IRRIGATION PRICING AND MANAGEMENT

ANNEX 2

Dominican Republic

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Dominican Republic

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LIST OF ACRONYMS AND ABBREVIATIONS

AEA	Agente de Extensión de Area
AID	Agency for International Development
ASPIRE	Association Para Inversion y Empleo, Inc.
BAGRICOLA	Banco Agricola
C por A	Compaña por Acciones
CADR	Centro de Administracion del Desarrollo Rural (ISA)
CDE	Corporación Dominicana de Electricidad
CEDOPEX	Centro Dominicano de Promoción de Exportaciones
CIAZA	Centro de Investigación Agricola en Zonas Aridas
CNA	National Agricultural Council
COCOPSA	Comite de Coordinacion de Planificacion Sectorial Agropecuaria
CONAPOFA	Consejo Nacional de Poblacion y Familia
DR	Dominican Republic
EEF	Extended Fund Facility
EMESIRE	Estudio para el Mejoramiento de sistemas de Riego Existentes
FAO	Food and Agriculture Organization of the United Nations
FEDA	Fondo Especial Para el Desarrollo Agropecuario
GDR	Government of the Dominican Republic
IAD	Instituto Agrario Dominicano
IDB	Inter-American Development Bank
IDECOOP	Instituto de Desarrollo y Crédito Cooperativo
IICA	Instito Interamericano para Cieucias Agricolas
IMF	International Monetary Fund
INDESUR	Instituto para el Desarrollo del Suroeste
INDRHI	Instituto Nacional de Recursos Hidráulicos
INESPRE	Instituto de Establizacion de Precios
IRR	Internal Rate of Return
ISA	Instituto Superior de Agricultura
mcm	Million cubic meters
NARMA	Natural Resource Management Project
O and M	Operations and Maintenance
OAS	Organization of American States
ODC	Oficina de Desarrollo de la Comunidad
ODESIA	Oficina para el Desarrollo Integral Agropecurio del Valle de Azua
ONAPLAN	Oficina Nacional de Planificación (del Secretariado Tecnico de la Presidencia)

ONE	Oficina Nacional de Estadistica
PRYN	Proyecto Riego Yaque del Norte
PROSEMA	Proyecto de Servicios y Maquinarias Agricolas
SEA	Secretaria de Egtado de Agricultura
UNDP	United Nations Development Program
URPRE	Unidades Regionales de Planificacion Economica
YSURA	Proyecto Yaque del Sur - Azua

CURRENCY EQUIVALENTS

US$ 1.00 = RD$ (Dominican Republic pesos) 1.00

US$ 1.00 = RD$ 3.14 (free market rate as of June 26, 1985)

WEIGHTS AND MEASURES

1 hectare (ha)	= 10,000 m^2 = 2.471 acres
1 tarea (t)	= 0.063 ha
100 hectares (ha)	= 1 km^2
1 kilogram (kg)	= 2.204 pounds
1 metric ton (MT)	= 1,000 kg = 2,204 pounds
1 bushel (bu)	= 28 pounds
1 quintale (qq)	= 100 pounds
1 libre (lb)	= 16 ounces
1 square kilometer (km^2)	= 100 ha
1 millimeter (mm)	= 0.04 inch
1 cubic meter (m^3)	= 1,000 liters
1 liter (l)	= 1.066 quarts
cubic meters per second (m^3/s)	= 1,000 liters per second

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ANNEX 2
Dominican Republic

A. Background

1. Economic background

a. Macroeconomic conditions and policy

The general progress of economic growth in the Dominican Republic (DR) during the 1960s and 1970s was very good. In some years real growth in Gross Domestic Product (GDP) reached 13 percent. (See Tables 2-1 and 2-2 for GDP estimates since 1970.) But all of this began to slow with the steep rise of petroleum import prices in 1978 and came to an end with the precipitous drop in world prices for important Dominican Republic export commodities, especially sugar and ferronickel. Earnings from these two items alone fell from US$ 670 M in 1981 to US$ 350 M in 1982.[1] In addition, during the past four or five years, high interest rates in world financial markets have made foreign credits scarce and expensive. GDP has grown little, if any, since 1982.[2]

