The average total production of major crops in the Study area during the last 5 years is summarized in table below.

(unit: ton)

Main Crop	Azua Irrigation District Area	San Juan Irrigation District Area	Yaque del Sur Irrigation District Area	Lago Enriquillo Irrigation District Area	Total In the Study Area
Plantain	81,400	4,400	113,100	14,000	212,900
Banana	23,300	5,000	41,100	800	70,200
Red bean	1,300	10,900	70	200	12,470
Rice	970	23,900	100	100	25,070
Sugar cane			34,200	230,000	264,200
Tomato	79,200		1,500	2,300	83,000
Sweet potato	3,500	27,600	1,400	700	33,200
Cassava	4,700	5,100	2,300	4,100	16,200
Corn	1,900	2,700	100	600	5,300
Sorghum	3,000	2,600	150	200	5,900
Pigeon pea	1,800	6,100	20	1,000	8,900
Coffee	1,600	375		1,000	3,000
Cocoa	120	60		100	280
Papaya	7,200	10,900			18,100
Pepper	1,200	2,100			3,300
Melon	1,200	2,600			3,800
Eggplant	1,100	2,400		150	3,600

3.3.4 Livestock Production

Livestock production within the Study area is small. The large majority of farmers engaged in livestock production within the Study area are doing this as a secondary economic activity. There is not accurate data on the livestock production within the Study area. A rough estimate of the existing livestock population indicates that within the Study area the cattle population is approximately 30,000 units, the pig population is 18,000 units, and there are relatively important production of goats and sheep but their population is not know.

Major limiting factors for the expansion of livestock production in the Study area are pointed out by farmers as 1) scarcity of pasture production, 2) lack of financial support, 3) high prices of feeds and medicines, 4) lack of effective extension service, and 5) scarcity of water. Most of the land devoted for pasture production are those with drainage problem.

The Agrarian Reform Institute (IAD) began in 1980 a land settlement for livestock production within the area of YSURA project. The livestock production settlement was initiated as a collective management system, but it did not work well because farmers did not like the collective system. Nowadays the livestock production settlement is managed directly by the government through IAD. There are about 240 heads of milking cows of pure Holstein race, that produce in average 13.4 lit/day/head that is higher than the national average of milk production per milking head. Their is an installed milk processing plant which distribute the produced milk in Azua province.

3.4 Marketing and Prices

The marketing system on agricultural products in the Study area is not well developed and most production is self consumed locally . As expressed before, due to insufficient

irrigation water, the Study area do not produce enough quantity of the basic staple food to satisfy local demand. The food deficit is bridged by importing food from other regions

There was the goal of self sufficiency in basic staple food specially rice. Most of the financing from the Agricultural Bank is devoted to rice production. The Government is the main stockholder of the wheat mill. After the Uruguay Round of Negotiation in 1994, the country established a 40% bound tariff for all imported items.

In the Barahona/Neyba area, plantains and banana are only crops with some surplus to be channeled mostly to Santo Domingo and export. In the case of San Juan red bean and rice are produced in quantities to satisfy local demands and market outside the Study area.

3.4.1 Marketing System of Main Agricultural Crop Production

The Agricultural marketing system is very simple in the Study area. Five different level were identify from the farm gate to the final consumer. Despite the lack of recent study regarding the percentage of the production that is channeled by each market agents it was estimated that a significant proportion is consumed within the region and only goes from producer to local middlemen and then the local market. (see Fig. 3.4.1).

Truckers and local middlemen market most of the plantain and banana production. A significant volume is now being exported to Puerto Rico, the United States and Holland. Fig. 3.4.2 shows the marketing system for plantain and banana in the Study area.

Production of sweet potato and cassava is oriented mainly to satisfy domestic demand, although there have been some export from the Study area last three years (Fig. 3.4.3).

Rice and coffee production is acquired and processed by rice and coffee mill which operates in the Study area.

Similarly, red beans have a simple marketing system although the Government intervenes through the Ministry of Agriculture (SEA) and INESPRE. In the case of pigeon peas, a significant proportion goes to processing plants and exporters.

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

Within the agreement for tomato production, the processing plants agreed to buy entirely the production of sorghum or corn produced by farmers who also planted industrial tomato. Tomato is grown only once a year (from late September up to late February) to scale down the impact of the white fly in the Study area.

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

dairy cows where milk is sold directly to milk processing plants located in Santo Domingo or to local producers of cheese.

3.4.2 Marketing of Farm Inputs

In the area there is the presence of Government sponsored centers for agrochemical inputs and seed sales. The Center for Input Sales (CEVEMA) distributes agrochemical inputs and fertilizers at subsidized prices. However, the bulk of inputs is acquired from private stores located in the agricultural areas. Often time CEVEMA's ran out stock of the most used inputs which forces farmers to turn to private stores.

Fertilizers are being produced locally by two main companies which mix imported raw material and prepare different fertilizer formulas. Those companies have sales outlets throughout the countries and have their own technicians to provide advice to farmers. Import of fertilizers is very low and it is used mainly on gardens. The most common fertilizer formulas is 15-15-15. During the Rapid Rural Appraisal and the Household Survey conducted by JICA Study Team, it was estimated that farmers usage of fertilizer is very low.

Those two companies also are major importers of other chemical inputs such as insecticides, fungicides and herbicides.

In regard to agricultural machines, SEA provides machine services through the Center for Machine Services (CESMA). The Service rate of Government owned tractors is much lower than the private ones and in some cases is free. The rate for tractor services for land preparation for 1998 was:

Type of Service	Gover. Rate (RD$/tarea)	Private Rate (RD$/tarea)	Difference (RD$/tarea)
Deep plowing	17	50	33
Furrowing	14	40	26
Ridging	10	35	25

However, the coverage of the Government machinery service is small due to low availability of tractors and equipment. Thus farmers use the private service to assure land preparation on time. In the Study area there are three Centers of Machines Services in Azua, Barahona and San Juan. In the case of Barahona 50% of the machinery is in critical condition due to the use low quality fuels and lubricants and the old. (SEA, 1997)

In June 1997 the Government enacted a law eliminating import taxes for imported agricultural inputs and machinery. Before that there was a of 3% levies for imported agricultural inputs.

3.4.3 Marketing of Consumer Goods

The Study area does not produce most of the consumer goods which are demanded by the population. Communities in the Study area have to rely on goods brought from Santo

Domingo and other geographical areas.

Most of the consumption of consumer goods is done through small local stores and public market plazas. Some sellers of consumers goods offered their products at the local plaza once a week and provide local stores of consumer goods. In some villages, specially in Barahona and Neyba there are some informal weekly market from commodities coming from Haiti. Similarly, some local vendors obtain merchandise at the Haitian border to market them in their villages. The most sought after items coming from Haiti are alcoholic beverages (Whisky), clothes, tennis shoes and food items (rice and beans).

3.4.4 Trade Condition

Within the Study area, there are exports of banana and coffee and in less quantity winter vegetables such as melons and Chinese vegetables. There is also some exports of organic banana and organic coffee to the European Union. Most of the export is shipped through Haina Port which about 70 miles from the Study area. There is also some unreported exports to Haiti. Recently the Barahona International airport was open but it is not in full operation

There are some problems with the size of the operation for a farmer to export to the United States which convey the necessity of farmers consortium for export. Some production have preferential market access to the European Union due to the Lome IV Convention. By virtue of that agreement export of agricultural produce, specially banana, could enter the European market free of duty.

The main market for national exports is the United States, which absorbs nearly 50% of the total country's exports. The other main markets are Holland, Puerto Rico, Korea and Japan.

3.4.5 Marketing Information System

The marketing information system is practically not existent in the Study area. Price information at the different level in the marketing channel is collected by extension agents and sent to Santo Domingo in an irregular basis. In Santo Domingo the data collected is used for statistical purposes more than to establish marketing policy actions and develop and setting policy objectives.

There is not a mechanism for the average farmer to be informed of the national price. However, some television programs with national coverage provide daily information on wholesale and retail prices at the Santo Domingo market.

3.4.6 Regulations Related to Marketing

After the New Economic Program of 1990 the Government reduced its level of price intervention in the agricultural sector. In 1994 after the GATT negotiation, the country made further commitments to deregulate and open up the economy.

The Price Stabilization Institute (INESPRE), the marketing Board in charge of price regulation, was practically closed down. Before 1990 INESPRE used to establish supporting

prices for a wide variety of crops such as rice, red beans, garlic, onions and potato. INESPRE was very active in the Study area setting up producer's prices and procurement programs for red beans and rice.

At present the Government still intervenes in a handful of crops. That is the case of rice, red beans, poultry and garlic. In the case of rice, the Government through the National Rice Commission agrees with producers and rice mill owners to establish a producer price and determine the amount that has to be imported by the country. The Government still pursues the policy of self sufficiency in rice and some other staple foods such as red beans, garlic and onions.

There are some government intervention in the marketing of agricultural products in the region. For instance, SEA is buying the recent production of red beans in February 1998. Additionally, INESPRE has been reactivated by the Government through selling program at subsidized price for urban consumers. INESPRE buy directly from producers. The main agricultural items being marketed by INESPRE are rice, plantain, onion, banana, potato and cassava.

There is still the National Institute for Price Stabilization, although its role has been greatly reduced. The Government made the commitment to eliminate all tariff and non-tariff barrier to agricultural production but they are still in place. The Ministry of Commerce still tries to set prices for some agricultural commodities such as poultry, rice, sugar and wheat flour and fuels. The Government still has some discretionary power to decide on import of some food items. Import licenses are issued to import pork, tobacco and coffee

3.4.7 Market Place Condition

In most of the Study area market infrastructure is not adequate, and in most cases very old. There is not good conditions for the display and storage of products. Most of the time agricultural produces are displayed on the ground and there is not much concern for their quality and preservation. The degree of value added is minimal and there exists an array of measures and weights which make it difficult to standardize the system.

During the Rapid Rural Appraisal, it was found that in most village the market structure is used only once a week by the local and regional merchants. The building is managed by the local authorities (sindico) which usually is rented to a local merchants. There is no supervision by the local authorities or any public institution (such as Secretariat for Public Health and Social Welfare) on safety standard and consumer satisfaction.

3.4.8 Prices of Agricultural Products

Farm gate prices for the main crops in the Study area show heavy fluctuation throughout the year and achieved it lowest point at the harvest time as depicted in Fig. 3.4.4 to 3.4.8. The marketing margin between producer and consumer price ranges from 35 to 70% of the final price. For most cases prices are determine by the market with a heavy influence of local middlemen. In the case of industrial tomato there is a predetermined price established in production contract by the agro-industries. In some cases farmer have to sell their production

before harvest to the local money lender due to some unforeseen circumstances. The marketing margin for the main crops is depicted in Figs.3.4.4 to 3.4.8.

3.4.9 Agroprocessing Facilities

The main agroprocessing facilities are rice mills in San Juan, Coffee processing (drying and peeling and bagging) and tomato paste processing. In the case of coffee the degree of processing and the capacity is minimal. Other processing facilities include small cassava processing (cassava bread), and small milk processing. Following table shows the main agroprocessing facilities in the Study area.

Name of companies	Location	Main activity
Alimentos Proteicos del Sur	Azua	Animal feed
Barcelo Agroindustrial	Azua	Tomato processing
Compania Agroindustrial	Azua	Tomato processing
Planta Procesadora de Leche Ysura	Azua	Milk processing
Sociedad Agroindustrial compostela	Azua	Agroprocessing
Semillas Surenas	San Juan	Seed Multiplication
Frito Lay of Puerto Rico	San Juan	Food processing
Agrroindustrial Morillo de Exportacion	San Juan	Processing and export
Ajies Steve Allen	San Juan	Export
Agroajies Dominicanos	San Juan	Export
Productos Tropicales Proexagro	San Juan	Export
Arrocera Matayaya	San Juan	Rice mill
Molino de Arroz	San Juan	Rice mill
Agroinversiones San Juan	San Juan	Rice mill
Habichuela Selecta San Juan	San Juan	Red beans bagging and selling
Procesadora de Granos Maguana	San Juan	Grain processing
Fecamba	San Juan	Coffee
Agrodelicias	Bahoruco	Seed and plat production
Empacadora de Mariscos	Barahona	Sea food packing
Feliz	Barahona	Food packing and export
Fenix S.A	Barahona	Export
Frutas y Vegetales Tanya	Barahona	Export
Hacienda Manachar	Barahona	Export
Hacienda Noelia Carolina	Barahona	Poultry

3.5 Irrigation and Drainage

3.5.1 Features of the Existing Irrigation and Drainage Systems

The geographic configuration of the Study area is shown in Figure 3.5.1. The Study area covers the entire basin of the Yaque del Sur river and areas served or expected to be served by the water resources of the Yaque del Sur river. The river system has two storage dams; Sabana Yegua with a 386 MCM capacity on the Yaque del Sur River and the Sabaneta dam with a 78 MCM capacity on the San Juan River, which is the biggest tributary of the Yaque del Sur River.

From the aspect of the INDRHI organization unit, the Study Area includes all the irrigation areas of San Juan Irrigation Zone of San Juan Irrigation District, and Azua Valley Irrigation District, and the Yaque del Sur river-benefited areas of both Yaque del Sur Irrigation District and Lago Enriquillo Irrigation District. The area of San Juan Irrigation Zone is mainly served by the San Juan river and the Sabaneta dam. The irrigation area of Azua Irrigation Zone is served by water of the Yaque del Sur river and Sabana Yegua dam through a trans-basin canal so-called YSURA head race. Also, most of the irrigation areas belonging to the Yaque del Sur or Lago Enriquillo Irrigation District are served by the Yaque del Sur river with the Sabana Yegua dam.

Irrigation area is estimated at 70,000 ha in total, of which about 85 % are served by the Yaque del Sur river system, and remaining irrigation areas are served by small streams or groundwater.

Summary of Irrigation Area in the Study Area

Unit : ha

	Y. del Sur or S.Juan R.	Tributaries of Y.del Sur	Other R.	Ground water	Total
San Juan Valle Irrigation District					
San Juan Zone	20,070	4,234	0	0	24,304
Azua Valle Irrigation District					
Azua Zone	13,473	0	1,182	1784	16,439
Padre Las Casas Sub-zone	0	2,625	0	0	2,625
Yaque del Sur & Lago Enriquillo Irrigation Districts	22,249*	400	2,978	868	26,495*
Total	55,792	7,259	4,160	2,652	69,863

Source : "Distritos de Riego de la Republica Dominicana" INDRHI and some area measured by use of 1 : 50,000 maps.

(1) San Juan Irrigation Area

The San Juan area is served by the San Juan River with Sabaneta dam and the tributaries. There are several major and minor irrigation systems diverting water from the San Juan river or the tributaries as shown in Figure 3.5.2 and Table 3.5.1. The irrigation area is estimated at 24,300 ha in total including an irrigation area of 3,800 ha situated outside the Study area, of which 20,070 ha are directly served by the San Juan River and remaining 4,230 ha are served by the tributaries of the San Juan river. The biggest irrigation system is Jose Joaquin Puello Canal system, which serves the area of 10,990 ha including 3,800 ha in Las Matas de Farfan located outside of the San Juan River basin or outside the Study Area.

Major Irrigation System in San Juan Irrigation District in the Study Area

Name of Canal System	Water Source	Irrigation Area
		(ha)
Jose Joaquin Puello	San Juan River	10,986
Las Matas de Farfan (outside the Study Area)		(3,798)
San Juan	San Juan River	5,526
Hato del Padre	San Juan River	2,059
Guanito San Juan	San Juan River	1,000
Mijo	Mijo River	2,390
Los Baos	Los Baos River	495

(a) Sabaneta Dam

Sabaneta Dam was constructed in 1970s and completed in 1978. It is located in the upstream reaches of the San Juan River, about 16 km north of San Juan city. At present, upstream slope of the dam is being reinforced with rock rip rap and in the left shoulder an emergency spillway is being constructed. These works were originally designed, but have been remained without execution until today. These works will be completed in this 1998.

Primary features of Sabaneta Dam are as follows:

Purposes of dam :		
Irrigation and domestic water supply and hydropower generation		
Catchment area		464 km2
Gross storage		78 MCM
Effective storage		67.5 MCM
Flood water level		El. 652 m
Maximum operation water level		El. 644 m
Low water level		El. 612 m
Dam type		Center core type rockfill
Dam volume		5,830,000 m3
Dam height		70 m max.
Dam crest elevation		El. 656 m
Dam crest length		800 m
Spillway	Capacity	920 m3/sec
Emergency spillway	Type	Overflow type
	Capacity	5,000 m3/sec
Hydropower plant	Max. power	6,853 kW

(b) Jose Joaquin Puello Canal System in the Study Area

The irrigation system was originally completed in 1978 with Sabaneta dam. It has been developed well from the head to the field level, although in the recent years salinity problem is revealed in the middle depressed area, about 3,300 ha in the Lateral 3 and 4 commanding area due to poor drainage.

The intake structure, which consists of fixed overflow type weir, sand flushing sluice and inlet equipped with five sluice gates is located at a 300 m downstream point of Sabaneta Dam outlet. It functions well. The main canal having a length of 25 km in total runs a mountainside by an open-cut and passes elevated lands by a tunnel of about 2 km in length. The canal is fully lined with wet stone masonry or cement concrete. There is a chute structure on the main canal at the point of 16 km from the headworks. The chute structure is conveying water by about 60 m drop.

The laterals are lined with concrete, which is placed in the overall rehabilitation stage in early 1990s. The tertiary canal systems are constructed with pre-casted elevated concrete flumes, which are advantage against the topographic undulation dominant in the fields commanded by Lateral 2, 3, and 4.

In the salt concentration area, PRODAS is carrying out experiments in order to measure the effect of drainage system, which consists of an open drain having a depth of about 2 to 2.5 m and plastic-made perforated pipe subsurface drain with filter made by sand and gravel laid out at the depth of about 1.8 m at an interval of 100 m. According to PRODAS, the experiments obtained good results with cropping of paddy at the first planting and sorghum at the second.

(c) San Juan Irrigation System

San Juan Irrigation system was developed in large-scale works in 1970s together with Sabaneta Dam. In 1992 to 1994, a new main canal was constructed in order to replace the old deteriorated one and to extend the irrigation area. At present this irrigation system is reinforced by the improvement of tertiary canal systems under PRODAS management.

