of the Project areas are already developed as agricultural land, and valuable vegetation and habitat areas do not exist. Also the proposed Projects do not have components with big scale earth works. Therefore few serious negative environmental impacts will occur by the Project implementation.

On the other hand, several positive impacts for the rural society are expected as described in section 3.3. The objective of a series of the proposed Projects concerning agricultural development is to improve the condition of water supply and raise the agricultural production and farmer's income. However, what is even more important, the Project implementation causes the social change toward democratic society. The implementation of the proposed Projects will be able to become the trigger of starting such change to realize a democratic and economically and psychically rich society with empowered people.

7.4 Overall assessment for the Project

The Project is technically sound and economically feasible. Moreover, the Project will provide substantial and sustainable socio-economic benefits not only with the Project area but also with the Yaque del sur river basin and the southwest region.

Almost of the Project areas are already developed as agricultural land, and valuable vegetation and habitat areas do not exist. Also the proposed Projects do not have components with big scale earth works. Therefore few serious negative environmental impacts will occur by the Project implementation.

On the other hand, several positive impacts for the rural society are expected as described in the previous section. The objective of a series of the proposed Projects concerning agricultural development is to improve the condition of water supply and raise the agricultural production and farmer's income. However, what is even more important, the implementation of the proposed Projects will be able to become a trigger of starting the social changes to realize a democratic and economically and psychically rich society with empowered people.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

(1) In the Master Plan on the Agricultural Development in the Yaque del Sur River Basin, 27 Projects related to the agricultural development plans such agriculture, agricultural support services, overall water management, irrigation and drainage including strengthening water user's organization, rural infrastructure, environmental conservation and water resources have been formulated. Among these Projects, the high priority area was selected and the feasibility study was conducted for the agricultural development Project in the lower Yaque del Sur River with an area of about 6,000 ha coupled with the improvement of Villarpand headworks and its function.

(2) The agricultural development in the lower Yaque del Sur River should be integrated with the following points for success.

(i) Improvement of irrigation facilities such as Villarpand headworks and the existing irrigation facilities will be improved.

(ii) Strengthing of water user's organization for operation and maintenance of irrigation systems by water user's organization.

(iii) For effective use of river water, the Yaque del Sur Water Management Center will be newly instituted.

(iv) Constructions of rural infrastructure of rual water supply and multipurpose community centers to improve quality of life of farmers.

(v) Strengthening agricultural support services relevant to a research program of adaptive and applied on-farm research for plantain, eduction and training for extension workers along with leaders of nucleus of water users to develop their capacity, preparation of cadastral ledgers and service for land resisters, establishment of a model agricultural cooperative land and a market information system.

(3) The Project is technically sound, economically feasible, financially justifiable and environmentally sound. Moreover, the Project will provide stabilization of the farmer's economic situation by increasing farm income, improvement of life quality of the farmers and (iii) creation of job opportunity for local people and improvement social welfare.

8.2 Recommendations

(1) It is recommended based on above conclusions that the Project shoud be implemented as early as possible. It is also recommended that the Project should be implemented stepwise as Phase-1 and Phase-2. In the Phase-1, improvement of Villarpand headworks and the Yaque del Sur water management center Project should be performed because more precise discharge control at Villarpando be

essential for the Project. In an irrigation system (Tamayo system with about 600 ha) in the uppermost area of the Project area, fostering water user's organization (WUO) and operation and management of the irrigation system including a night storage pond under WUO, which are proposed in the Project, should be undertook beforehand. And constraints encountered should be identified. In pararell with above, education and training for extension workers and nucleus leaders of irrigation water's organizations relevant to Tamajo irrigation system will be done. Also cadastral ledger and legal services on land registration will be provided with relevant farmers. Based on the results of the Phase-1, the Project should be smoothly and efficienty performed.

(2) The results of the non-uniform flow analysis indicate that carrying capacity of the lower reaches of the Yaque del Sur River is about 100 m^3/sec. It should be noted that the flood flow of 1 in 50 years, which is estimated at about 4,000 m^3/sec almost overflows before Canoa. During the flood periods, the river water overflows from the river cousrse on the downstream stretch of the Yaque del Sur River. It is recommented that a master plan study for flood control in the lower Yaque del Sur River should be carried out.

Tables

Table 2.1 List of Counterparts and JICA Experts

Name	Official Position
Counterparts	
Gilberto Reynoso	Chief Counterpart,
Rafaela Lima	Infrastructure engineer, INDRHI
José Ogando Montero	Agronomist, INDRHI
Fausto Colon	Structural engineer, INDRHI
Mayra A. Sánchez Santana	Hydrologist, INDRHI
Yasiris González Pineda	Environmentalist, INDRHI
Alice E. Bautista R.	Sociologist, INDRHI
Sergio J. Tejada R.	Irrigation and drainage engineer, INDRHI
Martha Corsino	Infrastructure engineer, IAD
JICA experts	
Kenjiro Onaka	Team leader
Hiroyosi Matsuura	Irrigation and drainage engineer
J. Delos Santos	Agricultural support expert
Luis Rosado	Agronomist
Nobuo Sambe	Hydrologist
Kunita Okuwa	Infrastructure engineer
Fumiaki Murakami	Structural engineer
Masahiro Ichikawa	Environmentalist
Hidetoshi Kakiuchi	Survey engineer
Tsuyoshi Seino	Survey engineer

Table 3.1.1. Political Distribution of the Feasibility Study Area

Province	Municipalities	Rural Sections
I. Barahona	1. Vicente Noble	a. Vicente Noble
		b. Canoa
	2. El Peñón	a. El Peñón
		b. Jaquimeyes
		c. Palo Alto
	3. Fundación	a. Fundación
		b. Batey Altagracia
		c. La Hoya
		d. Pescaderia
II. Bahoruco	1. Tamayo	a. Tamayo
	2. Uvilla	a. Uvilla
		b. El Jobo
		c. Mena

Table 3.1.2. Summary of Finding from the Community Workshops (1/4)

	Barahona					Bahoruco		
	V. Noble	Canoa	Jaquimejes	Fundación	Peñón	Tamayo	Uvilla	Mena
I-AGRICULTURE								
- Main Problems								
- Low water availability	X	X	X	X	X	X	X	X
- Pests and diseases	X	X	X	X	X	X	X	X
- Lack of agricultural Machines	X	X	X	X	X	X	X	X
- Bad roads			X					X
- Weak farmer Organizations	X	X				X	X	X
- Low Organization capacity	X	X						
- Insufficient irrigation canals	X	X	X	X	X	X	X	X
- Problems with access to credit for crop production	X	X	X	X	X	X	X	X
- Marketing problem	X	X	X	X	X	X	X	X
- Lack of storage facilities	X	X	X	X	X	X	X	X
- Inadequate water mgt. between Azua and Barahona	X	X	X	X	X			
- Alternatives								
- Supply of Water Pumps	X	X						X
- Increase availability of Agricultural machinery	X	X	X	X	X	X	X	X
- Use of dragline to get access to water	X	X	X	X	X			
- Create Water User Organizations	X	X						
- Strengthen Agricultural Cooperatives	X	X						
- Agricultural Machine Program to be managed by Agricultural Producers	X	X						
- Build Water Storage and Canals in both side of Yaque del Sur River	X	X	X	X	X			
- Build Dam at Monte Grande Site			X	X	X			
- Build Flood control facilities			X	X	X	X	X	X
- Forestry								
- Deforestation in the area	X	X	X	X	X	X	X	X
- Alternatives								
- Reforestation program with community support	X	X						
- Forest management with trained personnel	X	X						
- Planting of wood trees (mahogany and cedar)	X	X	X	X	X	X	X	X

Table 3.1.2. Summary of Finding from the Community Workshops (2/4)