A domestic economy slowdown does not necessarily result in a reduction in import demand. Indeed, import demand may rise relative to the slowdown if, as in the case of the Dominican Republic, the domestic currency becomes overvalued. Accompanying any major slowdown is a steady loss in confidence that the traditional exchange rate (1 peso [RD$] = 1 US dollar), reflects reality. However, as long as the Central Bank is willing to sell dollars at the official rate, more and more dollars will be purchased to finance more and more imports. The most immediate (but difficult political) remedy is devaluation. But devaluation is a bitter political pill so it is natural that other stratagems are tried first. These include import quotas on tariffs and restrictions on availability of foreign exchange. Black markets can also develop to relieve some of the pressure of an overvalued currency.

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[1]Inter-American Development Bank, "Dominican Republic Reformulation of Loan 570/SF-DR." Mimeo Document PR-915-Z. Memo to Board of Directors from the Secretary (Washington, D.C.: Inter-American Development Bank, 1984), p. 3.

[2]Instituto Nacional de Recursos Hidráulicos (INDRHI), "Resumen Proyecto de Presupuesto de operacion, mantenimiento y administracion para el año 1985" (Santiago: INDRHI Irrigation District Files, 1983), p. 2.

Table 2-1: Gross Domestic Product by Sector (1970-1982)
(Constant US$--1970 Prices)

Sectors	1970	1971	1972	1973	1974	1975	1980	1981	1982
Crops	232.6	247.0	253.9	279.3	279.1	262.8	296.3	310.3	318.4
Livestock	103.1	107.7	113.7	116.3	118.8	125.3	168.2	179.1	190.6
Transport	104.5	116.3	124.7	140.7	155.0	161.3	199.6	210.1	222.1
Government	152.1	157.8	156.8	157.1	168.6	183.1	277.7	274.7	281.7
Manufacturing	275.4	311.0	336.5	361.3	399.4	428.5	530.2	546.1	563.9
Construction	72.7	103.3	112.7	137.5	141.0	152.6	130.9	132.6	134.7
Commerce	237.6	269.9	308.9	340.3	369.0	385.6	475.6	491.6	506.6
All Other	307.3	334.1	411.1	519.6	549.0	589.6	655.1	692.9	670.8
TOTAL	1485.5	1647.1	1818.3	2052.6	2174.9	2288.8	2733.6	2837.4	2888.0

Source: I. Pazos and G. Reynoso, "Situacion del Riego en Republica Dominicana," Documents B-5 presented at VII Seminario Latin-Americano de Irrigacion, Santiago de Chile, 28 November-2 December, 1983, p. 8.

Table 2-2: Percent of Gross Domestic Product by Sector of Origin (1970-1982)

Sectors	1970	1971	1972	1973	1974	1975	1980	1981	1982
Crops	15.7	15.0	14.0	13.6	12.8	11.5	10.2	10.3	10.4
Livestock	6.9	6.5	6.3	5.8	5.4	5.5	5.9	6.0	6.5
Transport	7.0	7.1	6.9	7.2	7.1	7.1	6.9	7.0	7.3
Government	10.3	9.6	8.6	8.9	9.0	9.0	9.6	9.2	9.2
Manufacturing	18.5	18.9	18.6	18.3	18.7	18.7	18.3	18.2	18.5
Construction	4.9	6.3	6.2	6.7	6.5	6.7	6.8	6.6	6.4
Commerce	16.0	16.4	17.0	17.0	16.9	16.9	16.3	16.4	16.7
All Other	20.7	20.2	22.4	22.5	23.6	24.6	25.1	26.3	25.0
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: I. Pazos and G. Reynoso, "Situacion del Riego en Republica Dominicana," Documents B-5 presented at VII Seminario Latin-Americano de Irrigacion, Santiago de Chile, 28 November-2 December, 1983, p. 9.