San Juan new headworks consists of a fixed overflow weir, a sand flushing sluice equipped with two radial gates and an intake structure equipped with a few sluice gates. The sand flushing gates have not been operated since the headworks was constructed due to improper and defective installation of the winches. The intake gates have been damaged more or less especially in their spindles. The some of damages seem to be caused by biting wooden logs flowing into the inlet. No screens are furnished in front of the inlet, the same as other headworks.

The main canal is fully lined with concrete and maintained well, but some of gate structures are damaged in the spindles and gate leaf. All the offtakes and checks are furnished with sluice gates. Secondary canals and sub-secondary canals are also lined with concrete. Tertiary canals are of earthen canal type. PRODAS will soon implement the improvement works to replace the tertiary canals with pre-cast elevated concrete flumes.

(d) Hato del Padre Irrigation System

The Hato de Padre irrigation system has been rehabilitated as well as the Jose

Joaquin Puello. The major canals are of lining with concrete and most of tertiary canals are constructed with pre-cast concrete flumes.

(e) Guanito San Juan Irrigation System

Guanito San Juan System is located at the most downstream among the irrigation systems benefited by the San Juan river. Since then, the system is endowed with return flow from the Jose Joaquin Puello and the Hato de Padre. The headworks consists of an overflow weir, a scouring sluice equipped with one sluice gate and an intake with two sluice gates. In early 1990s, the headworks and main canal were rehabilitated, but the last reaches of about 5 km is still left as an earth canal. Water user's association is not organized yet. It is expected that water user's association is organized following to Mijo irrigation system where PROMASIR will guidance farmers to organize water users organization.

(f) Mijo Irrigation System

Mijo irrigation system is one of the oldest irrigation system in San Juan basin. The headworks is a typical diversion structure composed of an intake equipped two slide gates and an overflow weir. The weir including the apron made of stone masonry has been deeply scored and damaged. Most of the major canals are of earthen type having no retained the original shape. Also, many of canal-related structures are deteriorated more or less. PROMASIR has a concrete plan to assist farmers to organize their water users organization with improvement of the existing irrigation and drainage systems.

(g) Other systems

Vallejuelo I and II systems were constructed in 1970s. They takes water from the Los Baos river. The two main canals are of lined canal except 4.6 km reaches in the downstream. Water resources are insufficient to fully irrigate the system area according to INDRHI.

Other than the above systems, there are small irrigation systems in the San Juan river basin, of which the most takes water by free intakes. Small intakes serving the downstream of San Juan Irrigation system will be unified into one intake to be constructed by PRODAS on the Jinova river which collects water drained from San Juan Irrigation area.

(2) Sabana Yegua Dam

Sabana Yegua Dam is located in the middle reaches of the Yaque del Sur River, a point of about 3 km from a confluence of the Yaque del Sur with the San Juan river or the just a joint of three rivers such as the Yaque del Sur, the Grande, and Las Cuavas. It was constructed in 1970s and completed in 1978 for efficient use of water resources for domestic and irrigation in Azua and Barahona areas. Also the dam contributes to the hydro-power generation by using water released through a generator. The catchment area is 1,676 km2, which account for 30 % of the whole basin of the Yaque del Sur river, 4,636 km2 at Palo Alto. While the effective storage capacity is estimated at 386 MCM.

According to the information from the dam site office, the reservoir surcharge water level is set at El. 386.0 m during hurricane season from July 21st to September 30th and 396.4 m during the other seasons so that the spillway discharge does not exceed the design discharge. As the results, the dam spillway has not experienced overflowing through the spillway crest yet, since the dam was unveiled. As the dam and Sabaneta dam covers about 50 % of the mountainous area of the Yaque del Sur basin, both the dams contribute to mitigation of flood in the downstream basin of the Yaque del Sur river.

Primary features of Sabana Yegua Dam are as follows:

Purposes of dam		
Domestic and irrigation water supply with power generation		
Gross storage		433 MCM (design)
Effective storage		386 MCM(design)
Extraordinary Flood water level		403.9 m
Flood water level		400.8 m
Normal High water level		396.4 m
Low water level for generator		373.0 m
Normal low water level		358.0 m
Dam type		Center core rock-fill type
Dam volume		14.8 million m3
Dam height		96 m
Dam crest elevation		406.1 m
Dam crest length		1,156 m
Spillway	Type	Concrete overflow type
	Capacity	623 m3/sec
Hydropower plant	Max. power	13,000 kW

(3) Irrigation Area in Azua Irrigation District

Irrigation Area in Azua Irrigation District is largely divided into four areas; one is an irrigation area of 2,625 ha in Padres Las Casas Irrigation Sub-zone; second is an irrigation area of 3,466 ha consisting of 2,366 ha directly served by the Yaque del Sur river and 1,100 ha directly served by YSURA head race; third is an irrigation area of 10,007 ha located in the outside of the catchment area of the Yaque del Sur River but served with water diverted from the Yaque del Sur River through YSURA canal system, and fourth is an area of 1,784 ha irrigated by tubewells mainly in the eastern part of Azua plain. The total irrigation area served by the Yaque del Sur is estimated at 13,473 ha except Padres Las Casas zone, which is located in the upstream of Sabana Yegua Dam. Irrigation systems are shown in Figure 3.5.3 and major irrigation and drainage canals are listed in Table 3.5.1 and 3.5.2.

The YSURA canal area is further divided into two; one is an area of 7,732 hectares with 4,488 users made up of six (6) concrete lining laterals and the tertiary canals and second is an extension area of 2,275 hectares with 650 users, where the most of canals including the YSURA canal are remained without lining and the canal system seems not to cover all the areas probably cover the half or less. Through the YSURA area, three rivers

such as the Tabara river, the Rosa river, and the Jura River flow out the Caribe Sea. All the rivers are utilized for irrigation and drainage.

In the southern area of the Lateral 6, of which the elevation is less than 40 m, spring water is utilized for irrigation. Some of the southern part of the YSURA canal area, about 600 ha where the altitude is less than 40 m are suffering from salinity problems due to insufficient drainage facilities and improper irrigation practices.

The eastern part, Estevania is served mainly by groundwater resources. Tomato paste factory is situated in Estevania town. A private company or large land owners are cultivating tomato under irrigated farming applying a drip irrigation method.

(a) YSURA Canal System

YSURA System was built in 1978 together with Sabana Yegua Dam.

(i) Villarpando Headworks

The headworks consists of a weir and an intake equipped with three sluice gates to YSURA Head Race, and a sand flushing sluice equipped with one radial gate. To lead river water from the center of the river to the intake, an access canal has been provided. The weir portion has a crest length of 870 m, which is largely divided into two parts such as an overflow section of 115 m wide and an earthfill dam section in the remaining part. The flow section is made by rock masonry works. The crest elevation is El. 287.60 m. The earthfill section has a crest elevation of El. 292.60 m in the portion contacting to the intake and the flow section so that even maximum design flood of 1,250 m3/sec is safely drained at the water level of El. 291.00 m, and El. 290.00 m in the other part, which are designed to function at the time of the design flood of more than 740 m3/sec. The earthfill section is center core type protected by random rock fill in the upstream and downstream surfaces. Ordinary flood water level is estimated at El. 126.35 m at the flood of 460 m3/sec.

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

(ii) YSURA Head Race

The YSURA Head Race having a length of 29.5 km suffers from inflow of sandy soil and cobble stones carried through the Villarpando intake and coming

from the left side hill caused by erosion and land sliding in the upstream reaches of about 1 km in length. Earth sliding phenomena can be seen in the right outside-descending slope of the service road as well at some parts of the upstream reaches, where the canal runs the middle part of the mountainous slope. At the upstream reaches, INAPA divert water for domestic water supply for a few rural communities. Also, canal water is taken by privately-installed flexible pipes at many points in the upstream and middle reaches by use of siphon effect.

The YSURA Head Race is completely lined with concrete, having a bottom width of 3 m and the side slope of 1.5 : 1 in the beginning portion. According to the design, the capacity is 12 m3/sec with the water depth of 2.24 m at the normal operation time and 25 m3/sec with 3.17 m depth at the maximum time.

(iii) Tabara Headworks

The Tabara headworks is the same type as the Villarpando. It consists of a weir, an intake structure equipped with three sluice gates to YSURA Main Canal, and a sand-flushing sluice equipped with one radial gate. To lead river water from the center of the river to the intake, an access canal has been provided. The weir portion having a crest length of about 400m is divided into two parts such as an overflow section of 55 m wide and an earthfill dam section in the remaining part. The flow section is made by rock masonry works. The crest elevation is El.123.50 m. The earthfill section has a crest elevation of El. 128.00 m in the portion contacting to the intake and the flow section so that the design flood of 720 m3/sec safely flows down at the design max. water level of El. 127.35 m at . and El. 126.35 m in the other part, which are designed to drain water at the time of flood more than 460 m3/sec. The earthfill section is center core type protected by random rock fill in the upstream and downstream surfaces.

All the gates are driven by manual. The sand flushing gates are not functioning in recent years due to a breakdown of winches and left in closed position. Sediment depositing in a leading channel, which plays a role of sand trapping in front of the intake is drained by mechanical operation of a backhoe instead of sand-flushing by the sand flushing gates according to the information of Azua Irrigation staff. However it seems that the mechanical operation is costly and not so effective against the large amount of sediments at storm times. The downstream end of the chute leading water flushing through the sand flushing gates is scoured and damaged by water flushed out. Due to no opening of the sand flush gates, the leading channel to and in front of the intake gate suffers from the sedimentation of sand and gravel. Such conditions allow silt, sand, and gravel easy access into YSURA main canal as well as in the Villarpando.

(iv) YSURA Main and Laterals

The YSURA Main Canal has a total length of 21 km, of which 13 km has been lined with concrete up to a point of 13 km from the intake of the Tabara headworks or a point of 500 m from the point Lateral 6 is branched off. The

quality of the concrete lining is rather good only with a few cracks. In the last reaches after the 13 km point, the main canal has not been lined yet. The unlined reaches are about 8 km in length. The main canal suffers from the sedimentation coming from the Tabara intake due to mal-function of the intake gates and sand flushing gates in Tabara intake. The sedimentation has made the carrying capacity of the canal remarkably reduce, however it is not so severe problem at present, since the canal still has an enough capacity to convey water of 12 m3/sec to meet the actual irrigation water demand brought from the irrigation area of 10,007 ha. The check structures are equipped with steel-made radial gates. An offtake is equipped with a steel-made sluice gate. Some of them do not function well.

The canal has a bottom width of 2.4 m and the side slope of 1.5 : 1 in the beginning portion. According to the design, the capacity is 12 m3/sec with the water depth of 1.85 m at the normal operation time and 25 m3/sec with 2.87 m depth at the maximum time.

Other than the gravity irrigation area, the YSURA main canal contributes to areas about 100 ha located along its left hilly side which are higher than the position of the YSURA canal. The area is served by pumping up privately installed. INDRHI do not get water charge from them.

The YSURA main canal distributes water to six Lateral canals including Herman Cortes Canal, which diverts water from the Jura river and joins to Lateral 6. All the laterals have been lined with concrete. Some of the check and offtake gates are damaged mainly in their spindles, which are bent and thus can not be operated. Last one-third of the Lateral 6 has been abandoned and the commanded area is irrigated with water taken from drainage canals by damming up, which accelerate the salinity problem in the downstream. Concrete lining is generally maintained well, though cracks from which grasses are growing can be seen in the surface of lining in some sections.

Deep drainage canals and subsurface drains have been constructed after the irrigation was started, for mitigating the salinity problem. Their length are 150 km and 64 km in total, respectively.

The extension area remains without improvement of the irrigation and drainage system.

(b) Small Irrigation Systems along the Yaque del Sur River

There exist small irrigation systems along the Yaque del Sur river in the reaches from the Sabana Yegua dam to Los Guiros, which belong to Azua Irrigation District. These systems serves the riverine terrace formed along the river. The total number of the intakes is 10 and total irrigation area is estimated at 2,366 ha. All the intakes are of free intake type and all the irrigation systems are of earthen-made with only a few structures.

(c) Padre las Casas irrigation system and others

There exist small irrigation systems in the Las Cuevas river, which enters to the Sabana Yegua dam, the Viajama river, which is a tributary of the Yaque del Sur, the Tabara river, and the Estebania-Grande river. The Padre las Casas system, which takes water from the Las Cuevas is only endowed with perennial stream. Other systems serve their respective areas especially in the wet season.

(d) Tubewells

There are 45 tubewells owned by INDRHI, of which 38 wells are operated at present. Other than the INDRHI's wells, there exist about 30 wells owned by private sectors.

Capacity of the existing INDRHI's tubewells ranges from 30 lit/sec to 115 lit/sec and is 60 lit/sec on an average. Irrigation area is around 50 ha/ one well on an average. In these years, operated only for 6 to 8 hours a day due to frequent interruptions of the power supply. Without the interruption of the power supply, 16 hours operation is expected.

(4) Yaque de Sur - Lago Enriquillo Irrigation District

In 1996, Yaque del Sur Irrigation District is divided into two districts such as Lago Enriquillo Irrigation District and Yaque del Sur Irrigation District. Left bank irrigation areas of the Yaque del Sur river up to the irrigation area of Santana irrigation system as well as the other irrigation systems located along the northern hills of Neyba are managed by the Lago Enriquillo. Right bank irrigation areas and irrigation areas located along south edge of Neyba plain belong to the Yaque del Sur. Major irrigation systems are shown in Figure 3.5.4 and major canals are listed in Table 3.5.1.

Existing irrigation area is estimated at about 26,500 ha in the Study area, of which 84% or 22,200 ha are served by the Yaque del Sur river. The remaining areas are located south edge (Cabral section area) or north edge (Galvan) of Neyba plain served by small rivers, springs, or groundwater. Of the 22,200 ha served by the Yaque del Sur, sugarcane fields managed by Sugar Company; C.E.A occupies about 13,400 ha or 60 %.

Irrigation area served by the Yaque del Sur are divided into three zones from the characteristics of irrigation systems such as an area covered by (i) a group of small irrigation systems located along the valley of the Yaque del Sur river in the upstream reaches of Santana intake, (ii) Santana irrigation system, which is the biggest irrigation system in the downstream reaches of the Yaque del Sur, and (iii) an area covered by small irrigation systems located along the downstream reaches of the Yaque del Sur from the Santana intake point.

(a) Small irrigation systems before Santana Intake

As already explained in the item of Azua Irrigation District, the small irrigation

systems located in the upstream reaches are characterized that most of the diversion works are of free intake type except a few intakes, for example, the Quita Coraza intake and all the irrigation systems are of earthen-made type with only a few structures. The Quita Coraza, the intake structure is made of concrete and equipped with two sluice gates, but these gates are damaged and do not function well. Irrigation canals run on the irrigation fields, which are formed on the riverine terrace along the river with rather coarse material. Thus it leads much amount of water losses, but these losses mostly returns to the Yaque del Sur river and are reused in the downstream. Total benefited area is estimated at 2,791 ha and total number of intakes is estimated at least 11, of which the biggest is Fondo Negro system commanding 768 ha. San Ramon canal is being extended at present and expected to serve from present 366 ha to 1,116 ha.

(b) Santana Irrigation System

Santana Irrigation System is the biggest gravity irrigation system in the downstream reaches of the Yaque del Sur river. The system has been managed by Sugar Company C.E.A. and INDRHI serving mainly sugarcane plantation in the right bank area of the Yaque del Sur river, about 12,000 ha.

Santana headworks consists of an overflow weir, a sand flushing sluice equipped with two radial gates and an intake equipped with seven inclined sluice gates. All the gates are more or less deteriorated and only two intake gates function well. The Most of the canals are of earthen type. The canal system is not maintained well and related structures are much deteriorated. Under such physical conditions, water management can not be made properly and much amount of water is wasted as seen the much amount of water flowing down through drainage canals. In 1983, in order to improve such conditions, the World Bank made a study to improve the systems. Santana main canal has an inspection road, but it is not passable by vehicle except a limited upstream reaches, since miscellaneous small trees are growing with poor maintenance of the road. Other canals have no inspection roads.

Drainage canals having a depth of 2 m to 3 m are alternatively laid out with irrigation canals in the sugarcane fields. Drained water is collected into laterals and a main drainage canal called as Guaraquau drain carries water to the western fields which are little utilized due to saline soil. The discharge of the drain ranges from 0.5 m/sec to 1.5 m3/sec all year round except storm time.

(c) Irrigation system in the downstream from the Santana intake point

This zone is the lowest in the Yaque del Sur river and all the systems have a pumping station at the head except two small gravity systems and Vicente Noble system, which is a gravity system. The irrigation area is 7,458 ha in total of which the Vicente Noble system is 1,804 ha and others are 5,654 ha in total with about 30 pumping stations. INDRHI manages most of the pump stations and C.E.A. owns two. Some are owned by Agrarian Institute. All the pumps are of electric motor-driven type and functions well except a few pumps owned by C.E.A.. Other than the

above mentioned pumps, private-owned small gasoline or diesel driven pumps can be seen at many points along the river. Canal systems are provided with concrete lining or stone masonry lining in their major canals and earthen-made in the tertiary and small canals. Canal systems are not maintained well and more or less deteriorated. Most of major canals have no inspection roads.

(d) Irrigation systems other than Yaque del Sur origin

There exist small irrigation systems in the north edge of the Neyba plain, taking water from small rivers like the Panzo river and the Majagual river originating from the Loma Monte Bonito. Also small irrigation systems exist in the south edge of the Neyba plain, served by the small rivers like the Bermesi and the Lemba river originating from the Loma Pie de Palo. In addition to these small rivers, springs and groundwater are utilized for irrigation in these south and north edges of the Neyba plain. Total benefited area is estimated about 4,200 ha at maximum.

3.5.2 Organization for Operation and Maintenance and Water Management

The INDRHI is the institution in charge of all the water resources of the country and carries out river system water management including irrigation systems. In recent years since 1990, INDRHI has guided farmers to organize WUO through PRODAS, PROMASIR, and other projects in order to manage water instead of INDRHI in each of irrigation systems well developed up to tertiary canal systems, but in many irrigation systems, INDRHI has still directly executed the water management. Organization for O&M is briefly explained in this section in accordance with "Manual de Operaciones Y Mantenimiento de Los Systemas de Riego" prepared by INDRHI in November 1997.