	Barahona					Bahoruco		
	V. Noble	Canoa	Jaquimejes	Fundación	Peñón	Tamayo	Uvilla	Mena
- Establishment of dry forest projects		X						
II-Health								
- Main problems								
- Lack of Medical facilities			X	X	X			X
- Deficient Medical services (lack of medical specialists)	X	X						
- Lack of latrines			X	X	X	X	X	X
- Low vaccination coverage among children								X
- Malnutrition			X	X	X	X	X	X
- Main diseases								
- Conjuntivitis	X	X						
- Diarrhea	X	X						
- Tifus	X	X				X	X	X
- Skin rash	X	X	X	X	X			
- Stomach disorder			X	X	X	X	X	X
- Tonsils problems			X	X	X			
- Hepatitis B								X
- High Blood Pressure			X	X	X	X	X	X
- Constipation								X
- Parasites			X	X	X	X	X	X
- Severe Respiratory Infection (SRI)	X	X	X	X	X	X	X	X
- Alternatives								
- Provision of medical Equipment	X	X	X	X	X			X
- Provide Medial Specialists (psychologist, psychiatric)	X	X						X
- Build Medical facilities								X
- Build medical center for emergencies								X
- Program of Latrine Construction			X	X	x			X
III-Education								
- Main problems								
- Low authority	X	X						
- Overcrowded primary schools	X	X	X	X	X			X
- Low quality educational services	X	X						

Table 3.1.2. Summary of Finding from the Community Workshops (3/4)

	Barahona					Bahoruco		
	V. Noble	Canoa	Jaquimejes	Fundación	Peñón	Tamayo	Uvilla	Mena
- Lack of adult educational programs								X
- Lack of nursery education								X
- Lack of building facilities	X	X	X	X	X	X	X	X
- Alternatives								
- Build new school infrastructure	X	X	X	X	X	X	X	X
- Provide breakfast for primary students	X	X	X	X	X	X	X	
- Initiate literacy programs for adults								X
IV-Basic Services (Water, electricity, Garbage disposal)								
- Drinkable water main problems								
- water contamination	X	X						X
- High salt content in drinkable water obtained from well								
- High cost of buying water from trucks (RD$ 30-45/55 gls)	X	X	X	X	X	X	X	
- Lack of Aqueduct		X						X
- Low coverage of Aqueducts	X		X	X	X			X
- Alternatives								
- To finish construction of Aqueduct to be operated by gravity	X	X	X	X	X			
- Provide water Trucks for emergencies	X	X						
- Use the Guazara aqueduct to provide drinkable water	X	X						
- Rebuild the distribution system (hoses and joints)	X	X						
- Build aqueducts								X
- Main Electrical Problems								
- Frequent supply shortages	X	X	X	X	X			
- Bad conditions of distribution lines	X	X	X	X	X			
- Unfairness in the supply of electric power among communities	X					X		
- Lack of management at the Power Substation	X					X		
- Alternatives								
- Replacement and reallocation of distribution lines	X	X	X	X	X			

Table 3.1.2. Summary of Finding from the Community Workshops (4/4)

	Barahona					Bahoruco		
	V. Noble	Canoa	Jaquimejes	Fundación	Peñón	Tamayo	Uvilla	Mena
- Garbage Disposal Problems								
- Insufficient equipment for garbage pickup	X	X						
- Lack of local govt. authority			X	X	X			
- Low level of community awareness for garbage disposal								
- Alternatives								
- Joint efforts (community dwellers & local officials) to improve delivery of the service			X	X	X			
V -Gender								
- Main problems								
- Lack of employment	X	X	X	X	X			X
- high migration	X	X						
- Low educational level	X	X						X
- Disintegration of family nucleus	X	X						
- Low organizational capacity			X	X	X			X
- Discrimination	X	X	X	X	X	X	X	X
- Alternatives								
- Creation of training centers	X	X						X
- Furnishing of Training center	X	X						X
- Training programs on handicraft and technical issues								
- Allocate fund to pay the Training center staff	X	X						
- Allocate Govt. financial support to training center	X	X						
- Identify Resources for inverstment	X	X						
- Strengthen Women association	X	X						
- Provide training on reproductive health	X	X						
MAIN COMMUNITY PROBLEM								
LACK OF EMPLOYMENT OPPORTUNITIES	X	X	X	X	X	X	X	X

Table 3.1.3. Land Reform Settlements in the Study Area

LAND SETTLEMENT	MUNICIPAL DISTRICTS	LAND DISTRIBUTED (HECTARES)	NUMBER OF BENIFICIARIES	MAIN PURPOSE	AVERAGE FARM SIZE (HECTARES)
NATIONAL	NATIONAL	567,308.81	95,250.00	Crops, livestock, forestry	5.96
BARAHONA					
Pescadería	Vicente Noble	275.47	83.00	coffee, roots and tubers	3.32
Canoa	Vicente Noble	143.08	44.00	coconuts, roots and tubers	3.25
Los tres puentes	Barahona	162.89	136.00	Roots and tubers	1.20
Dumit	Barahona	53.14	54.00	Roots and tubers	0.98
Mena	Barahona	142.01	121.00	Roots and tubers	1.17
SUBTOTAL		776.60	438.00		1.77
BAHORUCO					
San Ramón	Tamayo	768.30	170.00	Roots and tubers	4.52
Tamayo	Tamayo	72.96	58.00	Roots and tubers	1.26
SUBTOTAL		841.26	228.00		3.69

Source : Boletín Estadístico 1996, Instituto Agrario Dominicano (IAD).

Table No. 3.1.4. Basic Indicator for the Study Area

	Barahona				Bahoruco					
	Vicente Noble	El Peñón	Fundación	Provincia	Tamayo	Uvilla	Provincia	Sub-Regiór	Región	Total Nacional
A. POPULATION										
TOTAL	18,152	7,905	7,685	164,835	19,080	14,777	105,206	327,636	844,598	7,293,390
URBAN AREA (PERCENT)	55	51	25	67	57	15	45	59	48	56
MEN	53	53	51	50	52	50	51	51	50	47
WOMEN	47	47	49	50	48	50	49	49	50	53
RURAL AREA (PERCENT)	45	49	75	33	43	85	55	41	52	44
MEN	54	51	54	55	54	52	53	54	53	50
WOMEN	46	49	46	45	46	48	47	46	47	50
B. HOUSEHOLD TENURE (PERCENT)										
TOTAL	100	100	100	100	100	100	100	100	100	100
OWNED	80	75	76	72	76	72	75	74	79	71
RENTED	14	16	18	20	18	12	14	17	14	21
MORGAGED	0	0	0	0	0	0	0	0	0	1
LOANED	5	7	6	7	5	15	9	8	6	6
OTHER	0	1	0	1	0	1	1	1	1	0
C. ELECTRIC SERVICE (PERCENT)	86	86	85	83	72	82	67	78	66	79
D. WATER SERVICE (PERCENT)	48	83	86	71	65	58	56	65	59	66
E. WASTE DISPOSAL	37	45	45	45	43	18	30	40	39	55
F. SANITARY SERVICE	16	17	19	17	16	12	13	16	14	19
G. ILLITERACY (5 YEARS AND OLDER).										
TOTAL	32	26	31	28	31	43	36	31	35	21
URBAN AREA	26	25	25	23	26	25	27	25	26	15
RURAL AREA	40	28	33	37	37	46	44	41	43	28
H. UNEMPLOYMENT RATE.	35	35	35	35	31	43	39			