Beginning in 1978, the Dominican Republic balance of payments suffered larger and larger annual deficits. Between 1978-83, the total deficit reached US$ 850 million, compared to a small surplus during 1973-77. The deficits have been financed by ever increasing external debt, a large part of which is short-term, high cost, commercial bank loans. Some of these debts were rescheduled in 1982-83 but the debt service ratio is now about 30 percent of GDP, up from 11 percent in 1980.

To some degree, the Dominican Government has utilized several strategies, but in general, imports (and US dollar hoarding) have been allowed if currency purchases have been made in the officially sanctioned "parallel market." Foreign exchange rationing is not new; the premium on the US dollar averaged 8 to 10 percent throughout the 1960s and was 25 percent by the end of the 1970s. The premium in the parallel market reached 200-250 percent in 1984. Consumer prices rose 40 to 50 percent on average, thereby materially reducing real incomes. Aggregate consumption, investment and imports have had to adjust.

Ordinarily, the Dominican Republic public sector is responsible for positive savings of 2 or 3 percent of Gross National Product (GNP). Now the rate is negative. On the one hand, public sector wages and employment rapidly increased at the end of the 1970s and further increases in current expenditures that were built in reached 25 percent per year by 1980. At the same time, receipts barely kept pace with inflation as operating costs of government entities rose to pay for petroleum and food imports which are largely exempt from duties.

Beginning in 1982, the new Jorge Blanco administration introduced emergency measures to reduce imports and public sector expenditures, and to increase revenues. Special drawing rights of US$ 371.25 million Extended Fund Facility (EFF) were negotiated. The EFF permitted restoration of orderly external payments and focused on reduction of the public sector deficit, forcing more and more imports onto the parallel market. Eighty-five million dollars of official imports were shifted to the parallel market, credit expansion of the Central Bank and the Reserve Bank was restricted and Central Bank external payment arrearages were reduced by US$ 100 million.

It has been less easy to satisfy second stage International Monetary Fund (IMF) conditions. The IMF wanted <u>all</u> official imports shifted to the parallel market, further reduction in public sector budget deficits and an overall balance of payments surplus for 1984. The push to the parallel market had a tremendous impact upon Instituto de Establizacion de Precios (INESPRE), which imports rice, the nation's most important food grain. Medicine, baby food, news print, overseas travel, fertilizer and some essential manufacturing raw materials are examples of imports denied access to foreign exchange at the official

rate. But the Government balked at including petroleum. As mentioned, consumer prices rose 40 to 50 percent immediately (some as much as 200 percent). Protests against the inflation erupted in street violence.[3]

A few months ago, the Government of the Dominican Republic (GDR) moved the official exchange rate to the parallel market level, thereby making the de facto devaluation official. A parallel (now officially illegal) market still exists but the premium appears to hover within a few percent of the daily bank rate.

b. The rural and agricultural sector

During the overall growth and industrialization of the Dominican economy in the 1960s and 1970s, the share of the agricultural sector in the GDP decreased from 22.5 percent in 1970 to 16 percent in 1980. (See Table 2-2.) This pattern of a declining agricultural sector is a typical one in development. Ultimately, the sector may contribute 12 or 10 percent. At 16 percent, agriculture remains the third most important sector in Dominican Repubic national income statistics and is an important source of employment (60 percent of the labor force) and food supplies. According to the 1981 census, about 48 percent of the population of 5.65 million live in rural areas and there are about 340,000 farms.

Although some of this relative downward shift is natural and normal, the pace has been accelerated by difficult times for the sector during much of the 1970s and its stagnation since 1980.[4] Exports of sugar, coffee, tobacco and cacao can account for nearly 60 percent of annual foreign exchange earnings, but production of sugar and cacao has been falling since the early 1970s.[5] Sugar plays a key role in the economy not only in terms of foreign exchange generation but also because of the land area devoted to cane, the employment generated and taxes to the government. (In 1974, these taxes represented 21 percent of the central government's current revenue.)[6] Larson has recently calculated that, through 1982, the real prices of six of 14 main crops and animal products had been falling for a number of years. (See Table 2-3.) It will be noted that rice is among the group. But this is a situation that cannot continue for very long unless real costs are falling even faster. Table 2-3 shows that rates of productivity growth (which affect costs) have been good for many crops. At the same time, in real terms, farm gate prices grew very

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[3]INDRHI, "Presupuesto," p. 3.