(1) Organization of INDRHI for Operation and Maintenance

(a) General

Operation and Maintenance (O&M) of irrigation and drainage facilities are conducted through the Irrigation District Department of el Instituto Nacional de Recursos Hidraulicos (INDRHI).

There are 10 Irrigation Districts under the Irrigation District Department in the Republic of Dominica, which covers an irrigation area of 261,000 ha with 309 irrigation systems. The irrigation area accounts for only about 16% of the national agricultural land, while about 60 % of the total crop production depends on irrigation. Further each Irrigation District is divided into a few zones. The Study Area is covered by four Irrigation Districts such as San Juan Irrigation District, Azua Irrigation District, Yaque del Sur Irrigation District, and Lago Enriquillo Irrigation District, which is separated from Yaque del Sur Irrigation District.

O&M of the irrigation and drainage canal systems, restoration of the access roads, repairing of the pumping units, heavy equipment and the other structures are the main obligations for the Irrigation District Offices.

(b) Irrigation District Department

According to Law No. 6 issued in September 8th 1965, the INDRHI is in charge of all the management of public waters. The Irrigation District Department has the responsibility of administrating, operating, conserving and improving all the existing irrigation systems of the Country.

This Department promotes efficient management and operation of the hydraulic structures such as dams and irrigation and drainage canals in order to allow the rational use of soil and water resources at the national level and to decentralize the administration and maintenance of the irrigation systems transferring them to the users.

The Department has four (4) divisions: Maintenance and Improvement of Hydraulic Structure, Water and Soil Management, Standards and Rules, and Organization and Training. The major works of each of Divisions are as follows:

(i) Division of Maintenance and Improvement

The Division prepares an annual program for maintenance and improvement of river facilities and irrigation and drainage facilities including dams and pumps, and supervises all the maintenance and improvement works for these facilities. The Division also conducts maintenance works of equipment and vehicles owned by INDRHI.

(ii) Division of Soil and Water Management

This Division's major works are to review an irrigation schedule prepared by each Irrigation District in collaboration with a person of Ministry of Agriculture in charge, to prepare an annual operation schedule of Storage Dams, to collect and compile meteo-hydrological records, and water release and distribution records, etc..

(iii) Division of Standards and Rules

This Division makes standards and rules for design of irrigation and drainage facilities and all the activities for the operation and maintenance.

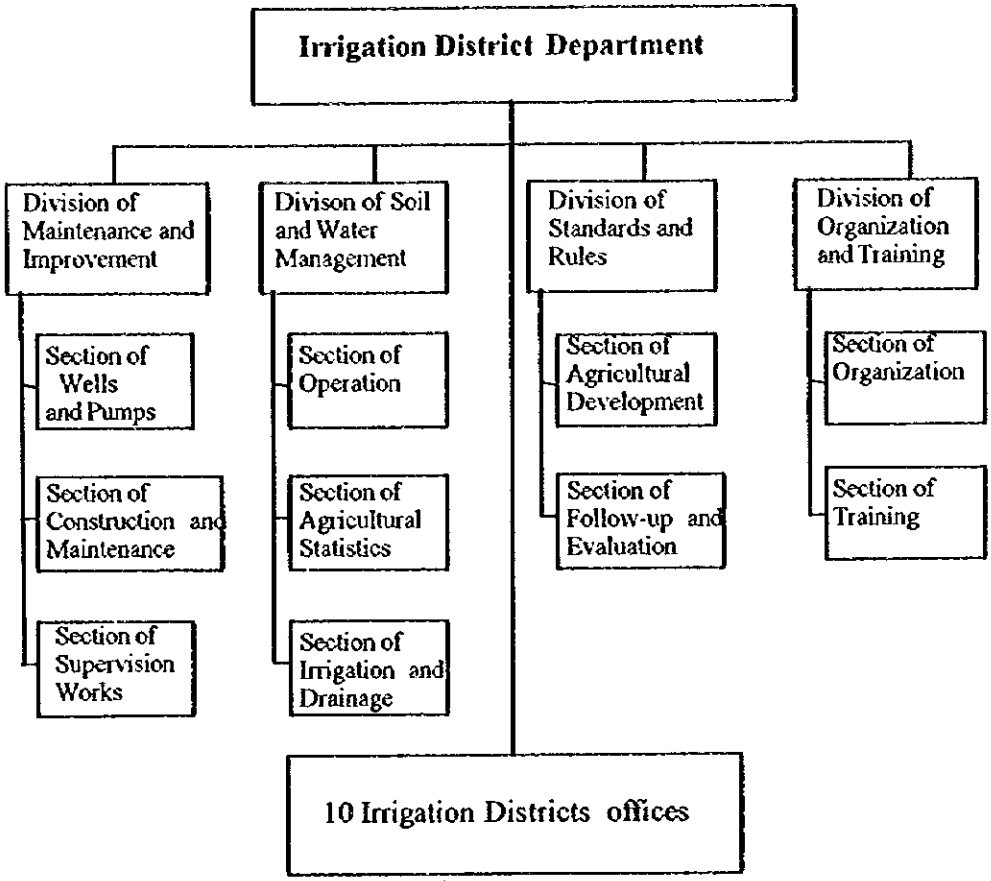
(iv) Division of Organization and Training

This Division's major works are to assist farmers to form WUO, to advise an existing WUO to keep good management and to further improve it and to make plans for all the training activities and to execute them.

These divisions propose to the Department the standard rules and policies taken in the Irrigation District offices, who directly administrate, operate and give maintenance to the irrigation systems in their respective areas. The Study area is divided into four Irrigation Districts such as San Juan Irrigation District, Azua Irrigation District, Lago Enriquillo Irrigation District and Yaque del Sur Irrigation

District.

Organization of Irrigation District Department of INDRHI



(c) Irrigation District

(i) District Office

Irrigation District office has to manage all the technical, economical and administrative matters for a good administration, operation and maintenance of the irrigation system of his/her District, to supervise and investigate all irrigation, operation and maintenance plans of the irrigation systems, to supervise all tasks of the District Units, to approve and take the necessary steps to obtain the budget for annual administration, operation and maintenance of all canals and drains in his/her respective system, to approve irrigation water charge in the Irrigation Zone and systems, and to coordinate all monthly and annual reports to be sent to the Irrigation District Department and to check all regulations on water distribution and use in his/her District. The District office has five units: Conservation and Improvement, Water and Soil Management, Pumps Operation

and Maintenance, Supervision and Investigation, and Organization and Qualification. The major works of each of units are as follows:

(ii) Conservation and Improvement Unit

The major works of this unit are to elaborate, together with the Water and Soil Management Unit the ordinary budgets and emergency budget for the conservation and improvement of irrigation systems, to supervise cleaning and repairing of canals, drains and the related structures, maintenance of all access roads, to care all office premises of the Irrigation District, to make routine maintenance of all heavy equipment of his/her District, and to manage all the canal and drainage systems.

(iii) Water and Soil Management Unit

The major works of this unit are to elaborate irrigation plans for each agricultural cycle concerning the water availability and cropping plan in coordination with the farming and livestock regional authorities, to supervise the delivery of water in all the irrigation zones based on available hydrologic information and the elaborated irrigation plans, to prepare studies for and solutions to the drainage problems and recovery of saline soil area, to advise farmers the correct management of the soil - water - plant system and the most convenient irrigation techniques to achieve more efficiency and to increase productivity, and to collect and keep the agricultural statistics of the planted areas, cultivated areas, and cropping productivity. These statistics will be used for defining the irrigation systems operation.

(iv) Pumps Operation and Maintenance Unit

The major works of this unit are to properly maintain all pumps and their equipment, keeping with the instruction given by the Soil and Water Management Unit Manager, to prepare budgets and to check all proposals made by companies or electrical engineers, concerning the electrification of pumps and repairs of all other parts of the pump unit, to supervise the duties of the operators and night watchmen in the Pumps Unit.

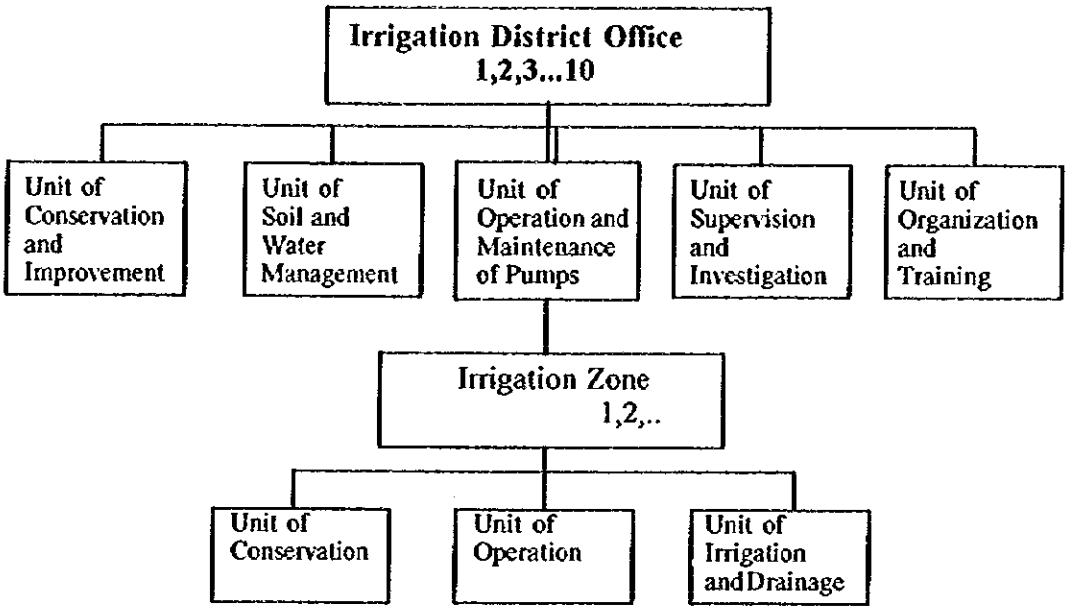
(v) Supervision and Investigation Unit

The major works of this unit are to supervise all structures that are being constructed in the District, to look after the performance of the specific techniques established by the institution, to prepare and take the necessary steps to obtain the payments for all structures that are being conducted in the Irrigation District, and to select and receive the programs concerning the implementation of works, and follow up the schedules.

(vi) Organization and Qualification Unit

The major works of this unit are to guide and advise WUOs in operation and maintenance of irrigation and drainage facilities and administrative works and to help farmers to make their water management and O&M organization in the irrigation system where it hasn't been created.

Organization of Irrigation Districts



(d) Irrigation Zone

(i) Irrigation Zone Office

Irrigation Zone office manager has to manage technical, economical and administrative matters necessary for a good administration, operation and maintenance of the irrigation systems in his/her Irrigation Zone, to supervise all duties of the Technical Units of the Irrigation Zone, to establish and manage all steps for the collection of irrigation water charge in the irrigation zone, and to prepare all monthly technical reports and annual notes of the activities conducted in the irrigation zone and send them to the Irrigation District.

(ii) Unit of Conservation

The major works of this unit are to elaborate budgets on conservation and improvement projects in the irrigation zone, to manage the cleaning of all canals and drainage, to prepare statistical data on costs and productivity of all tasks in conservation and improvement of the zone, and to manage the Zone's maintenance team in the execution of all construction works.

(iii) Unit of Operation

The major works of this unit are to operate canal systems in the zone based on an established irrigation plan, to keep permanently up to date the users list, to maintain and update the agricultural statistics of the sown areas, cropped areas, farming productivity and agricultural cropping, which should be reported to the Soil and Water Management District Unit manager, and to supervise all tasks performed by personnel in charge of water distribution.

(iv) Unit of Irrigation and Drainage

The major works of this unit are to carry out studies and supervise all the works done on irrigation and drainage and recovering of saline soil, to keep monthly reports of all climatological data, irrigation water quality, underground water level, and to elaborate and carry out implementation programs for the established plots of land for the proper use and management of water.

(2) Water User's Organization

(a) General

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

In San Juan valley irrigation zone, WUO so-called the Sabaneta Dam Irrigation Committee has been organized in the irrigation systems of right bank side of the San Juan river such as Jose Joaquin Puello Irrigation system and Hato de Padre irrigation system and being introduced in San Juan irrigation system together with tertiary canal system development under the guidance of PRODAS. Mijo irrigation system will be taken up as a first objective system for organizing water user's association under PROMASIR.

In the Azua irrigation zone, WUO so-called the YSURA Irrigation Committee was founded in 1980s in YSURA canal system area consisting of Lateral 1 to 6. This is a first organization in Dominican Republic.

Yaque del Sur - Lago Enriquillo irrigation zone have not WUO to carry out operation and maintenance of irrigation and drainage systems.

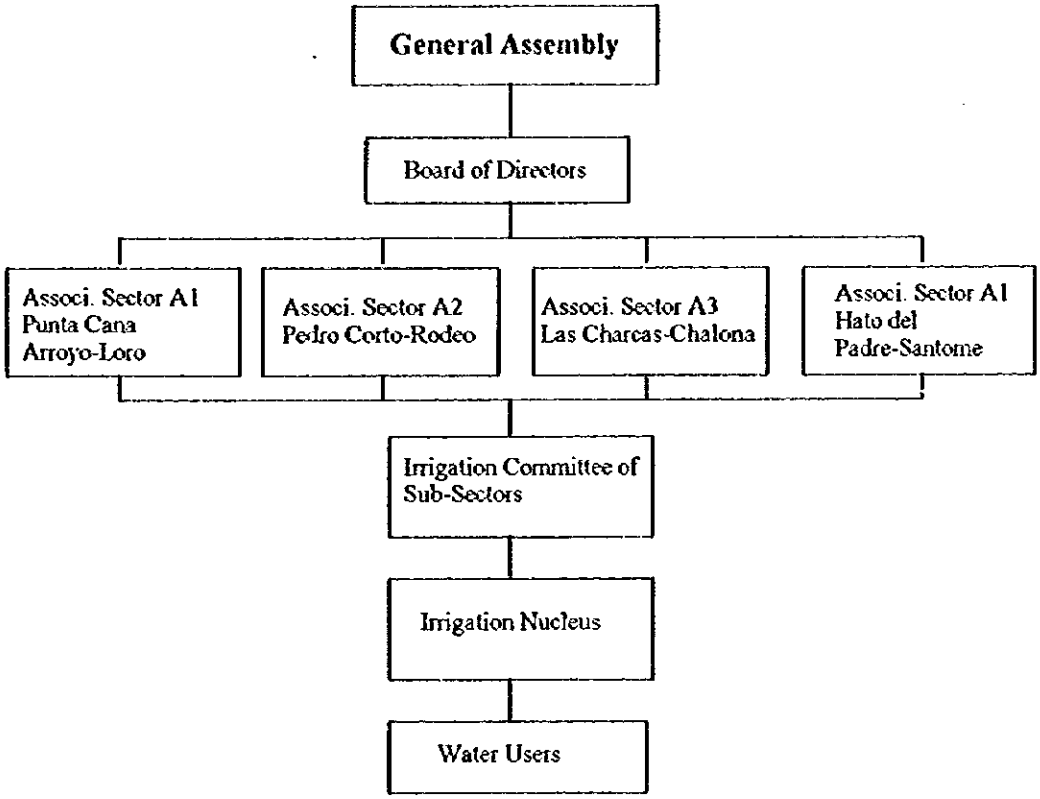
(b) Organizational Structure and Staffing

(i) San Juan Irrigation Zone

The organization of the Sabaneta Dam Irrigation Committee is shown in

the following figure.

Organization of Sabaneta Dam Irrigation Committee



By-laws of the Irrigation Committee were approved in the General Assembly held in 27th April 1994. The Irrigation Committee's major objectives are to administrate, operate, conserve and maintain all the Sabaneta Dam Irrigation Systems including J. J. Puello and Hato de Padre, although the San Juan irrigation system has not WUO and in general to conduct all operations, constructions, etc. which contribute to the improvement and strengthening the irrigation systems. All the farmers in the Committee's jurisdiction are the member of the Committee. A nucleus, which is a smallest unit of WUO generally consisting of 10 to 15 members is organized at a tertiary canal level, then an irrigation committee of sub-sector is organized at a lateral canal level. The irrigation committee of sub-sector level is operated by a representative elected among chiefs of the nucleuses of the jurisdiction. Then, there are four associations are organized in total at a few lateral level or one large lateral. The representatives of the irrigation committee of sub-sector select the representative of the association. who is automatically the member of the Board of Directors. The major duties of the chiefs of nucleuses and the representatives of associations and sub-sector committee are notification of water distribution schedule and execution and/or watching of the actual water distribution.

J.J.Puello main canal and one largest lateral are managed by technical management staff employed by the Committee of which organization is explained later.

The General Assembly, as a maximum authority will meet twice (2) a year and at a necessary time. Board of Directors is responsible for the management and administration of the Irrigation Committee.

The General Assembly is responsible for:

- Approval or reform of the present by-laws,
- Election of the Board directors and member that will function as a consultant,
- Approval of the actual expense and budget of the Irrigation Committee every year,
- Approval of the irrigation plan for each agricultural cycle, and
- Selection of a disciplinary committee to supervise and look after the irrigation committee's behavior among the members.

The Board of Directors is made up of one president, one vice president, a treasurer, two secretaries (one for documentation and the other for organization) and other few members. They are chosen by the General Assembly and will remain for two years in their position. The Board of Directors meets periodically as often as the members consider necessary, when called by the president, by 33% of the members or by the disciplinary committee. The status of the Board of Directors will be honorific and the execution doesn't let any advantage in the performance of their functions as an associated.