SOURCE: ONE, 7MO. CENSO DE POBLACION Y FAMILIA

Table 3.2.1 Main Characteristics of Soils in the Project Area

Soil Series or Association	Map Symbol	Main Characteristics
Fundación	Fu	The soil texture vary from silty loam to loamy clay, well drained, high cation exchange capacity (cic),(15-28%), high bases saturation percentage (37-63%), pH is 8.2, and basic infiltration is 1.2 cm/h.
Fundación-Bombita	Fu-Bo	The texture is silty clay loam, imperfect natural drainage, medium cation exchange capacity (cic) (17-25), high base saturation (38-50%), pH 7.6, basic infiltration rate 0.05 cm/h.
Canoa-Bombita	Ca-Bo	Texture vary from clay to clay loam, imperfect natural drainage, high cation exchange percentage (23-47), high percentage of base saturation (47-82%), the pH is alkaline (7.5)
Canoa	Ca	Texture is clay or loamy silt, poor natural drainage, pH is 7.4, high cation exchange capacity (23-34), high base saturation (44-82%), basic infiltration rate of 1.1 cm/h
Santana	Sa	The soil texture is loamy sand, shallow soil, excessive drainage.
Jaquimeyes-Tamayo	Ja-Ta	The soil texture is loamy clay (8.4), high cation exchange capacity (29-30) and high base saturation (58-70%), the basic infiltration rate is 0.3 cm/h.
Tamayo-Fundación	Ta-Fu	The soil texture is vary from loam to clay loam, the soil are well drained, the pH is 7.5, high cation exchange percentage (CIC) (15-30), high base saturation (35-63%), the basic infiltration rate is 0.4 cm/h.
Tamayo	Ta	The texture is silty loam, well drained, deep, alkaline, cation exchange percentage is high (CIC) (21-42), and base saturation is high (35-48%), the basic infiltration rate is 0.4 cm/h.
Habanero	Ha	The soil texture is loam or loamy clay, well drained, moderately deep, the pH is 7.7, low to medium cation exchange capacity (12-15), high base saturation (40-46%).
Vicente Noble	Vn	The soil texture is clay loam, well drained, high cation exchange capacity, (28-55%) and high base saturation percentage (26-45), the basic infiltration rate is 0.8 cm/h.

Source : Levantamiento Semidetallado de Suelos, Zona de Riego de Barahona, INDRHI 1982

Table 3.2.2 Climatic Features of the Project Area

Month	Nov.	Dec.	Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Rainfall (mm)	53.3	24.0	17.2	16.7	25.8	47.1	87.1	89.7	30.6	64.8	104.9	100.4	661.8
ETp (mm)	132.9	131.2	138.0	154.2	202.9	207.2	192.6	188.1	211.6	196.0	168.2	153.7	2078.7
Temperature (°C)	26.3	25.0	24.2	24.6	25.3	26.1	26.8	27.4	27.7	27.7	27.4	26.9	26.3
Relative Humidity (%)	75.1	72.8	73.2	72.8	72.1	72.6	76.2	76.3	72.2	73.1	76.4	78.3	74.3
Wind Speed (km/day)	222.7	228.5	249.6	278.4	303.4	299.5	276.5	284.2	297.6	278.4	253.4	228.5	266.7

Note: Data of Rainfall, Evapotranspiration, and Temperature are taken from INDRHI's meteorolgical station at Peñon.
Data of Relative Humidity are taken from CEA's meteorolgical station at Batey 3.

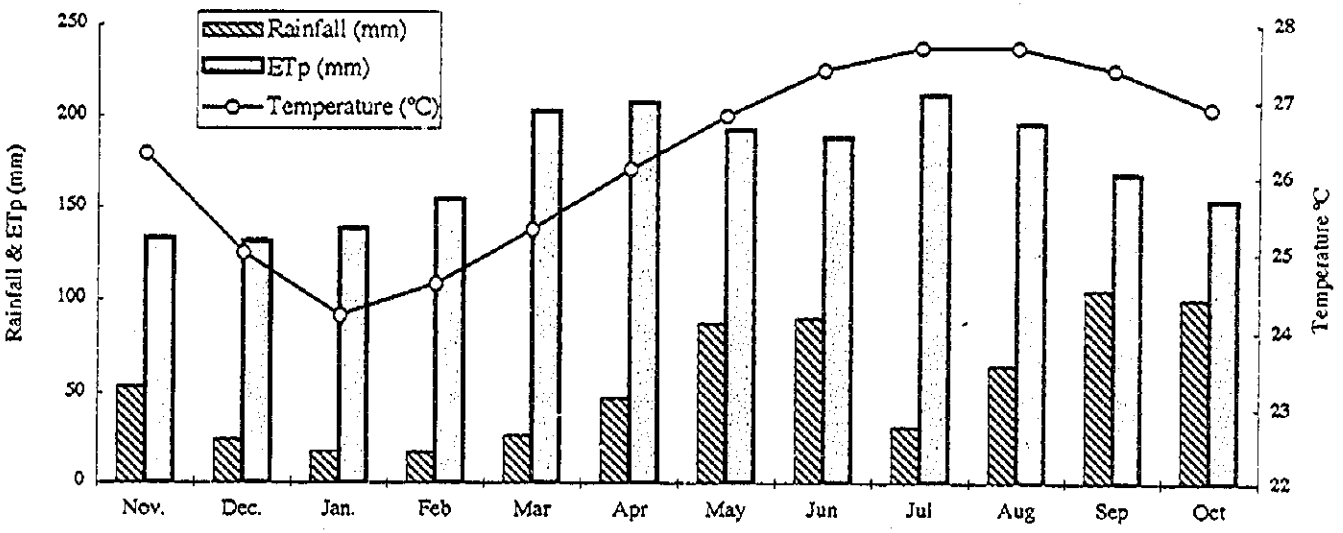
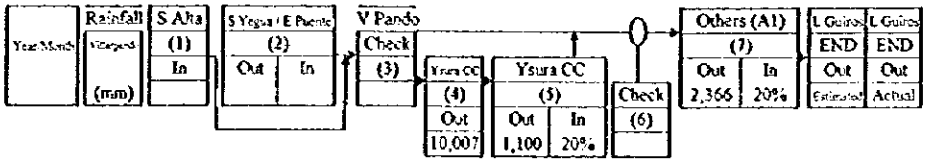


Table 3.2.3 Available Water under Present Conditions

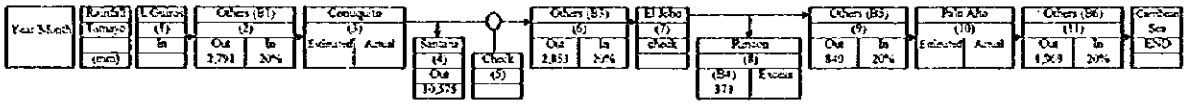
(1) AZUA BLOCK (VILLARPANDO)



	(uni	(mm)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)
1981		584.3	758.8	729.6	930.1	1739.0	278.5	21.2	4.2	1433.2	45.7	9.1	1456.6	-
1982		415.2	467.1	769.4	867.1	1334.3	278.5	21.2	4.2	1077.8	45.7	9.1	1041.2	-
1983		655.6	284.2	629.6	-	909.0	278.5	21.2	4.2	657.3	45.7	9.1	620.7	-
1984		409.1	412.2	404.9	-	838.7	272.8	21.2	4.2	591.4	45.7	9.1	554.8	-
1985		444.6	366.7	555.9	-	854.4	278.5	21.2	4.2	598.3	45.7	9.1	561.7	-
1986		475.2	385.9	588.8	-	1027.2	278.5	21.2	4.2	721.9	45.7	9.1	735.3	718.0
1987		584.4	384.6	502.1	-	818.4	278.5	21.2	4.2	564.0	45.7	9.1	527.4	633.0
1988		551.2	497.4	515.8	-	1119.3	278.5	21.2	4.2	866.7	45.7	9.1	830.1	867.1
1989		746.5	463.2	813.4	-	1205.3	278.5	21.2	4.2	955.6	45.7	9.1	919.1	920.7
1990		514.9	410.3	421.8	-	832.1	266.8	21.2	4.2	594.7	45.7	9.1	558.2	647.0
1991		447.1	280.2	705.0	-	996.2	278.5	21.2	4.2	751.1	45.7	9.1	714.5	-
1992		313.1	625.3	575.2	-	1164.8	277.5	21.2	4.2	915.3	45.7	9.1	878.8	-
1993		617.3	440.5	832.8	-	1173.2	278.5	21.2	4.2	921.6	45.7	9.1	885.0	-
1994		670.6	255.5	473.4	468.7	724.2	278.5	21.2	4.2	474.4	45.7	9.1	437.8	-
Mean		531.4	430.9	608.4	-	1052.6	277.2	21.2	4.2	801.7	45.7	9.1	765.1	-