[4]INDRHI, "Presupuesto," p. 4.

[5]Ibid., p. 4.

[6]D.W. Larson, "The Effect of Price and Credit Policies on Dominican Republic Agriculture." Consultant Report (Mimeo) (Santo Domingo: US Agency for International Development, September 1984).

Table 2-3: Rate of Increase in Production and Real Farm Gate Prices for Selected Crop and Livestock Products (1971-1981)
(percent)

Product	Production	Farm Prices	Wholesale Prices
Milk	2.72	-1.29	
Chicken	9.54	1.38	
Eggs	5.54	-3.39	
Rice	8.99	-1.94	
Maize	4.67	2.64	0.55
Sorghum	18.36	-0.87[a]	
Red Beans	7.60	8.81	2.97
Check Peas	2.14	-0.36	
Coffee	5.51	18.56	
Plantains	-0.05	29.88	12.3
Cocoa	-0.99	23.45	
Tobacco	12.02	-0.03	
Beef	5.15	1.5	
Sugar	-0.10	0.7	

[a]Rate of real price increase for the years 1973-1980.

Source: D.W. Larson, "The Effect of Price and Credit Policies on Dominican Republic Agriculture," Consultant Report to USAID/DR, Santo Domingo, August 15-September 15, 1984, Table 6. (Mimeographed.)

rapidly for some crops through 1981. Information on prices at the wholesale level is limited, but the rates of price growth shown are lower than comparable ones at the farm gate.

In the past, exports such as sugar and ferronickel could be relied upon to finance imports of raw and processed food products not otherwise available in the DR, principally wheat and edible oils. But, as hinted above, the world terms of trade have deteriorated from the DR point of view and the entire economy is under stress while major structural adjustments work themselves out. It appears that the longer run effect of economic policies now being pursued will tend to raise food costs for urban consumers and turn the domestic terms of trade in favor of the agriculture sector in general.

Even if the GDR continues a price stabilization policy on some adjusted basis relative to the past, the mere fact that INESPRE and the country's flour mills now have to pay world prices for grain imports should have the impact of increasing domestic farmgate prices, for rice, maize and other staples. In addition, considerable efforts are being made to lower production cost through education, research and development, and technology transfer[7], especially in the case of irrigated crop production. It seems, therefore, that the economic situation for non-export (and possibly some export) crop producers should improve.

The GDR has a history of heavy intervention in agriculture product and factor markets, mainly to stabilize prices, that tended to achieve that particular goal. Now these policies do not blend with unstable and deteriorating terms of trade for imported inputs and product exports. In the view of USAID representatives in the Dominican Republic, "Public actions on exchange rates and interest rates have discouraged private initiative. As a result, the balance of trade, fiscal revenues, agricultural incomes, rural employment and the nutrition of the poor are all lower than they would have been if a more neutral structure of incentives had existed".[8]

The key government agency for marketing, pricing and trading of agriculture commodities is INESPRE. Authority to control retail food prices is held by Direction General de Control de Precios. Normal commercial wheat imports are handled by Molinos Dominicanos, which is majority-owned by the Government and accounts for 90 percent of domestic flour production.

In addition to price stabilization for basic commodities, there has been a desire to provide food security, especially where rice is concerned. The Secretary of State for Agriculture (SEA) has made increasing rice production at a 6 percent annual rate an explicit

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[7]INDRHI, "Presupuesto," pp. 4-5.