The main duties of the Board are:

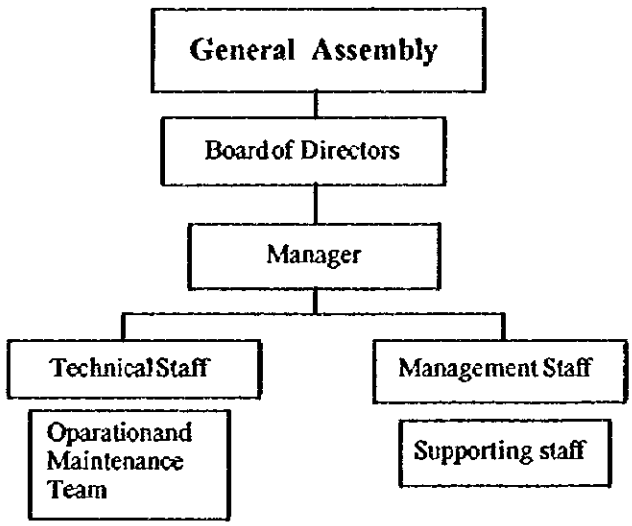
- To watch for the fulfilling of all the duties as said in this by - law,
- To call the General Assembly meetings when necessary and to manage the Assembly as a leader,
- To approve the annual budgets of operation,
- To carry out and help to carry out all agreements made by the General Assembly,
- To approve the amount of water charges,
- To select technical and administrative staff in collaboration with the manager and approve the remuneration of the staff,
- To approve the nominating of the manager,
- To prepare the annual report that must be given to the Ordinary General Assembly by the president,

- To operate, conserve and administrate the irrigation system under the influence of the Sabaneta Dam, under the supervision of INDRHI,
- To administrate and dispose of the committee in accordance with these by - laws and the laws of matter and to make payment for necessary activities,
- To watch for the good administration and direction of all technical and administrative personnel,

The Irrigation Committee have one or various bank account(s) managed by the president and the treasurer. From these accounts the operation funds are withdrawn. The Committee is operated by funds collected in the form of the water service charge.

The irrigation Committee employs a force of management staff, which actually executes the plans and programs under one manager.

Organization of Management Staff



The duties of the manager are:

- To execute the plans and programs of the Irrigation Committee.
- To prepare the following matters for the Director's Board:
  a) The annual budgets.
  b) The specific budgets of operation and maintenance works.
  c) The annual rates of water collecting from the users.
  d) The memoirs and accounts of the management.
  e) A monthly report of the activities.
- To select, along with the Director's Board the management personnel.

- To propose to the Director's Board plans, programs and projects that are benefited to the Irrigation Committee.

There are six management-supporting staff and four technical staff under the manager. They make operation plans and schedules and actually operate the J.J. Puello and Hato de Padre headworks and all the major offtakes along the J.J.Puello canal and Las Charcas lateral canal. In the administration unit, one accountant, two cashiers, one office boy and two drivers are employed.

(ii) Azua Irrigation District

WUO so-called the YSURA Canal Irrigation Committee was founded in 1980s in YSURA canal system area. The hierarchy of the Irrigation Committee is composed of water users, nucleuses, irrigation associations, and Board of Directors, almost the same as the Sabaneta Dam Irrigation Committee. The number of members (all the water users) is 4,488. In each of a tertiary canal level in principal, one to three nucleuses have been organized depending on the scale of the tertiary block. One nucleus consists of 10 to 50 users. They select one chief and an assistant for scheduling and managing water distribution in their jurisdiction. Then the irrigation association, which is composed by a lateral chief, who is to be principally selected among the chiefs of nucleuses have been organized in each of the blocks, which are eight in total composed of two blocks in Lateral 1 and 6 and one block in Lateral 2 to 5. Then the Board of Directors, which are actually managed by nine members; one operation chief and the lateral chief of 8 lateral blocks under a president selected among them. The Board makes a schedule of water distribution from YSURA main canal to laterals.

Also the same as the Sabaneta Dam Irrigation Committee a force of management staff has been organized under the Board of Directors in order to actually execute the plans and programs under one manager. The force is divided into a technical force and a management force.

The technical force consists of one person in charge of operation and six irrigation inspectors. They prepare irrigation schedules for their area in accordance with the water distribution plan informed from the Azua Irrigation Zone office, inform them to the chiefs of nucleuses, and instruct them actual operation of small gates and irrigation methods. They also directly operate turnout gates on the main and lateral canals. Many of the technical staff were the staff of INDRHI until February, 1998, getting salary from INDRHI. Still a few INDRHI staff are working at key positions. In the management unit, six personnel are employed; one accountant, 2 cashiers, one secretary, one office boy, and one driver.

(iii) Yaque del Sur - Lago Enriquillo Irrigation Districts' areas.

There are no WUO for irrigation water management. In each of the irrigation system, a few staff of INDRHI consisting of one water distributor and

either a gate keeper or a pump operator depending on the system, by gravity or by pumping, and a guard man.

(b) Financial Situation of Water User's Organization

(i) San Juan - Sabaneta Dam Irrigation Committee

The Sabaneta Dam Irrigation Committee budgeted RD$ 7.5 million in 1996/97 and RD$ 8.5 million in 1995/96 according to the information from the Committee. The contents are as follows:

Budget of the Irrigation Committee

Unit: RD$ 1,000

Particular	1996/97	1995/96
Administration	1,270	1,030
Transportation	298	308
Organization	142	300
O&M	5,124	6,103
Total	7,518	8,513

However, the above amount for O&M was not actually budgeted. INDRHI arranged and deployed equipment for maintenance and repairing with free of charge to the Irrigation Committee, of which cost was estimated about RD$ 3.5 million. Also, water users, which are members of the Committee were working on voluntary basis for O&M of irrigation and drainage facilities. This voluntary service was regarded as the worth of about RD$ 1.5 million. These amounts were included in the O&M item of the budget table.

The budget for the WUO mostly comes from the funds collected as a water charge to the farmers. The total amount of water charge actually collected is about RD$ 1.3 million in 1996. Even if all the members pay the water charge, total is about RD$ 2.5 million, which is far behind the required amount of RD$ 7 to 8 million for the activities of the Irrigation Committee. The Irrigation Committee probably needs at least RD$ 500 /ha, 2.5 times the present water charge for financially independence from INDRHI.

(ii) YSURA Canal Irrigation Committee

Annual budget for YSURA Irrigation Committee is formulated on the basis of the water charges on the assumption that all the members pay water charge. The budget is about RD$ 2.4 million.

Budget 1997 of YSURA Irrigation Committee

Particular	Unit: RD$ 1,000
Administration	676
Operation	425
Maintenance	787
Board of Directors	374
Contingency	113
Total	2,376

While, the collection rate of water charges is still low as shown in the following section (3). For example, in 1997, collected amount is RD$ 1.6 million, and so the shortage against the budget is RD$ 0.8 million, which almost corresponds to the budget for maintenance. Salary of the water management staff still coming from INDRHI are paid by INDRHI. In the YSURA Canal Irrigation Committee, the board members have pointed out that the operation and maintenance fund collected as a water charge from member is not enough to carry out repairing the irrigation and drainage systems.

(c) Current major problems

Major problem in the Sabaneta Dam Irrigation Committee is a constant dispute among beneficiaries due to lack of water, which sometimes causes restructuring in nucleuses and irrigation committees. It should be recognized by all the members that the lack of water is sometimes caused by the water management carried out by themselves, although shortage of water is also a serious problem.

(3) Water charges

(a) San Juan Valley Irrigation District

According to the information of the Irrigation District Offices, a collection rate of water charge remains at very low level of around 10 %. While, in the area operated by the WUO the collection rate was 52 % in 1996 and reaches already about 80 % in fiscal year 1997/98. Unit rate of the water charge is as follows:

- Area managed directly by INDRHI — RD$ 102 / ha in 1997
- Area managed by WUO
- Upland crops — RD$ 191 / ha in 1997 in less than 10 ha (12 pesos / ta)
  RD$ 382 / ha in 1997 in more than 10 ha (24 pesos / ta)
- Paddy — RD$ 382 / ha in 1997 (24 pesos / ta)

(b) Azua Valley Irrigation District

The collection rate of water charge is 10 % to 12 % only in the traditional irrigation systems where no WUO is founded. The reason of the low collection rate is that the irrigation service is quite irregular with poor water management and

defective and deteriorated infrastructures. While, the collection rate of water charge is gradually improved in the YSURA Irrigation Committee as shown in the following figures.

Collection Rate of Water Charge (%)

	1995	1996	1997	1998(target)
YSURA area	37	49	68	80

Note: data obtained by interview to the Committee

Water charges are as follows:

Surface water irrigation area
- Area managed directly by INDRHI RD$ 201 / ha in 1997
  RD$ 160 Pesos / ha in 1996
- Area managed by Water user's association RD$ 287 Pesos / ha in 1997
  (18 pesos / ta)
- Area irrigated by pumped-up water from canals
  a half of the above water charge
- Groundwater irrigation area
  a quarter of the above surface water irrigation area

(c) Yaque del Sur - Lago Enriquillo Irrigation Districts

The collection rate of water charge is very low about 5 to 10 % only. Water charges are as follows:

Yaque del Sur Irrigation District
- Plantain and upland crops : RD$ 160 / ha up to 1 ha
  RD$ 320 / ha for acreage over 1 ha
- Paddy RD$ 320 / ha up to 1 ha
  RD$ 640 / ha for acreage over 1 ha

Lago Enriquillo District (former Neyba Irrigation Zone) RD$ 110 / ha

3.5.3 Present Water Distribution and Maintenance

(1) Basin Water Distribution

(a) Basin water distribution operation

The Basin has been largely divided into two basins in present overall irrigation water management. One is a basin belonging to San Juan Irrigation District consisting of irrigation systems served by water of Sabaneta Dam and the San Juan river and its tributaries. The other is a downstream basin of the Yaque del Sur River and Sabana Yegua Dam including Azua Irrigation area benefited by the river system. Water management is carried out independently in each of these basins.

In order to coordinate and program the distribution of surface water resources of the Yaque del Sur river including those stored in the Sabaneta and Sabana Yegua dams to the irrigation zone of San Juan, Azua, Yaque del Sur - Lago Enriquillo, a committee is organized with 10 members; five (5), each from INDRHI head office and San Juan, Azua, Yaque del Sur, and Lago Enriquillo Irrigation District offices and four (4) of farmers' representatives and one from sugarcane company CEA as follows:

The member of the Committee will be:

- The person in charge of Waters and Soils Units of San Juan Irrigation District.
- The person in charge of Waters and Soils Units of Valle de Azua District.
- The person in charge of Waters and Soils Units of Yaque del Sur River District.
- The person in charge of Waters and Soils Units of Lago Enriquillo District.
- Irrigation District Department Director or the person in charge of Waters and Soils Division, INDRHI Headquarter.
- A farmer's representative of Azua Irrigation District.
- A farmer's representative of Lago Enriquillo Irrigation District.
- A farmer's representative of Yaque del Sur Irrigation District.
- A farmer's representative of San Juan Irrigation District.
- A Barahona sugar refinery representative .

This committee is to be held monthly and could be more frequently in case of drought or water poverty in accordance with the rules of the committee, but actually be held twice a year in a normal year or bimonthly in a drought year. This committee is responsible for the operation of the basin water distribution coming from dams and rivers as well as review, establishment and/or formulation of the policies and standard for the operation of the irrigation systems.

Prior to the committee, each Irrigation District Office discusses the cropping program, then estimates irrigation water requirements and make a draft irrigation schedule in collaboration with farmer's representatives, the Irrigation Committees and CEA. When it is forecasted in advance to be drought and the dam storage volume is small, the Irrigation District Department will instruct the availability of water resources in advance so that each Irrigation District Office can make an irrigation program in consideration of the water availability.

Immediate after conclusion in the committee, a joint committee of INDRHI and CDE is held to place the irrigation program as well as others concerning the operation and maintenance of the dam and hydropower plant on the agenda to decide water-release program. The committee is usually held twice a month. Then, CDE informs the water-release schedule to the site offices of Sabaneta and Sabana Yegua dams in

accordance with the decision. Based on the water-release schedule, the site offices of Sabaneta and Sabana Yegua dams regulate the outlets of the dams.

The water-releasing plan is made to keep the principle of the priority of the water distribution, which is put in the order of drinking water demands, irrigation water demands, and then hydro-power demands.

The reservoir water level of Sabaneta and Sabana Yegua dams is reported daily from the respective site offices to Division of Soil and Water Management in Irrigation District Department by telephone or radio. Data of the river water level is informed from Villarpando, Sabana Alto, Los Guiros, and Conuquito daily by radio as well.

(b) Water diversion at Villarpando to Azua Irrigation District area and Yaque del Sur - Lago Enriquillo Irrigation District area

When available river water is tight against the water demand, the river water is usually divided into the rate of 1 for Azua area : 2 for Yaque del Sur - Lago Enriquillo Irrigation District area at Villarpando Headworks according to the information of INDRHI.

In accordance with this water allocation schedule and in consideration of the current diverted discharge converted from the water level measured at the head of YSURA headrace and daily informed from the site, the Azua Irrigation Zone Operation Unit directs to his site staff to control the intake gate of the Villarpando.

He is directed to regulate intake gates to adjust the canal water level. Division of Soil and Water Management of Irrigation Department is indirectly monitoring the diversion discharge by the daily information, and he instructs the Azua to adjust the diversion discharge, if necessary.

It is noted in this operation that the river discharge is not directly taken into account in the diversion of river water by Azua Irrigation office. Only Irrigation District Department of INDRHI headquarter can take care of river discharge to Yaque del Sur -Lago Enriquillo area and then can instruct the Azua.

Even at a flood time, the intake gates of the Villarpando are not closed due to the heavy burden in the gate operation caused by manual operation and the break of the gates.

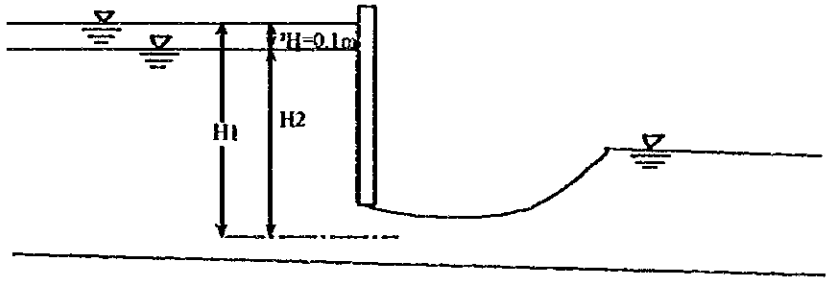
(c) Structural Defective on Water Diversion of Villarpando

The Villarpando headworks is a kind of a diversion structure and so has to fairly divert water between Azua area and Yaque del Sur - Lago Enriquillo area. However from the structural point of view, it is very difficult to fairly divert water due to different type of diversion structures: one is of orifice type and the other is of overflow

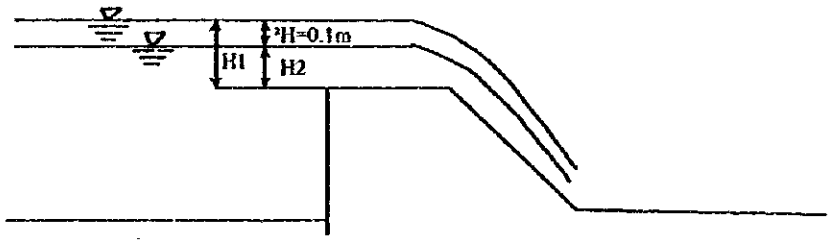
type. Water to Azua area is diverted through sluice gates and water to Yaque del Sur - Lago Enriquillo area flows over the fixed weir.

The former type is insensitive against the variation of water level and the latter is sensitive against that. For example, referring to the following figures, even when water head changes by 0.2 m decrease from 2.5 m to 2.3 m, the discharge through the sluice gate decreases by about 4 % only, while in case of the overflow weir like the Villarpando, when hydraulic head above the weir changes by 0.2 m from 0.5 m to 0.3 m, the discharge decreases by about 40 %. It means that the flow to the Azua area is very stable than that to the Yaque del Sur - Lago Enriquillo area. Also very lengthy crest of the overflow weir with shallow overflow depth brings about difficulty of the flow measurement. From this point of view, the Yaque del Sur - Lago Enriquillo area is handicapped.

Orifice Type



Overflow Type



(2) Irrigation System Operation

(a) San Juan Irrigation District Area

Based on the water released program of Sabaneta dam, which is determined by the joint committee of INDRHI and CDE as stated in previous item (1), San Juan Irrigation District office will make a water allocation schedule among J.J.Puello, San Juan and Hato de Padre irrigation systems in collaboration with the water users organization; the Sabaneta Dam Irrigation Committee. The allocation is determined

almost in proportion to the irrigation system areas. Then in accordance with this released program and allocation rate, water is diverted into each system. The Guanito San Juan system is not taken into account in the released amount of the Sabaneta dam, because the system is mostly maintained on the return flows from the J.J.Puello and the Hato de Padre. During the wet season generally all the three systems continuously takes water from the San Juan river. In the dry season, when reservoir storage decreases, rotation of water diversion is made among the three systems. Of 14 days, 8 days are allocated to the J.J.Puello to take water from the San Juan river and 6 days are allocated to the group of the Hato de Padre and the San Juan. In ordinary drought, amount released from the dam is usually 8 m3/sec for 18 hours and 1 m3/sec for the remaining 6 hours. Further in the severe drought, it is limited to only 6 m3/sec for 14 hours and 1 m3/sec for 10 hours. Usually, the former is applied in the drought season; March and April and the latter is applied, if it is severe and continued till reservoir storage is restored at a certain level. The "normal drought" and the "severe drought" are not clearly defined and there is not a definite operation rule of the dam according to INDRHI.

In accordance with the water management of the three system heads, the respective irrigation systems are managed on rotational basis as well. For example, in the J.J.Puello, rotation is made among laterals or in the laterals or in both. During the ordinary time, the main canal conveys water continuously and rotation irrigation is made in each of five blocks such as first block consisting of small systems served directly from the main canal in the upstream reaches, second block consisting of Lateral 0, 1, and 2, third block of only Lateral 3, and fourth block of LCM, LPC, LPS, and L0+6. During the drought time, the irrigation system is divided into only two blocks such as first block consisting of Lateral 0, 3, L0+6 and LCH and second block of Lateral 1, 2, LPC, and LPS.