Note: MCM, Million cubic meter
Out, Water extraction from the source (irrigation area in hectare in the above)
In; Return flow to the source (return flow rate in percent in the above)
In/Res.; Return flow, inflow from the residual catchment and the remaining flow to the downstream
Actual; Actual discharge in the records
Estimated, Estimated discharge by the simulation

(2) BARAHONA BLOCK (LOWER YAQUE DEL SUR RIVER BASIN)



	(unit	(mm)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)
1981		487.7	1495.6	309.4	21.9	1514.9	-	381.9	1133.0	111.8	22.4	1543.5	13.7	-	68.7	9.7	1611.0	956.4	79.4	15.9	547.5
1982		278.5	1041.2	309.4	21.9	1034.3	-	397.3	637.1	111.8	22.4	547.6	13.7	-	49.4	9.9	594.5	381.8	85.0	17.0	436.5
1983		341.8	629.7	309.4	21.9	572.4	-	280.9	291.6	111.8	22.4	202.1	13.7	-	49.4	9.9	156.5	-	73.9	14.8	95.3
1984		248.7	554.8	309.4	21.9	505.9	543.6	251.9	251.9	105.8	21.2	167.3	13.3	-	44.5	8.9	122.9	181.7	59.3	11.9	75.5
1985		655.3	561.7	309.4	21.9	558.6	412.8	276.1	282.5	111.8	22.4	193.1	13.7	-	68.1	9.6	148.9	218.1	68.7	13.7	93.9
1986		345.8	718.0	309.4	21.9	791.0	-	348.8	442.2	111.8	22.4	352.8	13.7	-	49.4	9.9	313.8	422.0	85.0	17.0	245.8
1987		476.9	633.0	309.4	21.9	618.3	513.6	289.8	328.5	111.8	22.4	239.0	13.7	-	45.2	9.0	197.3	-	60.6	12.1	148.8
1988		254.4	867.1	309.4	21.9	871.1	867.4	370.4	500.7	111.8	22.4	411.2	13.7	-	49.4	9.9	367.2	-	85.0	17.0	299.2
1989		303.5	920.7	309.4	21.9	884.4	-	383.2	498.2	111.8	22.4	408.7	13.7	-	49.4	9.9	361.6	-	85.0	17.0	293.5
1990		354.1	647.0	309.4	21.9	622.2	-	251.8	370.5	101.0	20.2	289.7	13.6	-	32.9	6.5	257.3	-	51.5	10.3	216.1
1991		157.8	763.8	309.4	21.9	658.0	666.9	329.1	337.9	111.8	22.4	248.5	13.7	-	49.4	9.9	199.8	-	80.6	16.1	135.8
1992		497.2	970.4	309.4	21.9	932.9	-	344.8	588.0	105.7	21.1	503.5	13.3	-	43.7	8.7	451.7	-	66.9	13.4	458.2
1993		449.6	885.0	309.4	21.9	890.1	-	351.0	539.1	111.8	22.4	449.7	13.7	-	49.4	9.9	405.5	-	82.2	16.4	340.0
1994		557.4	433.8	309.4	21.9	454.2	-	227.1	227.1	111.8	22.4	137.7	13.7	-	45.2	9.2	96.8	-	63.3	12.7	46.2
Mean		383.6	768.3	309.4	21.9	771.8	-	319.7	450.1	110.2	22.0	371.0	13.6	-	48.8	9.8	328.8	-	75.3	14.9	270.1

Note: MCM, Million cubic meter
Out; Water extraction from the source (irrigation area in hectare in the above)
In; Return flow to the source (return flow rate in percent in the above)
In/Res.; Return flow, inflow from the residual catchment and the remaining flow to the downstream
Actual; Actual discharge in the records
Estimated, Estimated discharge by the simulation

Table 3.3.1 Present Farming Practices for Main Crops in the Project Area

Crop: Plantain	Present/Without Project
Variety	"Macho por Hembra", "Gigante", "Enano"
Planting Density and Planting Materials	1,300 plants per ha. Planting material taken from previous plantation or neighbor farm without adequate treatment for insects and disease control. Long periods (up to 30 years) without replanting
Fertilizer (kg/ha)	N=50; P=50; and K= 40 kg/ha; About 30% of farmers do not apply fertilizers, and many apply very low quantity.
Labor (man-day/ha)	105
On-farm Water Management	Very irregular irrigation frequency varying from once in a month to once in two months. Some times excess of water is applied.
Insects & Diseases Control	The insects Cosmopolites sordidus and several Nematodes species are pest main problems. Very poor control of insects and nematodes; Some 36 % of farmers do not apply pesticides; Many apply pesticides more than required amount (25 kg/ha); Very few farmers use of Integrated Pest Management practices.
Crop: Tomato	
Variety	Gem, UC-82, Pepto, Napoli, and Chico
Planting Density and Planting Materials	30,000 plants per ha. Transplanting method
Fertilizer (kg/ha)	N=150; P=75; and K= 75 kg/ha;
Labor (man-day/ha)	110
On-farm Water Management	Inadequate water application, due to water shortage and farmers lack of knowledge on adequate on-farm water management. Most times soil moisture is deficient, some times excess of water is applied.
Insects & Diseases Control	The insect identified as "White fly" (Bemisia tabaci) is the mayor problem affecting tomato production. Integrated pest management practice is not extensively used by tomato producers in the project area. About 18 kg/ha of pesticides are used for insects and disease control.
Crop: Melon	
Variety	"Smith Perfect"
Planting Density and Planting Materials	0.7 kg/ha of seeds; direct seeding to open fields.
Fertilizer (kg/ha)	N=180; P=150; and K= 150 kg/ha;
Labor (man-day/ha)	65
On-farm Water Management	Ins afficient irrigation water supply.
Insects & Diseases Control	The insect identified as "White fly" (Bemisia tabaci) is the mayor problem affecting tomato production. Integrated pest management practice is not extensively used by tomato producers in the project area. About 20 kg/ha of pesticides are used for insects and disease control.
Crop: Papaya	
Variety	"Solo I", "Hawaiana", "Red Lady"
Planting Density and Planting Materials	About 1,200 plants per ha.
Fertilizer (kg/ha)	N=103; P=55; and K= 55 kg/ha;
Labor (man-day/ha)	120
On-farm Water Management	Irregular irrigation frequency, plants often suffer from water shortage.
Insects & Diseases Control	Virus disease is the most serious problem; Pest control is not adequate, due to lack of orientation to farmers; Use about 26 kg/ha pesticides por insects and disease control.
Crop: Pepper	
Variety	"Cubanela" and "California Wander"
Planting Density and Planting Materials	Seeds are sown on nursery beds; seedling are transplanted when reach about 15 cm hight at about 30 days old. Planting spacing is 1 m between rows and 0.75 m between plants for a planting density of about 13,000 plants per ha.
Fertilizer (kg/ha)	N=90; P=60; and K= 60 kg/ha;
Labor (man-day/ha)	125
On-farm Water Management	Inadequate water application, due to water shortage and farmers lack of knowledge on adequate on-farm water management. Most times soil moisture is deficient, some times excess of water is applied.
Insects & Diseases Control	Several types of insects species attack pepper plants in the project area; the "White fly" is the mayor problem affecting pepper production because it transmit a virus disease. Integrated pest management practice is not extensively used by pepper producers in the project area. About 12 kg/ha of pesticides are used for insects and disease control.