[8]INDRHI, "Presupuesto," p. 6.

policy objective in order to achieve a national goal of self-sufficiency. Other agricultural goals are to raise the nutritional level of poor people, to increase the level and even the distribution of income in rural areas, and to reduce agricultural imports, especially wheat.[9]

Similar goals are often pursued by other developing countries. They require compromise between forces that argue for domestic self-sufficiency and incentive producer prices and forces that argue for low consumer prices to stimulate industrial processing of raw materials and, more especially, to provide low cost food for urban consumers. In practice, the pressures for low urban prices often win out, and farmgate prices do not provide the incentive necessary to achieve the goal of self-sufficiency. In a small, open economy such as exists in the Dominican Republic, there is a direct connection between domestic price policies and trade policy. Any time the domestic currency becomes over-valued there is an automatic tendency to import basic foodstuffs, especially grains. This is what has been happening in the Dominican Republic. The steady, unintended, increasing discrimination against the agricultural sector has been the focus of several recent studies of Dominican Republic pricing policies.[10]

The crop most affected has been rice, which is grown on about 55 percent of all irrigated land in the country. The Dominican Republic has consistently encouraged rice production through programs of credit, agrarian reform, improved technical assistance and ever more access to irrigation water. Although production has responded quite well, the overall goal of self-sufficiency still has not been achieved.

INESPRE effectively has been the monopsony purchaser of domestic production and monopoly supplier of rice consumed. Until very recently, the agency was able to obtain all or part of its foreign exchange needs at the official exchange rate. Sensuar et al, have shown that if the overvaluation of the domestic currency is taken into

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[9]B. Sensuar, T. Roe and D. Green, "An Analysis of Foodgrain and Nature Policy in the Dominican Republic." Report under University of Minnesota/USDA, Office of International Crops and Development Research Agreement F. 58-319R-1-220 (Mimeo) (Santo Domingo: University of Minnesota/USDA, October 1982).

[10]Larson, "Price and Credit Policies"; A. Ortiz, Incentives and Comparative Advantages to the Dominican Republic Dairy Industry. Published MS Thesis (Columbus, Ohio: Ohio State University, 1983); M. Kosters, Price Control Policy in the Dominican Republic. (Santo Domingo: US Agency for International Development, 1984); and Sensuar, Roe and Greene, "Food Grain and Nature Policy."

account, for almost the entire period since 1970, INESPRE has paid more for imported rice in terms of its true cost to the economy than it has been willing to pay for rice from domestic producers.[11]

Export promotion is the cornerstone of the current Government's development strategy.[12] In order to rationalize conflicting agricultural policies and assess the consequences of the more liberalized and market oriented agriculture sector policies being put into place, the National Agricultural Council (CNA) has been revitalized and provided with a policy analysis unit.

Whether these very recent steps will materially affect irrigated agriculture is difficult to say. It has already been implied that INESPRE's new operating environment ought to begin to work to the advantage of domestic rice producers--and rice is the dominant irrigated crop. But traditional export crops other than tobacco have been rainfed, not irrigated. And for most of these crops, Dominican Republic policy makers cannot control international prices for what the country sells or the generally high price of money to finance inputs. Any substantial impact of irrigated production upon exports will, therefore, have to come from "nontraditional" crop sales. By substantial, we mean on the order of US$ 100 to 200 million per year.

In order for numbers of this magnitude to materialize, the country's agriculture must be competitive in world terms. Thus, whether traditional or nontraditional exports are under consideration, the most needed progress in Dominican Republic agriculture is to increase yields and reduce unit costs of production. (This would be the best thing that could happen for domestic production as well, assuming farmgate prices are reasonable).

2. Irrigation development

a. Description of irrigation systems

Much of the arable land in the Dominican Republic is suitable for rainfed agriculture, and most of the balance is near potential sources of irrigation water. With good management of available resources, the country could greatly increase output of crop and livestock products. Much infrastructure is already in place or is scheduled. Thus, technical constraints to agriculture sector development do not seem to be serious at the present time.

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[11]Sensuar, Roe and Greene, "Food Grain and Nature Policy," p. 17.

[12]INDRHI, "Presupuesto," p. 5.

An Organization of American States (OAS) survey of Dominican Republic natural resources identified 14 distinct hydrographic zones in which a striking diversity of conditions was found (Table 2-4). Rainfall in the zones ranges from 510 to 2,700 mm per annum, with total annual stream flow (all zones) exceeding 19 billion m^3. (Also see Figure 2-1.)