The operation of the head gate of each rotation block and the gates to tertiary canals is carried out by a few staff under the manager, who are employed by the Irrigation Committee in collaboration with the Board of Directors and the association chiefs. After the diversion to tertiary canals, management is generally made by farmers themselves in collaboration with the chief of each nucleus.

While the area directly managed by INDRHI, all the control and regulating structures from the headworks to the offtakes to tertiary canals are managed by INDRHI staff. Then after farmers themselves do the water management works.

(b) Azua Irrigation District Area

In the reaches of the head race, INDRHI makes no control of water diversion, farmers are diverting water freely from the head race by pipes installed by themselves all year round even in no water-using period without any payment of water charge. INDRHI is tolerating for a long time. In these years, the head race conveys water at the rate of 12 m3/sec at maximum and 8 m3/sec usually and the discharge at Tabara headworks is smaller by about 2.0 m3/sec than that at the Villarpando and thus it is estimated that much amount of water are taken by the private installed pipes. The

amount of water taken on the way is estimated for 15% to 25 % of the diversion discharge.

In the YSURA area, the main canal conveys water 24 hours all year round and diverts water to all the laterals with no rotation when the canal discharge at the head of the main canal is more than 7.4 m3/sec, but when water is less than 7.4 m3/sec and short against the irrigation demands, rotation of water supply is made between laterals. In case that the main canal discharge is in a range of 7.4 m3/sec to 5.0 m3/sec, rotation of irrigation water diversion to laterals is made between two groups ; Group A consisting of Lateral 1 to 4 and Group B of Lateral 5 and 6 and extension area. Further in case of the main canal discharge is less than 5.0 m3/sec, rotation is made among three groups such as Group A consists of Lateral 1 and 2, Group B consists of Lateral 3, 4, and 5, and Group C consists of Lateral 6 and the extension area. The rotation is made usually every 3 days. No rotation is usually applied in a period from March to September, in which water is usually abundant. Also on the judgment by the irrigation technician in charge rotation is made between tertiary canals located on the upstream reaches and those located in downstream reaches of a lateral except Lateral 2, which is shorter and small and thus in which no rotation is applied.

Small irrigation systems existing along the Yaque del Sur river have only a free intake, which can not control diversion discharge. Water enters into the main canals throughout the year without no regulation and the irrigation areas are generally endowed with sufficient amount of water. A person of INDRHI in charge of water distribution and an operator are assigned for operation of every groups of a few small irrigation systems. The person in charge has to make a simple schedule of irrigation and allocate a date of irrigation for each of farmers. Actually in almost all the year around, a farmer can take water freely at any time. The person in charge has not data of irrigation areas.

(c) Yaque del Sur - Lago Enriquillo Irrigation District Areas

In the more upstream reaches than the Santana intake point, where the most intakes are of free intake type, the same as those in Azua Irrigation District. A person of INDRHI in charge of water distribution and an operator are assigned for operation of a few small irrigation systems. Actually in almost all the year around, a farmer can take water freely at any time. The person in charge has not data of irrigation areas.

While, in the irrigation areas served by the Santana and Vicente Noble headworks and by pumping stations located along the lower reaches of the Yaque del Sur river, farmers and a person in charge of water distribution are suffering in the irrigation water supply during a drought period.

Santana system and the other systems located in the downstream of the Santana alternatively shares a week in 3.5 days each to take water from the Yaque del Sur in drought period. Santana intake is opened from Monday to Thursday' morning. There is no coordination rules except the rule between the Santana and the other

intakes.

The Santana Irrigation System is operated in cooperation between INDRHI and CEA. INDRHI and CEA staff make an irrigation schedule in cooperation. The Santana headworks is operated by four staff; two staff each from both parties. All the canal related structures are operated by CEA. According to the information from Irrigation and Drainage Section of CEA, 130 persons are working in the fields for irrigation practices including water distribution works. As already explained, all the irrigation facilities including control and regulation structures can not be properly operated due to severe deterioration. Thus water diverted through the Santana intake naturally flows down the irrigation canal system from the main canal to laterals and from a lateral to tertiary canals without rotation among canals. Although a rule provides that a half day from 2 A.M to 2 P.M and a half day from 2 P.M to 2 A.M are allocated for irrigation of sugarcane and other crops, respectively, it is hardly possible to realize the time allocation under such physical conditions of facilities.

As for the pump operation, the most importance is reliability of electricity supply. Electric supply is very erratic in these years. From the irregular interruption of electric supply, a person in charge of water distribution can not make an irrigation schedule. The daily operation hour is limited in five to eight hours. As all the pump stations in such limited operation period, when electricity is available are simultaneously operated, river flow suddenly decreases and the water level lowers. Due to the draw-down of river water level, pumps, of which most are of volute type sometimes encounter difficulty to lift water up . In order to maintain water level, a temporary weir made for example by sand bags is built. On the contrary, when the electric supply is shut down, the river water increases as water level rises and flows out to the sea without effective use. Shortage of pump spare parts is also the other problem. INDRHI or beneficiaries do not pay the electric charge to CDE. While, CDE does not pay amount for using facilities managed by INDRHI for hydro-power generation.

(3) On-Farm Level Operation

(a) San Juan Irrigation District area

In the area managed by water user's organization for water management, a chief of nucleus makes a irrigation rotation schedule among the members' farms in consideration of the kind of crops and cropping areas in accordance with overall irrigation schedule in the lateral system. The chief, the assistant and the concerned farmer distribute water in accordance with the schedule. According to the interview survey to farmers, farmers sometimes encounter the difficulty to obtain irrigation water. A farmer whose farm is located in the downstream reaches is sometimes obliged to carry out hard works like closing of offtake gates located in the upstream long reaches to lead water to his field, since no water sometimes flows down to his farm point even at the scheduled date.

In the area directly managed by INDRHI, a staff in charge of water distribution

releases water from laterals or sub-laterals to tertiary canals in accordance with an irrigation schedule, and farmers take water from field canals or directly from a tertiary canal to their fields.

Judging from the interview to farmers, most of them practice irrigation application at night as well as daytime, but they said they did not want to work at night time. Some farmers say they give water to upland crop fields in daytime and paddy fields in night time, because night time water supply to paddy fields little needs water management.

Beans and paddy crops are dominant in the San Juan area. Beans fields are irrigated by furrow irrigation method. First irrigation is applied in bean fields in the period between plowing and planting. Irrigation interval ranges from 8 days to 15 days. Paddy fields is located in the low-lying flat basin and irrigated by ponding method with continuous water supply.

In the irrigation system benefited by San Juan river and Sabaneta dam, paddy planting is prohibited in the dry season period from November to April by INDRHI due to the insufficient water, however, fields planting paddy can be seen actually and can not be controlled by INDRHI.

(b) Azua Irrigation District area

A small canal system including earthen tertiary canals are operated by a nucleus. A chief of each group makes an irrigation rotation schedule adjusting the requests of irrigation water from the members. The member shall arrange and maintain canals so as to properly convey water to his fields and upon the completion of irrigation, he is requested to arrange water way so that water goes to next area to be irrigated.

Furrow irrigation method is generally applied in upland fields. In the surface irrigation method, the irrigation rotation interval is generally 8 day to 12 day. Irrigation period is normally 12 hour to 1 day depending on the irrigation area and discharge. Night irrigation is also practiced according to the farmers interview, but as the same as San Juan, they do not want work at night time. Actually at night time water management in upland crop fields is difficult in the dark.

Some of large scale management areas are irrigated by drip irrigation method in tubewell-developed area in the western part of the Azua plain.

(c) Yaque del Sur - Lago Enriquillo Irrigation District area

In the more upstream reaches than the Santana intake point, where the most intakes are of free intake type, water enters into the main canals throughout the year without no regulation and the irrigation areas are generally endowed with sufficient amount of water. While, in the irrigation area served by pumping station located along the downstream reaches of the Yaque del Sur river, farmers and a person in charge of water distribution are always suffering in the irrigation water supply from the

irregular interruption of electric supply. Even if they made a schedule, they can not keep it.

In the sugarcane fields managed by CEA, employees of CEA manage water distribution. Sugarcane is irrigated by furrow irrigation method at 15 days to one month interval. Irrigation is practiced at daytime only and irrigation water is wasted during night time without utilization and/or with water-logging. The irrigation application efficiency seems to be very low.

In the other than the sugarcane fields, farmers are informed from the water distribution technician of INDRHI the date of water delivery to their fields. According to this information, farmers are working for water distribution in their fields. But the irregular interruption of electric supply sometimes disturb field irrigation practices. Plantain fields are irrigated by basin irrigation method about once a month. Fields planted with tomato are irrigated by furrow irrigation method at 10 to 12 days interval.

In case of plantain which is dominant perennial crop in this zone, farmers prefer to supply water to the fields at night time since plantain falls down due to soil-softening with water and by strong wind prevailing at daytime.

Women participation to farming practices are limited at the planting and harvesting times. Major farmers usually employ workers for water distribution. The employment fee is generally 80 pesos with meal to 100 pesos in daytime work and about 150 pesos in night time work in all the zones.

(4) Maintenance and Repairing of Irrigation and Drainage Facilities

(a) Data availability in Irrigation District and Zone Office

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

(b) Maintenance and repairing

It generally looks that maintenance works are little executed in all the irrigation systems in the Study Area.

Major canals and the related structures have to be maintained by Irrigation District Office or by water users organization, if the organization exists, in principal. It is, however, actually little carried out by the water users' organization except a

minor routine works and it is difficult for him to carry out maintenance works, since the budget is limited due to low collection rate of water charge. When repairing is needed, the organization asks to the Irrigation District Office, who has equipment. Such a situation is expected to be gradually improved with increase of collection rate so that routine and regular maintenance works are fully entrusted to the users' organization.

Irrigation systems directly managed by the Irrigation District offices also have not been maintained well. Especially most of the metal works are left with no lubricant and get rusty with little maintenance. Only one or two times a year, Irrigation District office carries out minor maintenance works such as canal cleaning, removing sediments and debris in major canals by manpower employing at 80 pesos/day. This minor works took 1.2 million pesos in 1997/98 in Yaque del Sur Irrigation District, however, major maintenance works such as painting, repairing or replacement of gates, repairing of concrete works and canal reshaping are rarely carried out due to lack of budget.

In the Santana irrigation and drainage system, it seems that CEA almost gives up the maintenance of facilities because of little budget. Only some of almost ruined gates are maintained with lubricant.

Inspection roads, which are provided along main and lateral canals can hardly be utilized in some of sections, for example, the inspection road of the YSURA head race in the downstream half and the most upstream portion and the road of the Santana main canal, since bushes are densely growing and also some of them due to muddy conditions in the rainy day.

Small canals are maintained by farmers. They are almost left with little maintenance works, which are resulted in the insufficient carrying capacity and impeding water delivery through shallow canal depth caused by both erosion of canal banks and sedimentation in the bottom and weeding inside the canal. Tertiary and quaternary canals composed of elevated flumes or concrete lining in J.J.Puello canal system area were constructed with good quality of works, but have residue in the some reaches of their canal bottom, although the residue is not much. It consists of mud and stones and often provides dens to snails, which may carry water-born diseases. It can be actually seen that many snails exist behinds stones of residue even in the lining or flume canals. They are easily removed from the small canals by man power. It is expected that farmers recognize the worth of water and carry out the routine maintenance works such as weed removal, sediment clearing and canal-reshaping by communal operation of beneficiaries.

In Yaque del Sur Irrigation District, pumping stations and pumps are maintained well in each by an operator and a watchman. They are carrying out the operation of pumps and regular maintenance.

3.5.4 Present Overall Irrigation Efficiency and Water Requirements

This section presents the irrigation water requirements estimated under the present irrigation condition.

(1) Net irrigation water requirements

(a) Calculation

Net irrigation water requirements are calculated as follow:

(i) Potential evapotranspiration (ETo) is estimated by the modified Penman method from the complete sets of climatological data of San Juan, Jimani, and Barahona obtained from Oficina Nacional de Meteorologia. These ETo are attached in Table 3.5.3 and the results are shown as follows:

Potential Evapotranspiration estimated by Modified Penman Method

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
San Juan	4.1	4.8	5.4	5.7	5.6	5.9	5.9	5.8	5.1	4.5	4.2	3.8
Jimani	4.7	5.3	5.9	6.1	5.8	6.6	6.9	6.6	5.9	5.0	4.4	4.4
Barahona	4.8	5.4	6.2	6.4	5.9	6.0	6.7	6.4	5.6	4.9	4.7	4.6
Average of Jimani & Barahona	4.7	5.4	6.1	6.3	5.9	6.3	6.8	6.5	5.8	5.0	4.6	4.5

ETo estimated by San Juan data is used for San Juan Irrigation District area. Averages of Jimani and Barahona are used for Azua Irrigation District area and Yaque del Sur - Lago Enriquillo Irrigation District area.

(ii) Calculation of consumptive use of water, which is a product of ETo and crop coefficient. Crop coefficients of perennial crops like plantain, banana, papaya, coconuts etc. and crops occupying small area are estimated at constant in 0.8 as an average. Crop coefficients of short growing crops like paddy, beans, maize, etc. and sugarcane are estimated from cropping patterns developed by actual growing period and season with their monthly cropping acreage. Crop coefficients are derived from " Crop Water Requirements" No. 24, FAO.

(iii) In case of paddy, water for land preparation and percolation loss are added to the consumptive use. They are estimated at 300 mm and 5 mm/day, respectively.

Percolation loss was measured in the paddy fields in the Lateral B of the San Juan system. The results are shown in Table 3.5.4. The percolation rates obtained are 15 mm/day and 19.0 mm/day. The paddy fields we carried out experiments are located in rather steep topography. According to the PRODAS, percolation rate of 0.5 mm/day is applied in

the canal design. It is, here in this estimate, assumed 5 mm/day in the estimate.

(iv) Effective rainfall is supposed to be simply 65 % of total rainfall.

(b) Results

The net irrigation water requirements estimated under the present irrigation condition are shown in Table 3.5.5.

(2) Irrigation efficiency and Irrigation Water Requirements

(a) Irrigation efficiency

Irrigation efficiency is generally presented by the product of conveyance efficiency, field canal efficiency, and application efficiency. Referring to "Crop Water Requirements" No.24, FAO and considering the canal and field conditions, and irrigation practices, these efficiencies are assumed as follows:

(i) Conveyance efficiency

- Large irrigation system

Lining canal : 0.9 for other than the following systems
: 0.85 for J.J.Puello system
: 0.8 for YSURA conveyance system to YSURA area

YSURA Head Race and main canal system is the longest system in the Yaque del Sur Basin. In 15th January and 6th February 1998, canal and river flow measurement was carried out on the YSURA Head Race and the Tabara intake. The results are shown below:

	Jan.15	Feb.6	
Discharge	9.0 m3/sec	6.9 m3/sec	at the intake of Villarpando
	7.5 m3/sec	5.1 m3/sec	at Los Toros
	6.5 m3/sec	4.0 m3/sec	at Tabara intake

From the YSURA head race, water was being diverted through many small pipes to the area of 1,100 ha. Assuming that 1 m3/sec were being diverted at those measurement times in accordance with the irrigation water demands estimated as shown in Table 3.5.5 (7/15), the conveyance efficiency of the YSURA was determined 0.8.

J. J. Puello also runs long distance in the hilly area. Considering it, the conveyance efficiency is assumed to be 0.85.

Earth canal : 0.8

- Small irrigation system: 0.9

Small irrigation systems directly diverted from rivers has a small length of conveyance system, but the canal often runs the riverine plain composed of pervious soils. Considering such a situation, 0.9 is taken.

Pump irrigation systems located in the downstream of the Yaque del Sur river, conveyance efficiency is neglected in consideration that the conveyance efficiency is included in the field canal efficiency.

(ii) Field canal efficiency

Lining canal	: 0.8
Earth canal	: 0.75 in San Juan zone and small irrigation system taken from YSURA Head Race
	: 0.7 in Azua YSURA area and Yaque del Sur- Lago Enriquillo areas

The field canal efficiency is determined considering operation loss and seepage loss. The Study team measured seepage losses from small earth canals in the Santana irrigation systems by ponding, using a dial gauge and a float. The results are shown in Table 3.5.6 and summarized below:

Small Canal Seepage Loss

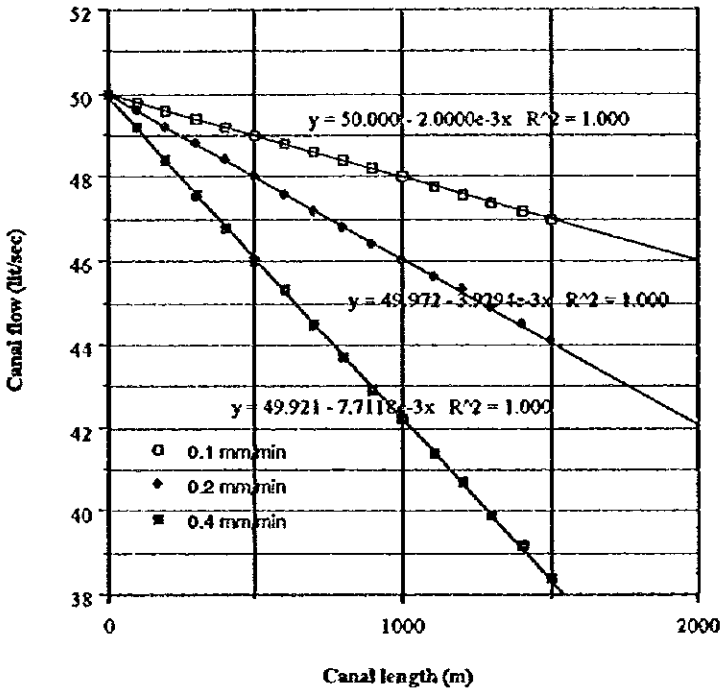
Location of canal	Seepage Loss (mm/min)
Field canal of Lat.H, near Mena	1.00
Field canal of Lat.A, near Quisquella town	0.26
Field canal of Lat.D, near Bomba de Agua town	0.093
Field canal of Lat.D-1, near Santa Maria town	0.25

Then they were compared with basic intake rates obtained from INDRHI as shown in Table 3.5.7. It indicates that the seepage rates from earth canal wetted perimeter are almost the same as the basic intake rates.