Table 3.5.1 Present Irrigation Systems

	Name of System	Gravity/ Pump	Left/ Right		Irrigation Area [ha]	Co-ordination of intake N	W	Pump [HP] Capacity [HP]	[liter/sec]
1	Vicente Noble-INDRHI	G	L		1,717	18 22.206	71 10.848	-	-
2	Los Habitantes	G	R	a				-	-
3	Charco Blanco	G	R	a	624 [total a]			-	-
4	Anon-Uvilla	G	R	a		18 23.775	71 11.630	-	-
5	Santana Lat-B	G	-		74			-	-
6	Santana Lat-E	G	-		122			-	-
7	Santana Lat-H	G	-		120			-	-
8	Caño Trujillo	G	R		190	18 20.799	71 11.984	-	-
9	Mena - IAD	P	R		144			250HP	
10	Guaba de Mena	P	R		82	18 20.366	71 11.681	30	158
11	Bombita-CEA	P	L		575	18 19.940	71 09.782	150&150	
12	Bombita-INDRHI	P	L	b		18 19.940	71 09.782	150&150	284&284
13	Jaquimeyes	P	L	b	465 [total b]	18 19.124	71 09.886	50&75	221&442
14	Juan Benito	P	L	b				75	442
15	Palo Alto-INDRHI/IAD	P	L	b		18 18.238	71 09.918	75&100	221&315
16	Palo Deleche	P	R		162	18 19.055	71 10.366	50&75 HP	126&473
17	Puente Palo Alto (Peñon I)	P	R		117	18 17.195	71 10.351	75&75	158&158
18	Palo Alto-CEA	P	L		666	18 17.195	71 10.351		
19	Fundacion I	P	L	c		18 17.742	71 10.707	40	379
20	Fundacion II	P	L	c	1,486 [total c]	18 16.843	71 12.017	40	379
21	Fundacion III	P	L	c		18 16.331	71 12.056	40	189
22	Peñon II	P	R		108	18 16.843	71 12.017	40&30	315&315
23	La Isleta	P	L	c		18 16.061	71 12.397	60&60 HP	189&189
24	La Guinea	P	R		61	18 15.863	71 12.965	30 HP	126
25	Osvaldo Feliz	P	L	c		18 15.370	71 13.326		
26	La Elena (Cachon)	P	L	c		18 15.358	71 12.140	50&50HP	
27	Paso La Elana	P	R		24	18 15.358	71 12.14	50&50HP	
28	Veras Pescaderia	P	L	c		18 15.421	71 10.955		
29	La Coco - IAD	P	L	c				75HP	
30	Caballero (INDRHI)	P	R	d		18 14.740	71 09.364	150&150HP	
31	Caballero 1-IAD (Habanero 1-IAD)	P	R	d	77 [total d]	18 15.120	71 09.433	38HP	
32	Caballero 2-IAD (Habanero 2-IAD)	P	R	d				50HP	
33	Hato Viejo - Pescaderia	P	L	c		18 15.589	71 09.587	30&30HP	221&158
34	Pescaderia - IAD	P	L	c		18 15.355	71 09.416	75HP	
35	La Hoya	P	L		104	18 15.256	71 08.938	20&20 HP	126&126
36	Habanero	P	R		175	18 15.139	71 08.375	30	158
37	Dumit	P	L		33	18 15.787	71 08.131	100HP	
	Total				7,126				

by Main Canal	5,533	[w/o CEA]4,292ha,[CEA]1,241ha
by Santana(CEA)	316	Lat-B,E,H
from the River	1,277	by Gravity-1, Pump-13
Total	7,126	[w/o CEA] 5,885ha

Note; G = Gravity, P = Pump

Table 3.5.2 Geological Investigation of Foundation of Santana and Villarpando Intake Weirs and Soil Mechanical Investigation of Embankment Materials

Summary of Boring Tests

Items	B-1	B-2	B-3	B-4	B-5
Location	Santana	Santana	Santana	Villarpando	Villarpando
Boring pit (depth ; description)	0-11.m ; gravel and sand	0-3m ; fine silty sand	0-1.5m ; concrete slab of Santana weir	0-9.5m ; sandy clay	0-0.5m ; sandy clay
	11-20m ; soft shale	3-20m ; Alluvial sediments, formed by cobbles and gravel	1.5-7.5m ; Alluvial sediments, formed by cobbles and gravel	9.5-12m ; fine gravel and sand	0.5-15m ; Alluvial sediments
			7.5-20m ; shale with sandstone	12-20m ; Alluvial sediments	15-20m ; conglomerate of fine grains
N - value in main layer	18< (firm)	80< (very firm)	38< (very firm)	14< (firm)	23< (firm)
Permeability	$5.4*10^{-7}$	$8.3*10^{-4}$	$6.9*10^{-7}$	$2.2*10^{-7}$	$7.4*10^{-7}$
Gradation (%, gravel : sand : fines)	G-5, S-20, F-74	G-11, S-55, F-34	G-1, S-15, F-84	G-0, S-45, F-55	G-0, S-15, F-87

Summary of Soil Mechanical Tests

Classification		Gradation (%)			Plasticity		Density insitu (kg/m3)		Compaction test	
		gravel	sand	fines	PL	PI	density	humid %	density	humid %
P-1	ML/GC	7	17	76	38	13	1478	14	1815	14
P-2	SM/ML	3	77	20	-	-	1630	6	1762	12.5
P-3	CL	15	17	68	34	18	1589	8.4	1912	12
P-4	GL	59	19	22	60	36	1643	5.9	1731	19.5
P-5	CL/ML	0	12	88	37	13	1459	22.9	1629	22.5
P-6	SM/CL	0	85	15	39	16	1831	5.4	1622	19
P-7	CL	0	12	88	35	14	1474	20.6	1665	19
P-8	CL/ML	2	7	91	34	23	1596	7.1	1739	15.5
P-9	CL/SM	0	3	97	40	16	1407	18.3	1616	22
P-10	ML	0	37	63	-	-	1384	21.2	1735	16.5

Table 3.6.1 Inventory of National Roads

(1) Secondary National Road

Code	Section		Length (km)		Surface Type	
DA-Ruta.Tr	Origin	Final	Pavement	No Pav	Pavement	No Pav
44-044.020	El Higuito (La Virgen)	C/C 514 (C/Vicente Nobre)	11.9		ASF	
44-044.030	C/C 514 (C/Vicente Noble)	Canoa	4.6		ASF	
44-044.040	Canoa	C/C 048 (C/Palo Alto)	6.6		ASF	
44-044.050	C/C 048 (C/Palo Alto)	C/C 046 (C/Cabral)	8.0		ASF	
44-044.060	C/C 046 (C/Cabral)	Entrada Barabona	3.7		ASF	
44-044.070	Salida Barabona	Paraiso	30.4		ASF	
44-044.080	Paraiso	Enriquillo	15.4		ASF	
44-044.090	Enriquillo	Oviedo	23.3		ASF	
44-044.100	Oviedo	ACC. Cabo Rojo	36.0		ASF	
44-044.110	ACC. Cabo Rojo	C/C 044 (Cabral)	11.8		ASF	
44-046.010	C/C 044 (Cabral)	C/C 533 (Cabral)	10.8		ASF	
44-046.020	C/C 533 (Cabral)	C/C 518 (C/Salinas)	11.2		ASF	
44-048.010	C/C 044 (Palo Alto)	C/C 529 (ACC.A Tamayo)	8.2		ASF	
44-046.020	C/C 529 (ACC.A Tamayo)	Batey 2 (Limite Ayudantia)	12.4		ASF	