Approximately 1.2 million ha, one-fourth of the land area of the Dominican Republic, is suited for cultivated agriculture and a little more than one-half of the latter (710,000 ha) is adapted to irrigation.[13] At present, an estimated 202,000 ha are served by irrigation developments. These lands are found within five main river basins draining 48 percent of the surface area.

These basins and smaller watersheds are drained by 23 rivers, 17 of which flow at average rates above 5 m^3 per second. In total, their estimated discharge exceeds 11,266,520 mm^3, the majority of which ends up in five major river systems: Yaque del Norte, San Juan, Yuna-Camú, Ozama-Nizao, and Yaque del Sur. These data are shown in Table 2-5.

Significant subterranean water resources also exist and are currently exploited as shown in Table 2-6. As may be imagined, the pumping in the various drainages represents one aspect of private development of irrigation.

At present the water demand by various sectors within the five basins has been estimated as shown in Table 2-7. It is clear that actual (and potential) demand is well below the amounts that are reasonably controllable in the five major basins.

Each basin listed in Tables 2-6 and 2-7 contains at least one dam classified as major by the Instituto Nacional de Recursos Hidraulicos (INDRHI), the national agency charged with managing and developing water resources. (See Table 2-5.) Planning for these major dams accelerated during the mid 1950s and construction has been more or less continuous since 1965-68. By 1984, controlled storage had reached about 2,600 mm^3 in five main dams. As yet, the river Yuna has no storage except on one of its tributaries.

The principal irrigated and rainfed crops, the areas they occupy, and their relative values as of 1982 are shown in Table 2-8. These crops occupy about 600,000 ha out of a total of slightly over 1,000,000 ha cultivated. About 300,000 ha are idle at any given time.

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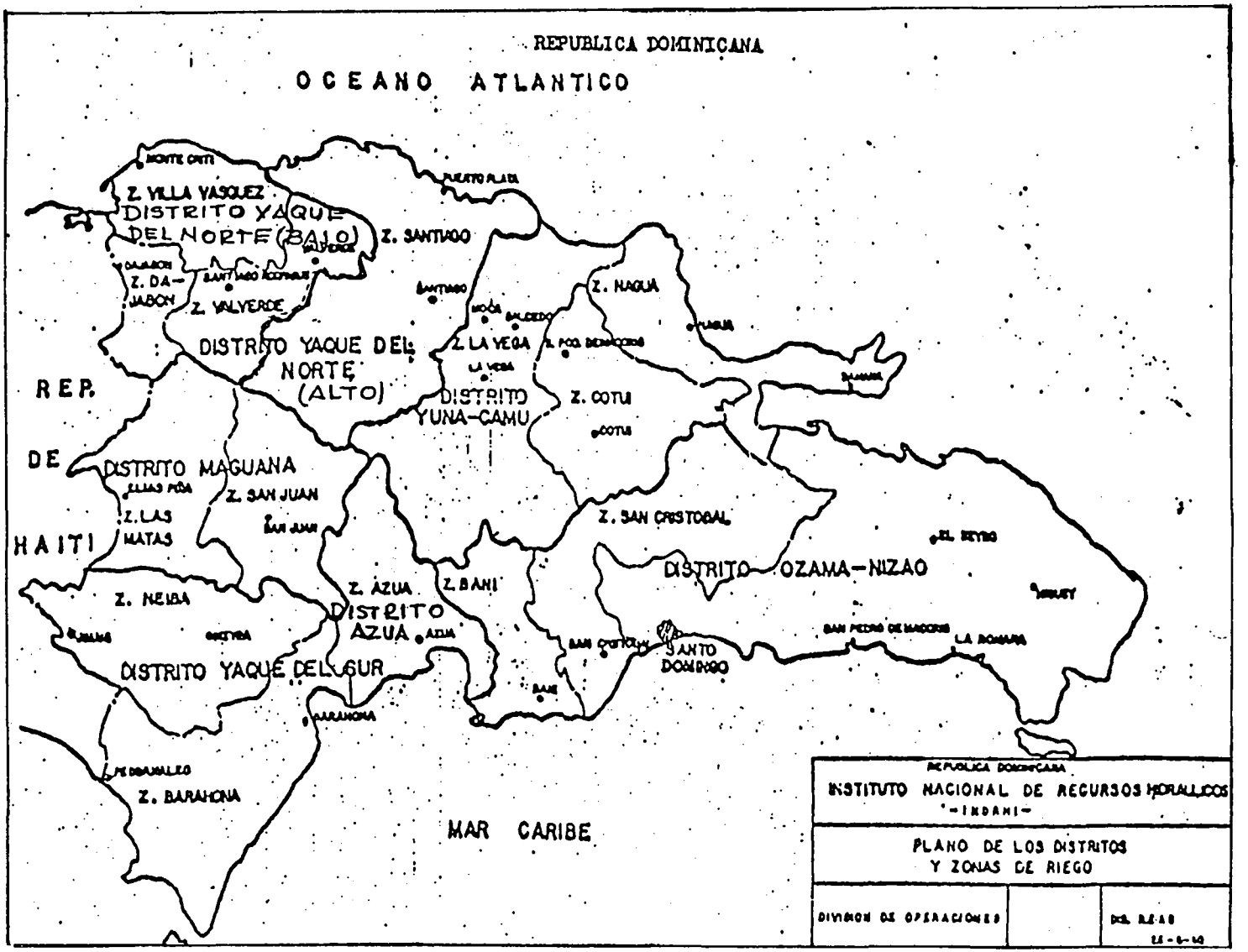
[13] M. Pazos and G. Reynoso. "Situacion del Riego en Republica Dominicana." Documents B-5 presented at VII Seminario Latinoamericano de Irrigacion (Santiago, Chile: 1983), Table 1.