Then , seepage losses of a small canal are estimated on the assumption that the bottom width is 50 cm, side slope is 1.5 : 1 and the roughness coefficient is 0.035, the canal gradient is 1/500, and the initial flow is 50 lit./sec at the seepage rate of 0.1 mm/min, 0.2 mm/min, and 0.4 mm/min.

The results are summarized below.

Conveyance Loss from Small Earth Canal



Seepage Loss in % for Initial Flow 50 lit./sec

	Canal Length in meters		
Seepage Rate	500 m	1,000 m	1,500 m
0.1 mm/min	2.0	4.0	6.0
0.2	4.0	7.9	11.8
0.4	7.9	15.6	23.2

Basic intake rate average
in irrigation area in San Juan Zone : 1.2 cm/hr, 0.2 mm/min in Manejo 9 and 10,
of which area largely occupies.
in Azua YSURA area : 2.5 cm/hour, 0.42 mm/min
in Yaque del Sur - Lago Enriquillo Irrigation District area (Santana area)
: 1.6 cm/hour, 0.27 mm/min

Assuming that the basic intake rate is almost equal to the canal seepage rate, the seepage loss from earth canals in the San Juan Irrigation District area is estimated to be 8 % in the field canal length of 1 km. Similarly, it is estimated to be 16 % in the Azua YSURA area and 16 % in the field canal

length of 1.5 km in the Yaque del Sur - Lago Enriquillo Irrigation District area. In addition to each of these seepage losses, an operational loss is supposed to be 15 %.

(iii) Field application efficiency

Upland-field	: 0.5 without water users organization
	0.55 with water users organization
Paddy	: 0.7

The above efficiencies are almost those obtained under the condition that the water management is properly carried out in the fields. As vertical percolation losses in paddy fields are already incorporated in the net irrigation water requirements of paddy, the high efficiency is adopted for paddy.

According to the " TOMO 4: Anexo C of Estudios de Factibilidad Y Disenos Finales del Area de Influencia de la Presa Sabana Yegua", INDRHI, 1984, the average application efficiency was in a range from 30 to 45 % in Azua area. Also the On-Farm Water Management Project (PROMAF) has estimated the application efficiency at on-farm level in a 35%. Basically the actual field irrigation practices have not been improved so much since such studies were made. In the sugarcane fields, the water flows in the field canals and enters into sugarcane fields, but without proper water management especially in the night time, water is stagnant in and near the inlet portion and the downstream part is remained dry without water. In such a situation, field irrigation efficiency is assumed to be very low. It is also difficult to properly manage irrigation water during night time. It is actually often neglected and much amount of water is wasted according to the information from INDRHI.

Based on the above considerations, the irrigation efficiency is determined as shown below. Irrigation Efficiencies are in a range from 0.28 to 0.40 for upland crops and 0.42 to 0.50 for paddy.

Irrigation Efficiency for Estimate of Present Irrigation Water Requirements

Irrigation Zone / Canal System	Kind of Field	Efficiency: Conveyance	Field canal	Field application	Project
San Juan Irrigation District					
J.J.Puello	Upland crop	0.85	0.8	0.55	0.37
	Paddy	0.85	0.8	0.7	0.48
San Juan	Upland crop	0.9	0.75	0.5	0.34
	Paddy	0.9	0.75	0.7	0.47
Hato de Padre	Upland crop	0.9	0.8	0.55	0.40
	Paddy	0.9	0.8	0.7	0.50
Guanito S. Juan	Upland crop	0.9	0.75	0.5	0.34
	Paddy	0.9	0.75	0.7	0.47
Other small system	Upland crop	0.9	0.75	0.5	0.34
	Paddy	0.9	0.75	0.7	0.47
Mijo	Upland crop	0.8	0.75	0.5	0.30
	Paddy	0.8	0.75	0.7	0.42
Azua Irrigation District					
YSURA H.R	Upland crop	0.9	0.7	0.5	0.32
YSURA area	Upland crop	0.8	0.7	0.55	0.31
	Paddy	0.8	0.7	0.7	0.39
Area A1	Upland crop	0.9	0.7	0.5	0.32
	Paddy	0.9	0.7	0.7	0.44
Yaque del Sur - Lago Enriquillo Irrigation Districts					
Area B1	Upland crop	0.9	0.7	0.5	0.32
	Paddy	0.9	0.7	0.7	0.44
Area B2	Upland crop	0.8	0.7	0.5	0.28
Area B3	Upland crop	0.9	0.7	0.5	0.32
	Paddy	0.9	0.7	0.7	0.44
Area B4	Upland crop	-	0.7	0.5	0.35
	Paddy	-	0.7	0.7	0.49
Area B5	Upland crop	-	0.7	0.5	0.35
	Paddy	-	0.7	0.7	0.49
Area B6	Upland crop	-	0.7	0.5	0.35
	Paddy	-	0.7	0.7	0.49

YSURA H.R : a group of small areas directly derived water from YSURA Head Race by private pipes.
Area A1 : irrigation area in the reaches from Villarpando to Los Guiros up (Azua Irrigation District Zone)
Area B1 : irrigation area in the reaches from Los Guiros to Santana upstream
Area B2 : Santana irrigation area
Area B3 : irrigation area in the reaches from Santana downstream to Tomate-Mena upstream
Area B4 : irrigation area in the Tomate-Mena system
Area B5 : irrigation area in the reaches from Tomate-Mena downstream to Palo Alto upstream
Area B6 : irrigation area in the reaches from Palo Alto

(b) Irrigation Water Requirements

Irrigation water requirements under the present cropping patterns are summarized in the following table and presented in Table 3.5.5.

Summary of Irrigation Water Requirements in the Area served by the Yaque del Sur River estimated based on Present Cropping Patterns (Unit : MCM)

Irrigation Zone & System	Nov.	Dec.	Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
San Juan Irrigation District													
J.J.Puello	5.3	13.5	14.5	9.4	2.7	2.2	9.4	16.4	12.1	10.1	6.8	4.0	106.4
San Juan	4.1	9.5	10.4	7.3	2.6	1.4	10.9	19.7	15.6	13.0	9.5	5.3	109.4
Hato de Padre	1.0	2.9	3.5	2.4	1.0	0.7	3.6	6.1	4.7	4.1	3.0	1.7	34.7
Ganito S. Juan	0.5	1.3	1.5	0.9	2.1	3.2	4.5	4.6	4.3	3.2	1.5	0.6	28.3
Other small system*	1.4	3.6	4.2	2.8	0.9	0.6	5.4	9.3	7.3	6.2	4.6	2.6	48.7
Mijo	3.5	4.4	5.9	4.2	1.8	1.3	5.3	9.2	11.2	7.9	5.8	4.3	64.8
Vallejuelo	0.7	0.9	0.4	0.1	0.1	0.2	0.2	0.4	0.4	0.2	0.1	0.1	3.6
Total	16.4	36.0	40.2	27.2	11.3	9.6	39.3	65.7	55.5	44.7	31.4	18.5	396.0
Azua Irrigation District													YSURA
H.R	1.4	2.0	2.5	2.5	2.3	1.7	1.3	1.8	2.6	2.0	1.3	0.8	22.2
YSURA	16.0	23.7	24.9	23.6	21.3	21.8	17.8	21.8	23.7	16.6	10.8	6.9	228.8
Total	17.4	25.7	27.3	26.0	23.6	23.5	19.1	23.5	26.3	18.6	12.2	7.7	251.0
Yaque del Sur - Lago Enriquillo Zone													
Area A1	3.1	4.4	5.3	5.3	5.0	3.6	2.8	3.8	5.6	4.3	2.9	1.8	47.9
Area B1	7.6	8.4	9.5	9.5	11.5	10.7	8.9	9.7	13.2	10.6	8.6	7.2	115.5
Area B2	36.5	37.6	39.3	36.0	41.3	37.1	29.7	34.1	49.3	44.0	40.5	36.8	462.1
Area B3	7.5	8.3	9.4	9.4	11.3	10.5	8.7	9.4	12.8	10.3	8.4	7.1	113.1
Area B4	0.9	1.0	1.2	1.2	1.4	1.3	1.1	1.2	1.6	1.3	1.1	0.9	14.3
Area B5	3.7	3.9	4.3	4.1	4.8	4.4	3.6	4.0	5.6	4.7	4.1	3.6	50.7
Area B6	6.8	7.3	8.1	7.9	9.4	8.7	7.1	7.8	10.8	9.0	7.6	6.5	97.1
Total	66.1	71.0	77.1	73.5	84.7	76.4	61.9	70.0	99.0	84.2	73.2	63.9	900.8
Grand Total	99.9	132.8	144.7	126.7	119.5	109.5	120.3	159.2	180.9	147.5	116.8	90.1	1,547.8

YSURA H.R : a group of small areas directly derived water from YSURA Head Race by private pipes.
YSURA area : including the extension area of about 1,140 ha out of 2,275 ha assuming that the half of the area is irrigated.
Area A1 : irrigation area in the reaches from Villarpando to Los Guiros up (Azua Irrigation District Zone)
Area B1 : irrigation area in the reaches from Los Guiros to Santana upstream
Area B2 : Santana irrigation area
Area B3 : irrigation area in the reaches from Santana downstream to Tomate-Mena upstream
Area B4 : irrigation area in the Tomate-Mena system
Area B5 : irrigation area in the reaches from Tomate-Mena downstream to Palo Alto upstream
Area B6 : irrigation area in the reaches from Palo Alto
Location of the irrigation areas is shown in Figure 3.5.2, 3.5.3, and 3.5.4.

3.5.5 Ongoing and Planned Irrigation and Drainage Projects

(1) San Juan Irrigation District Area

(a) PRODAS

In order to execute integrated agricultural and livestock development in San Juan de la Maguana, Proyecto Desarrollo Agricola Sostenible (PRODAS) has been formulated by a local consultant company assisted by foreign experts and IICA under the financial assistance from IDB in 1992. In 1994, a loan agreement with IDB and in 1995 a loan agreement with FIDA were concluded and actual implementation of various projects were launched in 1995. PRODAS is composed of six sub-projects, which are divided in consideration of the scope of works, geographical similarity, support system, and similarity of the projects. They are as follow:

(i) Project for completion of Sabaneta dam

(ii) Modernization of irrigation and drainage systems in the left bank of the San Juan river

(iii) Restoring of land containing salt in the right bank of the San Juan river

(iv) Support projects for social and producing sectors.

- Study of applied technology under the responsibility of Ministry of Agriculture, funds US$ 1,814,052 from IDB.
- Transfer of technology.
- Training sub-project
- Support of village communities

(v) Afforestation and Rural development

- Afforestation in upstream basin
- Conservation of Jose del Carmen Lamirez National Park
- Small communication facilities
- Agro-forestry development
- Land regularization project
- Environmental monitoring project

(vi) Institutional reinforcement

Of the above six sub-projects, the sub-project (i), (ii), (iii) and a part of (iv) are irrigation and drainage projects or the relevant project. These are briefly described as follows:

(i) Project for completion of Sabaneta dam

This project consists of the completion of works which were not completed at the previous construction time and repairing works. Major works are:

- Repairing of concrete surface and construction of air ring for water relief tunnel
- Repairing of energy dissipater
- Construction of rock riprap on the upstream surface of the dam and heightening of dam crest.
- Construction of emergency spillway. etc.

These works are commenced in August 1996, and the works will be completed in 1998.

(ii) Modernization of irrigation and drainage systems in the left bank of the San Juan river

This project is composed of construction and improvement of irrigation and drainage facilities in the left bank of the San Juan river - San Juan irrigation system and the downstream area. By this construction, area of 3,000 ha is to be newly incorporated into the irrigation area.

In this project, a diversion weir is planned to be constructed to obtain water from the Donado and Jinova rivers in addition to the San Juan river. The site is a confluence of both the rivers. The height of the weir is designed to be 14 m. Also, following works are planned:

Pre-casted canal	: 49 km
Concrete lining canal	: 14.7 km
Major drainage canals	: 22 km
Pre-casted concrete flume	: 173 km

Note: data in December, 1997

The tendering to select contractors was completed and the implementation of actual construction works is expected to be soon commenced.

(iii) Restoring of salinized area in the right bank of the San Juan river

As explained in Section 3.5.1, the central depressed area in the middle and lower reaches in lateral 2 and 3 of Jose Joaquin Puello has been gradually deteriorated with saline soil caused by high groundwater table with poor drainage condition since the irrigation was started. In order to restore the area including the surrounding about 5,000 ha, following works are expected to be executed under the supervision of PRODAS.

Improvement of natural drains	: 122 km
Sub-surface pipe drain	: 33 km
Sub-surface pipe drains in plot	: 242 km
and related structures	: 48 drop structures and 36 culverts, etc..

The tendering of this sub-project also was completed and the implementation of actual construction works is expected to be soon commenced.

(iv) Support projects for social and producing sectors- Support of village communities - Reinforcement of existing water users organization

The San Juan irrigation system area is in the jurisdiction of the water users organization; the Sabaneta Dam Irrigation Committee, however farmers have not been organized in the San Juan irrigation area. Following to or in parallel to the construction and improvement of the irrigation and drainage infrastructures as described as the sub-project item (ii) above, PRODAS plans to assist the farmers and the Sabaneta Dam Irrigation committee to organize water users organizations in the San Juan irrigation area including the extension area of 3,000 ha to be incorporated into the irrigation area. Also, PRODAS is now assisting the water users organizations existing in the right bank area of the San Juan river.

(b) PROMAASIR project

INDRHI has a plan to implement rehabilitation and improvement of Mijo

Irrigation system and to organize beneficiaries of the Mijo system into water users organizations in order to implement water management under PROMASIR.

(2) Azua Irrigation District Area

There are several on-going irrigation and drainage projects in the Azua Irrigation Districts such as Amiama Gomez pump-up irrigation project, Biafara irrigation project, Drainage improvement project in Azua plain and groundwater development project in Azua Plain. Amiama Gomez and Biafara projects are now being implemented.

(a) Amiama Gomez project

In accordance with strong request from farmers in Amiama Gomez, INDRHI studied and designed in 1993 and is constructing the irrigation facilities at present with the cooperation and some donations of Peace Corps. It will be completed in 1998. The project aims at the increase of crop production and the improvement of life quality of farmers. The target beneficiaries and benefited area is 53 families and 160 ha (2,600 tarea), respectively. Pump station equipped with two (2) sets of electric pumps, of which one is standby and a pipe line having a length of 800 m and a diameter of 20 inches is being constructed near the YSURA head race to pump up and convey water to Amiama Gomez area. The design discharge is 0.3 m3/sec. At the end of the pipe line, water is received and distributed by an open canal irrigation system. The canal system has 3.8 km in total length consisting of three lining canals having 0.5 m in width and 0.5 : 1 in the side slope. The total construction costs are estimated at RD$ 5.3 millions.

(b) Biafara irrigation project

INDRHI is constructing the irrigation facilities at present. It will be completed in October 1998. The project aims at the increase of crop production and the improvement of life quality of farmers. The target beneficiaries and benefited area is 775 families and 2,000 ha (31,000 tarea), respectively. The project is a gravity system diverting water from YSURA head race to irrigate about 2,000 ha. The canal system consists of one main and four laterals. The main canal has a length of 13 km and a capacity of 2.5 m3/sec. The bottom width is 1.6 m. The height is 1.1 m and the side slope is 1 : 1. The total construction costs are estimated at RD$ 60 millions.

(c) Drainage improvement project in Azua plain

In the majority of the YSURA irrigation system area, drains were not contemplated at the design stage. The most of the drains were constructed later mainly by producers, because drainage problems were generated with over-irrigation by YSURA canal system due to poor irrigation water management with some deteriorated facilities caused by lack of maintenance. Thus, INDRHI carried out studies for definitive improvement plans during the period from 1988 to 1992 for obtaining a financial assistance from the World Bank for development of three areas including YSURA irrigation area. The project aims at the efficient use of limited surface water resources, increase of agricultural production, and improvement of

farmers income. The major scope of works of the project are strengthening of existing water users organization and rehabilitation and improvement of drainage systems in YSURA, consisting of rehabilitation of existing drains 37 km, construction of new drains 31 km, installation of drain pipe 13 km and sub-surface pipe drains 150 km with land leveling of 3,200 ha in net. Total amount of loan is RD$ 525 million for the three areas. At present INDRHI is, however, reviewing the original development plan in the scope of works and upon the reviewing work, the project implementation is expected to be soon commenced.

(d) Groundwater development in Azua plain

Groundwater potential was investigated all over the nation in 1982 - 1983 in Plan Nacional de Investigacion, Aprochamiento y Control de Aguas Subterraneas (PLANEACAS - I) by TAHAL Consulting Engineer LTD. under INDRHI-BID and the Azua plain was identified as a promising zone of groundwater resources. According to the report 1983, available groundwater resources are estimated at 75 MCM/year.

Annual recharge	: 60 MCM
Excess from irrigation and infiltration from canals	: 25 MCM (minimum)
Outflow to the sea	: 5 MCM
Evaporation from soil surface	: 5 MCM
Available resources	: 75 MCM

Even if the excess from irrigation practices and infiltration is neglected, 50 MCM can be utilized a year.

At present a consulting company employed by INDRHI is making investigation in more detail to evaluate the potential groundwater resources in Azua plain as well as Neyba - Galvan zone in Lago - Enriquillo Irrigation District area by the financial assistance of LOME IV. The results are scheduled to be come out in 1999.

(3) Yaque del Sur Irrigation District and Lago Enriquillo Irrigation District Area

There are two on-going small-scale irrigation development projects and a groundwater investigation project in the Study area in Lago Enriquillo District.

(a) Prolongation of San Ramon Canal (AGUACATICO)

In response to the requests from farmers, INDRHI is directly constructing a main canal from the end point of the existing San Ramon canal. The anticipated beneficiaries and land are estimated at about 340 persons and 750 ha (12,000 tarea). The canal is a concrete-lining canal having a capacity of 1 m3/sec and a length of 8.6 km. The total construction cost has been estimated at RD$ 15.4 million. It is now scheduled to be completed in November 1998. Due to a financial difficulty, however, the rehabilitation and improvement works of the existing San Ramon intake and canal have not been scheduled yet. The main canal dimensions are 0.6 m in bottom width,

1.1 m in height, 1 : 1 in side slope. An inspection road having a width of 3 m is provided.