(2) Tertiary National Road

Code	Section		Length (km)		Surface Type	
DA-Ruta.Tr	Origin	Final	Pavement	No Pav	Pavement	No Pav
44-514.010	C/C 044(ACC/Vicente Noble)	Vicente Noble	5.9		TSA	
44-514.020	Vicente Noble	Tamayo	4.6		TSA	
44-518.010	C/C 048	C/C 046 (C/Salina)		9.0		GRA
44-529.010	C/C 048 (C/Mena)	Tamayo	6.2		TSA	
44-531.010	C/C 046 (C/Cabral)	El Peñon	8.0		ASF	
44-531.020	El Peñon	C/C 048		2.2		GRA
44-533.010	C/C 046 (Cabral)	Polo	19.9		ASF	

Remarks ; ASF : Asphalt pavement *(Asfalto)*
TSA : Superficial Asphlt Treatment *(Tratamiento Superficial Asfaltico)*
GRA: Gravel *(Grava)*

(3) Rural Road

Code	Route	Length (km)
43-03-05-01-28	Tamayo - San Ramón	5.0
44-04-07-00-36	Canoa - Vicente Noble	3.9
44-04-07-02-40	Vicente Noble - Arroyo Grande	12.5
44-04-09-01-33	Fundación - Pasos de las Elenas	4.2
44-04-09-04-32	Habanero - Fundación	7.6
-	El Vigia-Penon	4.8
-	Penon-Palo de Leche	1.5
-	La Uvilla-salsipuede	2.9
-	Vicente Noble-El quemado	3.2
-	Canoa-La zurza	3.2
-	Salsipuede-El copo	1.7
-	El Quemado-La cerca	1.7
-	El copo cont. Tamayo-Vicente Noble	3.0
-	Vicente Noble-Canoa La Baitoa	3.3
-	Fondo Negro-El Maitazo	3.8
-	Fondo Negro-El Memiso	2.0

Code	Route	Length (km)
-	Fondo Negro- Los Fondos	1.0
-	El Miatazo	3.0
-	Canoa-Mata Frio	3.0
-	Palo Alto -El Sitio	1.2
-	Bombita-al 25	1.7
-	Jaquimeyes-San Benito	4.3
-	Palo Alto-San Benito	2.6
-	Palo Alto-El Sitio	1.2
-	Canoa-Playa	20.0
-	Habanero-Cabral	2.8
-	La Hoya-	1.7
-	La Isleta-La cu(fundacion)	3.6
-	Cachon-Pescaderia	2.2
-	Fundacion-Guayacanes	2.2
-	Coboa-Pescaderia	3.8

Table 3.6.2 Inventory of Water Supply System (INAPA)

	Vicente Noble Multiple Aqueduct	Tamayo Multiple Aqueduct	Uvilla-El Jobo Multiple Aqueduct	Mena Multiple Aqueduct	Pescaderia Multiple Aqueduct	Cabral Multiple Aqueduct
Service Community	Vicente Noble, Arroyo Grande, Canoa	Tamayo, Monserrate	Uvilla, El Jobo	Mena arriba, Mena abajo	Caballero, Habanero, La Holla, Hato Viejo, Pescaderia	Cabral, Tierra Blanca, Guayuyo, Penuela, Cachon, Peñon, Fundación, Palo Alto, Jaquimeyes
Source	Yaque del Sur river	Yaque del Sur river	Groundwater	Groundwater	Groundwater	Groundwater and spring
Type	Pump	Pump, 2 nos, ϕ 24"H.S, L=101.8 m	Vertical pumps, 200 gpm, 15 HP	Vertical pumps, 100 gpm, 7.5 HP Submergible pumps, 140 gpm, 10 HP	Pump, 25 HP	No.1 Pump, 300 gls/min, with 40 HP engine No.2 Pump, 1,300 gls/min, with 150 HP engine No3 Pump, 250 gls/min, with 30 HP engine
Treatment	Simple chlorinating	Simple chlorinating	Simple chlorinating	Simple chlorinating		Simple chlorinating
Impulsion Line	ϕ 20"L.J., L=3,581.6 m ϕ 12"P.V.C. (RDS-26) L=100.0 m	ϕ 20"L.J., L=2,030.0 m ϕ 12"P.V.C. (RDS-26) L=100.0 m	Well No.1 ; ϕ 6"P.V.C. (RDS-26) L=517.0 m Well No.1 ; ϕ 4"P.V.C. (RDS-26) L=633.0 m Well No.2 ; ϕ 6"P.V.C. (RDS-26) L=473.80 m	ϕ 4"P.V.C. (RDS-26) L=382.35 m	ϕ 6"H.F., (RDS-26) L=888.45 m	ϕ 12"steel, L=273.7 m ϕ 12"H.F., (RDS-26) L=2,469.9 m ϕ 8"steel, (RDS-26) L=145 m
Storage Tank	Superficial regulating tank 1,200 m3	Superficial regulating tank 300,000 gls	Reinforced concrete elevated tank H=12.0 m, V=66,000 gls	Reinforced concrete elevated tank H=15 m, V=26,400 gls	Superficial regulating tank 500 m3	Superficial metallic tank 100,000 gls, 500,000 gls
Main Line	ϕ 12" PVC (SVR-26), L=1,651.0 r	ϕ 12" PVC (SVR-26), L=3,367.1 r	ϕ4" PVC (SVR-26), L=25.4 m	ϕ 4" PVC (SVR-26), L=33.9 m, 2 pipes	ϕ 8" A.C(Class C), L=1,295.0 m,	ϕ 6" A.C. class D(SVR-26), L=866.4 m ϕ 12" PVC (SVR-26), L=780.0 m ϕ 12" PVC (SVR-26), L=1,571.2 m
Conduction Line	ϕ 6" PVC (SVR-26), L=618.4 m ϕ 4" PVC (SVR-26), L=2,821.4 m		ϕ 4", ϕ 3" and ϕ 2"PVC (SVR-26 and 21) L=6,398.55 m	ϕ 4", ϕ 3" and ϕ 2"PVC (SVR-26 and 21) L=6,968.24 m		ϕ 12", ϕ 8", ϕ 6", ϕ 4", ϕ 3" and ϕ 2"PVC (SVR-26 and 21)
Distribution System	ϕ 6", ϕ 4", ϕ 3" and ϕ 2"PVC (SVR-26 and 21)	ϕ 6", ϕ 4", ϕ 3" and ϕ 2"PVC (SVR-26 and 21)			ϕ 6"(Class B), ϕ 4", ϕ 3"(SVR-26) and ϕ 2"PVC (SVR-21)	
Connections	2,000 units	1,928 units	459 units	408 units	518 units	3,921 units
Population	13,333 (actual in 1995) 21,333 (designed for 20 years)	11,586 (actual in 1992) 18,509 (designed for 20 years)	2,754 (actual in 1995) 4,460 (designed for 20 years)	2,448 (actual) 3,197 (designed for 20 years)	3,108 (actual in 1998) 4,973 (designed for 20 years)	24,033 (actual in 1993) 37,821 (designed for 20 years)
Design flow	28.90 lit/sec (actual in 1995) 46.30 lit/sec (designed for 20 years	32.52 lit/sec (actual in 1992) 50.42 lit/sec (designed for 20 years	5.98 lit/sec (actual in 1992) 9.56 lit/sec (designed for 20 years)	5.31 lit/sec (actual in 1992) 8.50 lit/sec (designed for 20 years)	6.74 lit/sec (actual in 1998) 16.19 lit/sec (designed for 20 years	52.15 lit/sec (actual in 1993) 83.44 lit/sec (designed for 20 years)