Table 2-4: Surface Water Resources by Hydrographic Zone

Zone	Area (ha)	Annual Rainfall (mm)	Annual Stream Flow (billion m3)
Sierra de Bahoruco	281,400	750-2,000	320
Azua, Bani, San Cristobal	446,000	750-2,250	1,516
Ozama River Basin	270,600	1,400-2,250	1,586
San Pedro de Macoris and La Romana	462,900	1,000-2,250	2,444
Higuey	220,700	1,000-1,750	609
Miches and Sabana del Mar	226,500	2,000-2,700	1,284
Samana Peninsula		n/a	
Northern Coastal Zone	426,600	1,000-2,300	3,870
Yuna River Basin	563,000	1,170-2,250	2,375
Yaque del Norte River Basin	705,300	500-2,000	2,017
Dajabon River Basin	85,800	750-2,000	370
Yaque del Sur River Basin	534,500	700-1,150	1,181
Lake Enriquillo Basin	304,800	600-1,200	312
Artibonito River Basin	265,300	1,200-2,000	1,190
TOTAL	4,793,400		19,074

Source: The World Bank, Dominican Republic: It's Main Economic Development Problems (Washington, D.C.: The World Bank, Latin American and the Caribbean Regional Office, December 1978), Table 14.



IRRIGATION PRICING AND MANAGEMENT: DOMINICAN REPUBLIC

Figure 2-1: Map of Dominican Republic

Table 2-5: Important Rivers and Dams, Volume, Average Annual Releases and Dam Characteristics