(b) Alto Latuna Agricultural Development Project

The Project canal facilities are being constructed by INDRHI to develop 100 ha (1,570 tarea) in collaboration with farmers-reclaiming area. Water is planned to be derived from the lateral drain of Santana system. The Project facilities are scheduled to be completed in 2000.

(c) Groundwater investigation project

At present a consulting company employed by INDRHI is making groundwater investigation to evaluate the potential groundwater resources in detail in Neyba-Galvan zone as well as Azua plain by the financial assistance of LOME IV. The results are scheduled to be come out in September 1999.

3.6 Rural Infrastructure

3.6.1 Living Environment

The Study area is situated in the zone of the poverty and the condition of the rural infrastructure and the living environment are recognized as one of the lowest in the Country. The inhabitants suffer from not only insufficient housing facilities and amenities but also lack of the basic human needs.

Most of the family in the Area engages in agriculture, of which 51 % live in the rural area and 49 % in the urban area. Housing environments in the rural area are very poor comparing with the urban area. Based on the Census in 1993 for the Study area, housing materials consist of wood (28%), palm tree (28%), soil with palm tree (10%) or concrete / concrete blocks (33%) for the wall, and palm tree (*yagua*) (13%), zinc (65%), or concrete/cement asbestos (22%) for the roof. Drinking water supply to individual houses are limited and not covering whole municipalities. A large number of the farmers are still depending on some point water sources, like perennial streams, rivers or canals etc. Electricity supply is also limited in the Area and not covering the whole municipalities. Even in the electrified area, distribution are not sufficient to individual houses and the beneficiaries suffer from frequent power-cut due to the absolute shortage of electric generation. According to the same Census, some 52% of population in the rural area of the Study area have no water supply system and 49% have no electricity distribution in their houses.

Sanitary situations are also very poor. Drinking water quality is not sufficiently controlled especially in the rural area, though the municipal water supply systems are equipped with treatment plants or chlorination. Meanwhile most of the houses in the rural area lack individual lavatory and the sewerage system nor the domestic rubbish disposal system. They own jointly simple lavatory holes outside surrounded by wooden wall or other simple materials. Due to the lack of efficient system, they are dumping domestic rubbish in the river or other open spaces. Such poor sanitary environments affect health care and living conditions in the Study area. The data of the rural infrastructure in the Census is summarized in Table 3.6.1 and

illustrated in Fig. 3.6.1, which show that the conditions of the rural infrastructure in the most of the municipalities in the Study area is poorer than the national average level, especially in Bahoruco and Barahona provinces and the hilly / mountainous areas in San Juan and Azua provinces.

3.6.2 Roads

(1) National Road Network

The Study area are traversed by a national road network administrated by SEOPC (*Secretaria de Estado de Obras Publicas y Comunicaciones*). The national road system consists of three categories, namely 1) principal national roads (highway) called "*careterra*", 2) secondary and tertiary national roads called "*camino*" and 3) village road called "*Caminos vecinales*".

Route 2 national road (Sanches Road) runs approximately in the center of the Study area from southeast to northwest, originating from Santo Domingo city, linking the cities of Azua, San Juan and further extending to Comendador in the west. Route 2 branches off some secondary national roads of Routes 41, 44, 48 and 50, leading to Constanza, Barahona, Neyba and El Saercado, respectively. The route map of the national road network in the Study area are shown on Fig. 3.6.2.

The primary and secondary national roads are almost asphalt pavement roads of single lane (partly two lanes for Route 2). These roads are recognized to be well maintained in relatively good condition. However, village roads running among the villages and farms and linking the other roads are normally gravel or earth surface and partly asphalt pavement. The maintenance, rehabilitation and extension are carried out by SEOPS for the primary and the secondary roads periodically and occasionally, which are better compared with those work for the third and village roads. At present, rehabilitation program covering the year from 1996 to 1998 are proceeded under the financial assistance of BID. Total length of the national roads within the Study area are summarized below.

	Total Length	Pavement
Primary national roads	225 km	100 %
Secondary national roads	425 km	67 %
Tertiary national roads	310 km	90 %
Village roads	1,018 km	47 %

(2) Rural Roads

In addition to the national roads, a large number of rural roads including farm roads and footpath roads are identified in the rural area. These are all earth roads, mostly constructed by farmers themselves or their communities. The roads are mainly utilized by the farmers for their daily farming activities manually or with small vehicles, tractors, motorbikes and cattle etc. Though the maintenance is being carried out by the farmers or

community according to necessity, the activities is quite limited and hence the condition is recognized to be poor especially with the muddy surface in the rainy seasons and raising of dust in the dry seasons.

(3) Irrigation Inspection Roads and Sugar Cane Feeder Roads

Irrigation inspection roads constructed along the major irrigation canals like the Ysura and the Santana canals are managed and maintained by INDRHI, while sugar cane feeder roads within the sugar corporation area are under the responsibility of SEA. Canal inspection roads are generally attached to only major canals and no roads are found along the secondary or below leveled canals. These roads are also playing an important role for traveling of the farmers and transportation of the farm products and commodities. The maintenance activities are the responsibilities of the respective authorities, however the conditions of theses roads require more frequent maintenance activities in order to facilitate the equipment for the canal maintenance activities such as repairing of canal lining and desilting works in the canals.

(4) Transportation

Public transportation services are operated by only private individual transporters in the Study area under the administrative supervision of OTT (*Oficina Nacional de Transporte Terrestre*). Pick-up tracks are commonly used for the passengers' transportation in the rural area within some short distances (called *"moto-concho"*), while mini-buses or large buses are used for relatively long distances connecting the major cities and to Santo Domingo. Public transportation by motorbikes are also prevailing within the villages.

Bus services to Santo Domingo are daily available and operated 3 ~ 6 trips everyday in most major towns, such as Azua, San Juan and Barahona etc. Transportation fares vary depending on the distance and the conditions of buses (air-conditioned or not, etc.), for example, DR$50/passenger for one-way trip by the air-conditioned bus between San Juan and Santo Domingo.

The farmers travel from their house to the farm on foot or by vehicles, motorbikes, bicycles, horses or donkeys according to the topographic and road conditions and the farmers' economic means. Transportation of farm products from farm to the villages is also made by above means or tractors with trailers, while the ox-cart transportation is not popular in the Study area. The transportation of the farm products and commodities between the villages and Santo Domingo or other major cities are also rely on the land transportation, and other means are not available except one railway system for the sugar cane transportation within the sugar corporation farm. Though there is an international airport at Barahona constructed in 1996, it is used only for special charter flight and not used for normal transportation at moment.

3.6.3 Municipal Water Supply and Water Use

(1) National Water Supply System by INAPA

The development and supply of drinking water in the Study area are mainly the

responsibilities of INAPA (*Instituto Nacional de Aguas Potables y Alcantarillaodos*) for both urban and rural areas under the supervision of SESPAS (*Secretaria de Estad de Salud Publica y Asistensia Social*), while implementation of water resources development and special water supply projects are administrated by INDRHI. Since 1970s, INAPA has put efforts to construct a number of drinking water supply systems of pipe line networks (called "*acueducto*") in the Study area. There are 63 existing systems as shown in Table 3.6.2, which rely their water sources on the river water or groundwater with intake facilities and/or pumps, which supply in principle treated water to the towns and villages in the Study area. The location map is shown in Fig.3.6.3.

In addition to the above, INAPA manages 22 water supply facilities operated by windmills (called *"molino"*) and shallow tube wells with hand pumps. Most of the windmills were constructed in 1980's mainly under the foreign aid or INAPA in San Juan and Bahoruco provinces. Shallow tube wells with hand pumps were mainly constructed by NGOs or respective municipalities.

Existing INAPA water supply systems are facing various problems, which are poor maintenance, insufficient discharge capacity against increasing beneficiaries and so on, therefore a large number of the rural peoples are suffering from the lack or shortage of the well treated water supply. Drinking water quality of INAPA system is in principle controlled at 16 treatment plants in total within the Area in accordance with the standard, however some systems have a problem of water contamination due to the lack of maintenance of the pipe lines or shortage of chemicals.

INAPA has various operational and on-going projects and existing plans for the development of the rural water supply as shown in Table 3.6.2 and Fig. 3.6.3. INAPA plan however does not envisage a long term program of works to be carried out in the study area. In addition, INAPA is eager to realize the master plan study to evaluate the development potential of the groundwater in the south-western zone for the drinking water supply projects, which is still awaiting financial assistance for the study .

(2) Rural Water Supply without INAPA System

In the Study area, there are still many communities suffering lack of the water supply system especially in the sparsely populated remote area and hilly area with less accessibility. The villagers out of the INAPA systems (including the INAPA areas where systems are not well functioning) are mainly depending on some point water sources, such as rivers, irrigation canals, springs and shallow wells, etc. It requires daily transportation of water from the source to their houses with the distance of 0 to 2 km or more, of which the heavy task is predominantly performed by women or children. In addition, some villagers rely their drinking water on the pay water which are sold by bottle or supplied by private water tankers.

In the Study area, various kind of activities are performed by NGOs in order to improve the domestic water supply conditions. During the field survey in the field and Santo Domingo, following NGO's activities are identified.

- Dominican Churches Social Service (SSID)
- Foundation for Community Development (FUDECO)

3.6.4 Electric Supply and Consumption

(1) National Electricity Supply System

Electric supply and rural electrification is the responsibility of CDE (*Corporacion Dominicana de Electricidad*), besides development of hydroelectric power stations. INDRHI is the state official responsible of the hydraulic project development from its study through its construction. CDE takes over the plant after construction for its operation. For the hydraulic project with multiple purposes, the reservoir is operated with the program made by a inter institutional committee of CDE-INDRHI.

(2) Electricity Condition in the Study area

The Study area is situated mainly in the south electrical zone of the CDE national grid and partly in the central Cibao zone (Constanza) as shown on Fig.3.6.4. The 69 kV transmission lines, which cover the Study area, run along Route 2 and Route 44 connecting the Sabaneta and Sabana Yegua hydropower stations, Barahona thermal power station and Pizarrete and Barahona transformer substations. One 34.5 kV transmission line is branched out at Barahona station connecting Las Damas hydropower station and supply power to the Neyba area.

There exist four (4) hydropower stations in the Study area consisting three (3) dam projects and one (1) mini-hydropower project constructed without reservoir. The Sabaneta and Sabana Yegua hydropower stations are constructed in 1981 and 1979 respectively. Las Damas station, located out of the Yaque del Sur river basin, is supplying electricity to the Study area. Mini-hydropower stations is located in Constanza. In addition, one thermal power station is exist in Barahona, which is being constructed at moment in 1998. Their inventories are tabulated in Table 3.6.3.

Transformer substations are located in Cruce San Juan, Sabaneta and Las Damas as shown on Fig.3.6.4. A number of distribution lines which mostly run along the national roads are branched out from high voltage transmission line and leach to the individual municipalities.

Power demand in the Area is steadily increasing compared with its generation. Actually, there is commonly power cut-off around 8 hours a day in the Study area due to the power generation shortage. The supply losses including illegal distribution is increasing these years and improvement in supply reliability has not been realized. A improvement program of the transmission and distribution system covering the year of 1996 - 2015 is being performed including rehabilitation and newly construction of the transformer substations as shown in Fig.3.6.4.

(3) Rural Electrification

Electrification in the rural area has not been attained sufficiently. In the Study area,

only 68 % of household is energized, in which 89% in urban area and 51% in rural area. According to the CDE inventory, though most municipalities are electrified, distribution to the individual households are limited. In addition, there area many illegal connection to the CDE distribution line using simple wiring, on which however reliable data and information is not available, hence it affects the proper management and maintenance by CDE.

In order to accelerate the rural electrification since 1970's to early 1980's, INDRHI has made various study under the national policy of the development of mini-hydropower project collaboration with the foreign consultants, however their implementation has not been realized due to the lack of budgetary arrangement. There are some mini-hydropower potential sites are identified, of which details are described in Section 4.6.4.

3.6.5 Hospital

The provision of health care services is the responsibility of the SESPAS (Secretaria de Estad de Salud Publica y Asistensia Social). The health care facility are categorized into 1) provincial hospital, 2) Rural clinic, 3) private hospital and 4) others.

	Azua	San Juan	Baboruco	Barahona
Provincial hospital	1	1	1	1
Rural clinic	29	29	6	23

Provincial hospitals, which are mainly located in only major towns, are generally providing health care services including general consultation, prenatal and baby clinic, examination, treatment, operation, immunization and dental service, etc. On the other hand, zonal office of the SESPAS are administrating the governmental health care activities including health education, family planning, supervision of the drinking water quality, sewerage condition and sanitary inspection etc. Village clinics in principle exist in the main villages and are providing the general medical services. However, most of clinics are actually poorly operated due to lack of budget, vehicles, equipment, medical supplies and drugs. The government, therefore plan to improve such situations.

3.6.6 Schools

The Study area situated in the one of the lowest educational zone according to the government reports. Actually, the ratio of literacy rate are 66 % in the year of 1996 while 79 % of the national average. The Government is keen to raise the literacy rate in the rural area and has accordingly put much emphasis on primary education, on which services are the responsibility of the SEEC (*Secretaria de Estado de Educacion y Cultos*). Education system in the country consists the initial school providing one year program, primary school for eight years and secondary school for four years. In the Study area, there are 424 initial schools and 814 primary schools as shown below.

	Azua	San Juan	Bahoruco	Barahona
Initial school	186	74	105	56
Primary school	218	272	186	135
Secondary school	28	18	7	16

For the above, 803, 3,419 and 814 teachers are allocated for the initial schools, primary schools and secondary schools, respectively. According to the SEEC program, some 12% of school buildings are in bad condition requiring rehabilitation. Most of schools adopt the two or three shift schooling due to the lack of class space. Normally, first shift class start at 8 o'clock in the morning, second shift class start at 2 o'clock and third shift class start at 6 o'clock in the afternoon.

3.6.7 Community Center and Communication System

(1) Community Hall

In the Study area, there exist a number of community halls, most of which are located in the center of some municipalities providing spaces for the villagers' social activities such as various meetings and village level communications. Generally, they are just simple buildings made of concrete block wall with a wide room and are not furnished with special facilities and amenities. In the rural area, community halls are not found but some other place are utilized for this purpose, for example schools, churches, villagers' residences and some open spaces.

(2) Communication Systems

Postal services are provided by IMPOSDOM (*Instituto postal Dominicano*) through the post offices established in the major municipalities. Telephone services are available in most villages, which are provided by two private companies (CODETEL and TRICOM) under the administrative control by the SEOPC. The telephone line networks are traversed covering the Study area, and even in the rural area, telephone services are available except some remote areas. Though the almost villagers do not have telephone set in their house, they are able to access to either the telephone offices or public telephone booths provided in most of the villages. In addition, radio communication system are also prevailing in the Study area. Most of government zonal / district office and some individual private sectors are equipped with the radio communication facilities.

3.6.8 Sanitary Services

In the Study area, there exist four (4) sewerage treatment stations at Azua, San Juan, Neyba, and Barahona, however due to the lack of budget, plants are not fully operated and some are not functioning, while there is no sewerage system in the rural area. Actual situation of existing sewerage treatment station is summarized below. As described in Section 3.8.2, such poor sewerage treatment condition, in addition to the lack of domestic rubbish disposal system, the river water is seriously affected causing the problem of water contamination. On the other hand, other important sanitary service like lavatory sewerage system or septic tank

are not found in the rural area.

3.7. Agricultural Support Services

3.7.1. General

The agricultural support Service system at the national and regional level is depicted in Fig. 3.7.1. This Support Services system is affected by general (macro-economics) and sectoral policies. The setting of priority and budget allocation are decided at the national level and carried out at the regional and local level.

The three main independent State branches are the Congress, the Supreme Court and the Executive (President of the country).

The national budget is submitted by the President to the Congress for approval. Similarly, some initiatives that affect agricultural support services are introduced and sanctioned by congress. This is the case of the economic structural reform initiatives including monetary, fiscal, foreign exchange and sectoral reforms.

The Executive is responsible for implementing and allocating funds to the activities included in the national budget through the different Ministries and decentralized institutions.

In the case of the Study area, agricultural support services are carried out mainly by the Ministry of Agriculture (SEA), the Agrarian Institute (IAD), Agricultural Bank, the Institute for Cooperative Development (IDECOOP), the Special Fund for Agricultural Development and the National Institute for Water Resources (INDRHI).

3.7.2. Extension and research

(1) General

Agricultural research is carried out by the Government through Research centers, Universities and private organizations. The Agricultural Research Department of SEA is responsible for the research policy in the country.

Agricultural research and extension services policies are determined by SEA through the Vice-ministry of Research and Extension. In mid 1980's there was an effort to create a National Research Institute (IDIA) to include all institutions engaged in agricultural research. This institute would operate in an independent basis with its own budget and the active participation of the private sector both in the identification of research needs and funding. Demand for research would come precisely from the private investors and producers.

However, even when the Government created the Institute by law, it never initiated operation due to the resistance from the public sector. Nowadays, The Department of Agriculture Research of SEA is the entity which overseas agricultural research as shown in Fig.3.7.2

Extension services are offered by the Government through the national extension services system using regional offices, zones and area. In addition, there exist specialized institutions such as Fomento Arrocero (rice Development Division), the Tobacco Institute and the General Directorate for Livestock which provide extension services. The extension service systems are shown in Fig. 3.7.3.

(2) Overall Organizational Structures of Research Services

There exist nine agricultural research centers with specific research objectives and regional coverage. In the private sector, the institutions engaged in agricultural research are the Instituto Superior de Agricultura (ISA), Politecnico Loyola, Universidad Autonoma de Santo Domingo (UASD) and Universidad Pedro Henriquez Urena (UNPHU). The Foundation for Agricultural Development (FDA) provides funding for research .