Table 3.6.3 Tariff of Water Supply

Category Type	Numbers of Water faucet	Water Rate (RD$)	Sewerage Rate (RD$)	Water Fee (RD$)	Sewerage Fee (RD$)	Basic volume (M3)*1
R1	1~ 2(*3)	13.50	4.05	27.00	8.10	10
R2	3~4	45.00	13.50	90.00	27.00	13
R3	5~7	69.00	20.70	138.00	41.40	16
R4	8~10	117.00	35.10	234.00	70.20	20
R4 *2	10 and more	117.00	35.10	234.00	70.20	20
C1	1~3	110.00	55.00	220.00	110.00	18
C2	4~7	190.00	95.00	380.00	190.00	23
C3	To 8	260.00	130.00	520.00	260.00	28
C3*3	8 and more	260.00	130.00	520.00	260.00	28
I1*3	To 8	430.00	215.00	860.00	430.00	40
I2*3	To 8	690.00	345.00	1,380.00	690.00	55
H1*3	To 8	980.00	490.00	1,960.00	980.00	65
H2*3	To 8	9,960.00	3,980.00	19,920.00	9,960.00	600
P1*3	To 10	100.00	50.00	200.00	100.00	0
E*3	To 10	15.00	4.50	30.00	9.00	0
IE		265.00	0.00	700.00	0.00	0
P4						

INAPA, 1997

Remarks;
"R" Class ; Housing and used for health
"C" Class ; Economic activity
"I" Class ; Economic activity (water is not a reinvestment or raw material)
"H" Class ; Hotel in tourist zone
"P" Class & "E" Class ; Community service or without economic purpose

Symbol;
*1: In the case of measured service
*2: Charge of RD$ 2.50 for each additional water faucet
*3: Charge of RD$ 10 for each additional water faucet

Notes;
- The rate of the well (p4),is express in RD$0.35 for liter
- Sewerage rate accounts for 30% of water rate for house
- The sewerage service is 50% of the water rate for the other category
- Hotel in tourist zone are classified as "H" , others are classified as commercial rate.

Table 3.6.4 Summary of Social Infrastructure

	Vicente Noble	Canoa	Bombita	Peñon	Los Robles	Jaquimeyes	Palo Alto	Fundación	Altagracia	La Hoya	Pescadería
Transportation											
Bus stop	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y
Moto-concho	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
Communication											
Telephone office	Y	N	N	N	N	Y	N	N	N	N	N
Public telephone	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y
Telegram office	Y	N	N	N	N	N	N	N	N	N	N
Post office	Y	N	N	N	N	N	N	N	N	N	N
News paper	Y	Y	N	Y	N	N	Y	N	N	N	N
Social infrastructure											
Hospital	Y	Y	Y	Y	N	Y	N	Y	N	Y	N
School	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Church	10	1	1	1	1	4	3	5	1	1	4
Library	2	0	0	1	0	1	0	2	0	1	0
Baseball ground	1	1	0	1	1	1	1	1	1	1	1
Football ground	0	0	0	0	0	0	0	0	0	0	0
Community hall	1	1	0	1<*1	0	1	1<*1	0	0	1	1
Park	1	0	0	0	0	0	1	1	0	1 <*3	0
Sanitary Service											
Rubbish disposal system	Y	Y	Y	Y	N	N	Y	Y	N	N	N
Leterine	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y

	Hato Viejo	Tamayo	Monserrate	La Caida	Uvilla	El Jobo	Mena Abajo	Mena Arriba	Cabral	Cachon	
Transportation											
Bus stop	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	
Moto-concho	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	
Communication											
Telephone office	N	Y	N	N	N	N	N	N	Y	N	
Public telephone	N	Y	Y	Y	Y<*2	N	Y	Y	Y	N	
Telegram office	N	Y	N	N	N	N	N	N	Y	N	
Post office	N	Y	N	N	N	N	N	N	Y	N	
News paper	N	Y	Y	N	N	N	N	N	Y	N	
Social infrastructure											
Hospital	N	Y	N	N	Y	N	N	N	Y	N	
School	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	
Church	1	7	1	1	4	1	1	0	Y	2	
Library	0	1	1	0	2	1	0	0	1	0	
Baseball ground	1<*1	1	0	1	1	0	0	1	1	1	
Football ground	0	0	0	0	0	0	0	0	1	0	
Community hall	0<*3	1	1	0	1	1	0	1	0	0	
Park	0	1	0	1	0	0	0	0	Y	0	
Sanitary Service											
Rubbish disposal system	N	Y	N	N	Y	Y	N	Y	Y	Y	
Leterine	Y	Y	Y	Y	N<*4	N<*4	Y	Y	Y	Y	

Source ; JICA Team, 1998

Remarks
Y ; Available
N ; Not avairable
*1 ; Bad condition
*2 ; Out of service
*3 ; Under construction
*4 ; Destroyed by Hurricane

Table 3.7.1. Agricultural Loans from the Agricultural Bank in the Study Area,1997

Activity	Provincial Branch at Barahona[1] Quantity (# of loans)	Value (DR$000)	Coverage (Hectares)	Provincial Branch at Neyba[2] Quantity (# of loans)	Value (DR$000)	Coverage (Hectares)	Study Area Quantity (# of loans)	Value (DR$000)	Coverage (Hectares)
1.- Project Area									
- Rice	4	153.38	28.30	2	59.74	5.03	6	213.12	33.33
- Corn	-	-	-	2	122.83	59.62	2	122.83	59.62
- papaya	4	171.25	7.86	5	315.00	10.25	9	486.25	18.11
- Plantain	208	6,333.49	446.16	18	509.31	31.38	226	6,842.80	477.54
- Banana	3	272.65	15.41	-	-	-	3	272.65	15.41
- Pepper	1	15.00	0.94	2	241.67	23.27	3	256.67	24.21
- Industrial Tomato[3]	-	-	-	-	-	-	-	-	-
- Pigeon peas	12	249.65	104.09	11	174.30	41.82	23	423.95	145.91
- Red beans	1	26.28	5.03	-	-	-	1	26.28	5.03
- Sweet potato	5	4.00	5.66	5	52.48	5.66	10	56.48	11.32
- Cassava	22	615.43	66.60	2	91.00	13.52	24	706.43	80.13
- Marketing (pulses)	2	60.00	-	-	-	-	2	60.00	-
- Irrigation pump acquisition	1	46.00		-	-	-	1	46.00	-
Total in the Project Area	**263**	**7,947.12**	**680.06**	**47**	**1,566.33**	**190.57**	**310**	**9,513.46**	**870.63**
2.- Other Crops Outside the project Area[4]	**262**	**10,641.89**	**1,763.97**	**86**	**6,292.32**	**379.44**	348	16,934.21	2,143.41
Total	**525**	**18,589.01**	**2,444.03**	**133**	**7,859**	**570**	**658**	**26,448**	**3,014**

Note:

[1]. This branch manages the satellite offices located in Barahona and Vicente Noble

[2]. This branch manages the satellite office located in Tamayo

[3]. Industrial tomato production is being financed by agroprocessing firms through production contracts

[4]. Crops that are not being produced in the study area but received loans from those AgBank Branches

Source: Banco Agricola, Boletines Estadisticos, 1998

Table 3.7.2. Agricultural Cooperatives and Associations in the Study Area (1/3)

No.	Association Name	Municipality	# Members
		Vicente Noble	
1	Tomateros y Platanero	Vicente Noble	16
2	Asoc. Lucia Pérez	Vicente Noble	6
3	La Progresista	Vicente Noble	25
4	Buringa	Vicente Noble	10
5	La Zurza	Vicente Noble	26
6	Lucrecia Pérez	Vicente Noble	22
7	Pro-Desarrollo	Canoa	24
8	Productores de la Zurza	Canoa	42
9	Emeterio Vargas	Canoa	23
10	La Solitaria	Canoa	28
11	El Repollo	Canoa	60
12	Arroceros Miramar	Canoa	24
13	Agua de la pena	Canoa	40
14	Productores de Yeso	Canoa	32
	SUBTOTAL		378
		Fundación	
1	Agrícola Incorporados	Fundación	32
2	La Buena Esperanza	Fundación	53
3	Hato Viejo	Fundación	72
4	Muevo Amanecer	Mundito	42
5	27 de Febrero	Hato Viejo	38
6	La Bienvenidad	Hato Viejo	48
7	La Buena Fé	La Hoya	65
8	Amór hacia el Progresos	La Hoya	26
9	Club de Madres	La Hoya	24
10	Mujeres de Pescadería	Pescadería	17
11	Agricultores de Ezequiel	Pescadería	30
12	La Bienvenida	Pescadería	26
13	AC-153	Pescadería	58
14	Juan Pablo Duarte	Pescadería	30
15	Los Labriegos del Yaque	Pescadería	22
16	Mujeres en acción	Guazara	32
17	La Altagracia	Guazara	26
18	Eugenio Mayoral	Guazara	70
19	Unidad de Desarrollo	Guazara	43
20	Junta de Vecinos	Guazara	15
21	Juan de la Cruz de León	Guazara	290
22	La Guazara en progreso	Guazara	40
	SUBTOTAL		1,099

Table 3.7.2. Agricultural Cooperatives and Associations in the Study Area (2/3)

No.	Association Name	Municipality	# Members
		Peñón	
1	Santa Lucía	Peñón	130
2	Palo de Leche Alberto	Peñón	132
3	Petronila Matos	Peñón	30
4	Ciudadanos Peñoneros	Peñón	14
5	Maria Sepulveda	Peñón	20
6	Emma Féliz	Peñón	35
7	Pena Cassó	Peñón	80
8	Asoc. Agrícola Cucuses	Jaquimeyes	60
9	Ganadero Los Jaquimeyes	Jaquimeyes	22
10	Voluntarias Españolas	Jaquineyes	
11	Sagrado Corazón de Jesús	Jaquimeyes	28
12	Juan Benito Inc.	Jaquimeyes	112
13	Los Ajicitos	Peñón	20
14	Asociación de Regantes	Peñón	278
15	La Altagracia	Palo Alto	150
	SUBTOTAL		1,111
	TOTAL		2,588
		BAHORUCO	
		Tamayo	
1	Asoc. Técnica Prod. de Tamayo	Tamayo	20
2	La Conquista Inc.	Los Conuquitos	33
3	La Conquista #2	Los Conuquitos	24
4	Los Conuquitos	Los Conuquitos	33
5	Aguacatico	Tamayo	43
6	San Ramón	Tamayo	40
7	Club cultural y Deportivo	Los Conuquitos	14
8	Felicia Dotel	Tamayo	20
9	La Buena Esperanza	Tamayo	8
10	Mujeres Unidas	Los Conuquitos	18
11	Mujeres Hacia el Progresos	Los Conuquitos	26
	SUBTOTAL		279
		Uvilla	
1	La Magdalena	Batey4-Uvilla	21
2	Asociacion la Buena Fé	Mena Abajo	60
3	Unión y Progreso	Mena Arriba	122
4	La Lagunita #2	Mena Abajo	30
5	Margarita Francois	Mena	16
	SUBTOTAL		249
	TOTAL		528

Table 3.7.2. Agricultural Cooperatives and Associations in the Study Area, Landless Peasant (3/3)

NAME OF ASOCCIATION	MUNICIPALITY	# MEMBERS
	Barahona	
Los Desposeidos	Monteada	21
Los Desamparados	Cañada	31
	Vicente Noble	
Los Desposeidos	Vicente Noble	65
Los Unidos	Vicente Noble	26
	Fundación	
Los Sufridos	Canoa	6
TOTAL		149

Table 3.7.3. Main Non-Government Organization that operate in the Study Area

Name	Location	Main Activities
Vision Mundial (World Vision)	Study area	Technical assistence in agroecology, funding for community projects
Fundacion para el Desarrollo Dominicano (FDD)	Barahona	Economic support to farmers assocations and microenterprises
Asociacion Dominicana de Microempresas (ADEMI)	Study area	Credit to small business
Centro Lemba	Barahona	Education, Tecnical and financial assistance, marketing for agricultural commodities
Fondo FIME	Study area	Credit provision to small farmers and rural poor
Instituto de Desarrollo de la Empresa Asociativa Campesina	Barahona and Bahoruco	Legal support and credit to farmer's associations
Buen Samaritano	Tamayo, Sugar plantation	Health and nutrition programs
Centro de Promocion de Agricultura Organica	Bahoruco	Education, Agroecology and environmental programs
Plan Internacional	Study area	Education, community projects
Fundacion pera el Desarrollo de Barahona	Barahona	Community projects
Agencia Internacional de Canada (CIDA/IHA)	Study area	Drinkable Water Resewoir, Letrines Construction
OXFAM	Study area	Agricultural Development and Institutional Strenghtening
Fondo de Desarrollo de la Juventud Rural	Study area	Community projects
Centro de Asistencia Juridica	Study area	Community projects
Servicios Social de Iglesia Dominicana	Study area	Community projects
Promocion de la Mujer del Sur	Study area	Community projects
Grupo de Educacion Campesina	Study area	Community projects
Fundacion de Apoyo al Sureste	Study area	Community projects

Source: JICA study Team, 1999.

Table 3.10.1 List of Participant in the First Public Consultation Meeting

No.	Name	Institution or Organization
1	Luis Ferrera Gómez (Néstor)	Mayor, Vicente Noble
2	Daisy Margarita	Santa Luisa de Marillac Mothers' Club
3	Jesús Pineda	General Secretary of Civil Defense Committee, and member of Vicente Noble Development Committee
4	Luis Emilio Moreta	Agrarian Reform Institute, Barahona Office
5	Tomás Reyes González	Vicente Noble's Association of Tomato and Plantain producers.
6	Domingo Guillermo Pineda	Yaque del Sur Basin Peasant Association
7	Ernesto gonzález	Vicente Noble's Association of Tomato and Plantain Producers.
8	Sor Silvia Gil	Vicente Noble Development Committee
9	Ramón Marrero	Office for Community Development. (ODC)
10	Oscar Jiménez	Vicente Noble Development Committee
11	Salvador Medina Feliz	President, Peñon Development Committee
12	Morgan Batista	Palo de Leche Water Users Association.
13	Juan Antonio López Cornielle	President, Palo de Leche Water Users Association.
14	Guarionex Leger	In charge Yaque del Sur Irrigation District (INDRHI).
15	Manuel E. Feliz	INDRHI, Yaque del Sur Irrigation District
16	José de los Santos Reyes	Water Users Association Ubillita-Fundación
17	Elpidio Feliz González	Agrarian Reform Institute, (IAD).
18	Juan Ferreras	Administrator IAD settlement AC-52,Vicente Noble
19	Anurfo Gómez	Association for Improvement of Agriculture Production in Jaquimeyes.
20	Teresa Pérez	INDRHI, Yaque del Sur Irrigation District, WUA.
21	Rafael Pérez Suárez	INDRHI, Yaque del Sur Irrigation District
22	Guillermo Arturo Beltré	Water Users Association, canal la Lajita
23	Diomares Encarnación	Health Committee Vicente Noble.
24	Rolando González	Farmer, Vicente Noble.