Agricultural Research Center	Location	Res. Activity	No of Researcher	Budget for 1997 (1,000 Peso)
CESDA	San Cristobal	Corn and Beans	34	7,331
CEDIA	Bonao	Rice	13	6,700
CIAS	San Juan	Beans	13	5,337
CIAZA	Azua	Pigeon Peas, Sweet Potato, Plantains, Industrial Tomato	10	2,305
CENATA	La Vega	Appropriate agricultural Machinery	1	260
CENIP	San Cristobal	Livestock	6	815
DUQUESA	Santo Domingo	Seed	15	2852
CENDETECA	San Francisco de Macoris	Cocoa	9	394
CIRESS	Neyba	Recuperation of Salty and sodic Soils	*	*

*means not in operation
Source: Secretaria de Estado de Agricultura Departmento de Investigacion Agropecuaria

Research activities have been neglected by the Government. Research centers have been closed down and an exodus of trained researchers in different technical areas has occurred due to low salary and poor definition of research priorities. The budget allocation is very limited and there is a lack of appropriate laboratory equipment. This in turn has affected the capacity to generate useful research finding and it has reduced the ability to prepare good research proposal to access private and international research funds.

Research efforts have been aimed at increasing production with little regard for sustainable agriculture and the development of technology for irrigated areas. As a consequence, the system has not been able to obtain appropriate answers for the deterioration of soil due to erosion and salinization.

In 1996 the Government allocated RD$30.9 million to agricultural research out which 99% went to pay salaries and only 0.8% to research materials.

As an alternative, the private sector promoted the creation of a research foundation (FDA) to sponsor research to individuals and universities. However, the foundation's resources are limited and can not supply all funding required for the country agricultural research needs.

The extension service is also responsibility of the Undersecretary of Research and Extension. The country is divided in 8 regional offices comprised of 2-3 provinces. Each regional office is subdivided into zones (regularly covering a Municipal District) and then each zone is further divided into subzones and areas. (see chart).

In addition to SEA, there is some extension being done by the Agrarian Institute to the Land Reform Beneficiaries. Some agroprocessing plants and export companies have their own technicians who provide technical assistance to farmers under production contracts (industrial tomato and melon mainly).

Based on information from the public officials, it was found that limiting factors to carry out effective extension services to producers include deficient and scarce mean of transportation such vehicles, motorcycle and bikes, poor definition of plans at all levels (central, regional and community level), and poor work with farmers cooperatives.

As a result, data gathering and technical assistance are very weak in the villages around the Study area. There is not schedule to visit farmers on a regular basis and most times it depends on the worker availability of mean of transport.

Resources allocated by SEA for extension activities in 1996 were RD$14.5 millions representing 0.19% of the total SEA budget for that year. Around 99% of the budget goes to pay salaries and small fraction to training of farmers.

(3) Offices in the Yaque del Sur River Basin

In the Study area there are two regional offices: South office which includes Barahona and Bahoruco provinces and Southwest offices which include Azua and San Juan provinces.

Province	Subzones	No. of Areas	No. of Extension Workers
Azua	Peralta	07	7
	Azua	10	10
	El Sisal	11	7
	Las Yaras	12	8
	Padre Las Casas	12	8
Barahona	Vicente Noble	06	7
	Tamayo	09	12
	Cabral	11	15
	Barahona	12	9
Bahoruco	Neyba	12	12
	Galvan	11	14
San Juan	Sabana Alta	12	10
	Bohechio	04	5
	Pedro Corto	17	11
	Juan de Herrera	16	18
	Las Matas	14	8
	Vallejuelo	07	7
	Arroyo Loro	09	10
Total	Arroyo Loro	192	178

Source: Secretaria de Estado de Agricultura. Departamento de Extension, 1997

The facilities for extension offices in the Study Area is shown in Table 3.7.1.

(4) Research Centers in the Yaque del Sur River Basin

(a) Locations

In the Study area there are two research centers and an experimental station in Barahona. The Southwest Agricultural Center (CIAS) located in Arroyo Loro, San Juan is devoted to do research on red bean mainly. Even though rice is being produced significantly in the area, there is not any kind of research on that crop. The main researcher holds a Ph.D. degree in genetics and plant pathology. There are also two researchers with master degree.

There are two ongoing research projects funded by FDA and the University of Nebraska through the CRSP Bean/cowpea project. Additionally, the center is responsible for the research component of the PRODAS project .

The Center for Agricultural Research in Arid Zones (CIAZA) is located in Azua but was closed down and is now being reopen to do some research on alternative crops. There is not researcher with higher degree and 10 hold bachelor degrees (Agricultural engineers).

In Barahona there is a research extension used only for crop production specially plantain. The Research Center for the Recuperation of Salty and Sodic soils

(CIRESS) was established in 1984 in Galvan, Neyba to develop technology for the vast valley of Neyba. Actually this center is not in operation.

(b) Staffing, Budgets and Facilities

The centers of CIAZA and CIAS show insufficient infrastructure and equipment to carry out the necessary research for crop diversification and generate basic information on appropriate cropping pattern and water usage.

Even when the new administration in trying to strengthen the research capability of the center there has not been appointed good researchers. At present there is not a staff with post baccalaureate degree. Regarding the budget allocated to both centers, resources to fund research comes in spurs and respond to unforeseen events more than to a priority setting system.

In the case of CIAS there is good infrastructure but it lacks of some necessary laboratory equipment. The center consists of a research experimental station of 40 ha, a main building and two greenhouses. In some cases researchers make use of producers farms as demonstratives research plot .

CIAZA lacks laboratory equipment and trained personnel. CIAZA has been engaged in research on Integrated Pest Management (IPM) being funded by tomato processing companies. Since late 1980's, tomato production has been badly affected by the "White Fly" and a germinivirus reducing the productivity of this crop. Efforts have been carried out to reduce its level of infection through integrated pest management practices. Actually the Association of Agroprocessing Companies (AFCONAGRO) provides funding to the Agricultural Research Department of SEA in a monthly base to support research on IPM on tomato in Azua and the Southwest region.

Similarly La Junta Agrompresarial Dominicana (Dominican Agribusiness Council, JAD) provides technical assistance and research funding to Integrated Pest Management Program and livestock activities.

Even when the area surrounding the CIAZA setting is plagued with salinization and drainage problems, there has not been any effort to do research on those topics. In fact part of the land under CIAZA experimental station faces CIAZA drainage problems.

3.7.3. Agricultural Credit

(1) General

Starting in June 1993, the Dominican Authorities adopted a new approach toward banking supervision and regulation. The objective was to increase banking supervision to comply with international standards and improve transparency regarding prudential regulations, accounting and disclosure of information of financial institutions (IMF, 1995)

This reform affected agricultural loans in two ways: first, Interest rate skyrocketed. Since then the real interest rate for agricultural loans (after accounting for inflation) has been higher than 20%/year. Thus the cost of production in agriculture has been negatively affected by the cost of money.

Second, due to the new norm on provisions, loans should be classified according to the debtors payment record and capacity to repay as well as the quality of the collateral backing the loan. Commercial Banks have been reluctant to offer credit to agriculture activities because they have to make higher provisions (higher percentage of outstanding balances) due to the high risk of those types of loans. Most agricultural loans are classified in the Significant Risk (d) and High risk (e) categories which ask for 20% and 40% provision, respectively

(2) Governmental Policy and Programs for Agricultural Credits

Since August of 1996 the Government launched a program to provide credit to the agricultural sector. Some measures taken in that direction were the debt restructuring of farmers with the Agricultural Bank, the State Bank (Banco de Reservas) and commercial banks. Furthermore, the Government channeled RD$300 million through the Agricultural bank to provide new loans to agriculture as well as RD$150 million through the Central Bank's Department of Financing (DEFINPRO). The interest rate for the final user of this latter fund is 14%.

(3) Credits Systems for Agricultural Business

The banking system is supervised by the Superintendency of Banks which establishes the norms of provisioning and limits on lending for the financial institutions.

Most of the financing of agricultural business comes from different sources: The Agricultural Bank, whose funding comes mainly from budgetary allocations from the Government; Commercial Bank, Agroprocessing firms, money lenders and specialized Non-profit Organizations

Most of the Agricultural Bank loans is devoted to the production of rice (55%), Red beans, coffee, garlic, plantain and poultry and cattle raising. In 1996 the amount disbursed by the Agricultural Bank was RD$646.3 million with RD$353.4 million going to finance rice production. (Agricultural Bank, 1997).

Commercial Banks have reduced its participation in agricultural business caused by the new norms of provisioning and the inability of farmer to honor their debts with the banking system. In many cases commercial banks hold producer farms which were used as collaterals, but can not resale them.

Agroprocessing firm usually make financing available for farmers who contract their production with them. Along with the financing, agroprocessing firms provide technical assistance to assure the necessary production for processing.

A significant proportion of the agricultural business financing comes from the money lender because the requisites are less and the money is readily available. Despite its importance, there is no an assessment of the amount of money channeled to agricultural business through this outlet because it is not included in the formal financial system. However, some economists estimate that around 40% of the agricultural business financing comes from money lenders. The interest rate charged by these money lenders is high averaging 20% a month.

Another credit outlet for agricultural business are the specialized non-profit organization which target those farmers who can not get access to the formal banking system. Normally those loans are aimed at small and poor farmers as well as women in rural areas. The interest rate for those types of loans ranges from 18% to 36% annually (1.5% to 3% monthly).

Agricultural loans are mainly issued to cover cost of production. Few financial institutions lend money for long term investment in agriculture. Most of the time the loan has to be paid at the end of the harvest season. In the case of production contracts, the agroprocessing companies deduct the loan from the payment to the producer charging the agreed interest rate.

In the case of money lenders, farmers pay the interest rate every month for the capital at the end of the harvest period. In many cases farmers honor their debts by making payments in kind to the money lenders.

(4) Activities of Credit Services in the Yaque del Sur River Basin

(a) Organization of Credit Services in the Basin

The Agricultural Bank is the credit institution with most presence in the Study area. There are Bank offices in each of the main cities in the provinces of Azua, Barahona, Bahoruco and San Juan. Table 3.7.2 shows the destination and amount of credit provided by the Agricultural Bank in 1996. It is noticeable how the Agricultural Bank's portfolio is concentrated in few crops. For instance, loans are provided for rice and red beans in San Juan and Azua; plantain in Azua and Barahona; coffee in Barahona and Azua and sorghum in Barahona.

The Study area is well served by the financial institutions. There exist provincial branches for most commercial Banks which also provide loans to agricultural business in a lower scale than other type of business. The State Bank (Banco de Reservas) has branches in Azua, Barahona and San Juan provinces.

		Azua	Barahona	Bahoruco	San Juan
1	Banco de Reservas	X	X		X
2	Banco Popular	X	X		X
3	Banco Intercontinental	X	X	X	X
4	Banco Gerencial y Fiduciario		X		X
5	Banco BHD				X
6	Banco Regional Dominicana				X
7	Banco Metropolitano	X			X
8	Banco de Desarrollo del Arroz				X
9	Asociacion Peravia de Ahorros y Prestamos				
10	Asociacion Barahona de Ahorros y Prestamos		X	X	
11	Asociacionn Maguana de Ahorros y Prestamos				X
12	Cooperativa de Ahorros y Credito			X	
13	Banco Continental de Desarrollo		X		
14	Banco Nacional de la Construccion		X		
15	ADEMI			X	
16	Banco Dominicano del Progreso				X

Source: Superintendency of Banks and JICA study Team, 1998.

The industrial tomato production is financed entirely by the agroprocessing firms located in the Study area. In the region operate, Non-Government Organizations which allocate funds to small farmers . Among the most active NGO's, LEMBA, the Foundation for the Development of the South (FUNDASUR), Servicio Social de Iglesias (Social Services of Churches, SSI), World Vision, Fundacion de Desarrollo Dominicano (Dominicana Development Foundation, FDD) and Fundacion salud y Bienestar (Health and Welfare Foundation, FUSABI) provide loans.

3.7.4. Seeds Multiplication

(a) Location

In the Study area, private companies which work on seed multiplication for commercial purposes operate. The main seeds that are multiplied are rice and beans. SEA often makes arrangements with some farmers to produce bean seeds.

Rice and red beans seeds are sold directly by private companies. In some case, farmers keep part of their production as seeds to be used in the following cropping season. Seed materials for plantain, sweet potato, cassava and banana are produced individually by farmers which used them on their plots. (SEA obtains seed materials from farmers and distribute them among farmers free of charge.)

There is no quality control for those seed materials. This is a major problem for the homogeneity of the production and for pest control. Seed materials are transported within and outside the Study area with no regard for disease diffusion. Furthermore, when seed material is used from previous harvest there is not seed homogeneity and usually yield is reduced.

(b) Staffing, Budgets and Facilities

The Center for Agricultural Inputs Sales (CVMA) also offers a variety of seeds such as red beans, sorghum, pigeon peas and vegetables. There are 14 CVMA outlets located throughout the Study area.

In the Study area the extension agents are responsible for the distribution of seed material. They do not produce those materials. They distribute them according to the demand from farmers. Usually farmers go to SEA's office in the area or subzone. The Government allocates resources to acquire and distribute subsidized material among small farmers. In 1996 the funding allocated to this activity by SEA amounted RD$1.8million. There is not reliable data for the Study area but the Southwest regional office distributed 5,400 hundred weight of seed materials among farmers and 5,330 hundred weight in the southwest regional office in 1996.

3.7.5. Agricultural Cooperatives

The number of rural organization is high in the Study area. There are numerous farmer associations and cooperatives. Usually farmer associations are formed among those producing the same type of crops or farmers living nearby in the villages. Most of the associations have no more than 20 members

Most associations are institutionally weak. Based on the Rapid Rural Appraisal it was estimated that the level of farmer's integration and identification with the association's goals are very low. Often an association is created only for short term needs, such as a loan or to get access to funding from an Non- Government Organization, or to ask for land distribution or the construction of irrigation facilities. Once the need is satisfied the association vanishes.

When asked about the benefit of belonging to a farmer association most farmers indicated the ability to get better prices and market access. However, farmers do not used this mechanism to sale their crops.

It was significant the number of association consisted of landless peasant and very small farmers. Those associations were more common in Azua and their main goal is to obtain land for cultivation. Table 3.7.3 depicts a list of main cooperatives and farmer association in the Study area.

In the case of the land Reform Settlement, the Agrarian Reform Institute (IAD) requests land beneficiaries to belong to a production cooperative. This mechanism is used to channel credit, technical assistant and market outlet. Usually an extension agent acts as manager and coordinates actions with a social worker and a training coordinator.

It is noticeable the presence of Non Government Organizations in the Study area. Most NGOs were created and employed technicians who previously used to work in the public sector. Due to the inability of public officers to deliver technical assistance and training to farmers and rural residents, NGOs became the alternative way to provide those services. Similarly, International Cooperation Organization allocate their funding through local grassroots organizations under the premises that those organization are more effective in the delivery of services and they are in close contact with the targeted population.

Those NGOs work mainly on strengthening the institutional capability of farmer organizations and rural organizations specially women and youth. It is also significant that NGOs are engaged in natural resources conservation activities specially in the upper part of the Yaque del Sur Basin. A list of NGOs and their main activities are shown in Table 3.7.4.

SEA provides some assistance to farmers through the Department of Rural Organization. However, the presence in the Study area is limited working with extension agents in training activities to strengthen institutional capabilities.

3.7.6 Settlement

(1) General

The Government has pursued a Land distribution program since 1962. The overall objectives has been to reduce land concentration and make land more accessible to landless peasants.

Since 1962 the Government has gathered 578,682 ha of land and distributed among 95,250 landless peasants. Most of the land distributed were either Government Land (59%) or land bought by the Government (30.44%). The two other sources are donations and through the land quota Law. The average plot was 60 tareas (3.75 ha) to be cropped individually. In 1972, when the Government enacted a group of a law affecting agricultural lands, the collective farm was established. Those settlements evolved into associative farming where farmers divided up the whole plot into individual plots. Farmers still negotiate loans and prices collectively, but each beneficiary is responsible for his/her plot of land.

Up to 1996, land distributed under land reform is considered a familiar asset and the beneficiaries can not sell their plots. There is no definitive land title but only the right to usufruct it.

Land acquired and distributed by the Land Settlement Program is as follows:

Type of Acquisition	Ha
Recuperated Goverament Land	341,654
Land bought by the Government	176,194
Donations	38,973
Law on Land Quota	21,861

Source: Instituto Agrario Dominicano. Boletin Estadistico 1996.

At present, the Government has launched a program to provide land settlements with definitive titles. This effort is aimed at helping farmers to get access to commercial bank's credit and to make land market more dinamic..

(2) Organization in charge of Settlement

The Dominican Agrarian Institute (IAD) is a decentralized institution responsible for land settlement in the country. The institution has 13 regional offices and 10 decentralized projects nationwide.

IAD is responsible for land acquisition and land distribution. In addition it provides technical assistance and ancillary services to the land settlements. Each settlement is served by a technician (usually a agronomist) who act as the settlement manager. He is responsible for technical assistance, obtaining credit and identifying market outlets for production.

(3) The Existing Settlement Programs

(a) Government Policy and Criteria for Settlement

The Government policy framework on land settlements is laid out on the set of Laws enacted since 1962. The beneficiaries should be landless peasants, living within the area, farmers who have been displaced by a public infrastructure (hydroelectric dams, highways) or by natural disasters (hurricanes). In Table 3.7.5, are shown the main land reform law and its purposes.

(b) The Existing Settlement Programs

In Barahona, there is a regional office of which provides services to Barahona, Bahoruco, Pedernales, Independencia and Pedernales provinces.

Since 1962 there have been 72 settlements in the Study area benefiting 6,948 landless peasants in an extension of 113,478 ha. Most of the land used was Government land and land acquired through the quota system. (By mean of law 391 any landowner who benefit from a new Government irrigation facility such as dams and canals, should surrender part of his land as a contribution to the Government). Table 3.7.6 depicts the local land settlement in the Study area by villages.

Land settlements face problems with water availability, salinity and poor water distribution . In average the plot of land was 60 tareas (3.75 ha) out of which only half has access to irrigation water.

(c) Planned Settlement Programs in the Yaque del Sur River Basin

In the village of Quita Coraza the Government plans to distribute 4,000 tareas (250 ha) among 100 landless peasants. In Galvan (Neyba) there is also the possibility of land distribution.