River	Basins	Annual Discharge (mm^3)[a]	Average Releases (m^3/Sec)[b]	Dams	Total Storage Capacity (mm^3)	Available Storage (mm^3)	Spillway Capacity (m^3/Sec)[b]
Macasías	Artibonito/Macasías	180.07056	5.71				
Joca	Artibonito Joca	168.08688	5.33				
Nizao	Río Nizao	532.01232	16.87	Valdesia	186.07	128.00	7,200
Artibonito	Río Artibonito	485.33904	15.93				
Yaque del Sir	Río Yaque del Sur	697.26096	22.11	Sabana	401.00	386.00	
San Juan	Río del Sur/San Juan	294.54624	10.44	Sabaneta	78.00	68.00	4,000
Mijo	Río Y. del Sur/Mijo	168.40224	5.34				
Yaque del Norte	Río Yaque del Norte	1457.2786	46.21	Tavera	417.00	251.00	6,000
Mao	Río Y. del Norte/Mao	654.05664	20.74				
Amina	Río Y. del Norte/Amina	303.06096	9.61				
Bao	Río Y. del Norte/Bao	622.836	19.75	Bao	(in conjunction with Tavera)		
Yuna	Río Yuna	1195.2144	37.90				
Payabo	Río Yuna/Payabo	210.34512	6.67				
Jima	Río Yuna/Jima	334.59696	10.61	Rincón	75.5	60.5	390
Chavón	Río Chavón	172.81728	5.48				
Nizaito	Río Nazao	134.974080	4.28				
Jura	Río Jura	39.42	1.25				
Ocoa	Río Ocoa	109.74528	3.48				
Haina	Río Haina	154.21104	4.89				
Soco	Río Soco	317.25216	10.06				
Duey	Río Duey	123.62112	3.92				
Cenoví	Río Yuna/Cenón	42.88896	1.36				
Jaya	Jaya	34.65891	1.06				
TOTAL		11,266.521					

[a] mm3 = billion cubic meters
[b] sec = second

Source: I. Pazos and G. Reynoso, "Situation del Riego en Republica Dominicana," Documents B-5 presented at VII Seminario Latin-Americano de Irrigacion, Santiago de Chile, 28 November-2 December, 1983, Tables 3 and 6.

Table 2-6: Summary of Exploitable Ground Water Potentials
$(mm3)^a$

Basin	Total	Presently Exploited	Additional Potential
Yaque del Norte	45	13	32
San Juan	50	2	48
Yaque del Sur	540	40	500
Yuna-Camu´	225	20	205
Ozama-Nizao	550	170	380
TOTAL	1,510	245	1,265

[a] mm3 = billion cubic meters

Source: I. Pazos and G. Reynoso, "Situacion del Riego en Republica Dominicana," Documents B-5 presented at VII Seminario Latin-Americano de Irrigacion, Santiago de Chile, 28 November-2 December, 1983, Table 4.

Table 2-7: River Basin Water Demand by Sector (mm^3/year)[a]

Basins	Urban	Agricultural	Industrial	Total
Yaque del Norte	39.6	820	11	870.6
San Juan	8.4	148	0.3	156.7
Yaque del Sur	15.8	543	3.9	532.7
Yuna	32.7	533	4.4	570.1
Ozama-Nizao	190.8	79	62.3	332.1
TOTAL	287.0	2,123	82.0	2,492.0

[a] mm^3 = billion cubic meters

Source: I. Pazos and G. Reynoso, "Situacion del Riego en Republica Dominicana," Documents B-5 presented at VII Seminario Latin-Americano de Irrigation, Santiago de Chile, 28 November-2 December, 1983, Table 5.

Table 2-8: Main Crops and Features of Cultivation (1981)

Crops	Areas (ha)	Yield (ton/ha)	Percent of Cultivated (ha)	Value of Prod. (US$)	Percent of Area Cultivated	Av. Water Requirement (m^3/ha)
Rainfed	425,871					
Café	229,063	1.44	17.58	96,073,000		
Cocoa	119,690	0.28	9.13	61,830,000		
Sugar	77,119	6.40	7.71	335,223,000		
Irrigated	188,169					
Rice	94,859	3.004	9.46		50.4	30,000
Sugar	16,432	?	1.64		8.73	20,000
Plantains	12,622	48[a]	1.26		6.7	14,800
Pastures	12,386	-	1.23		6.58	16,000
Tomatoes	4,346	1.3	0.4		2.3	6,200

[a]Measured in hands/ha.

Source: I. Pazos and G. Reynoso, "Situacion del Riego en Republica Dominicana," Documents B-5 presented at VII Seminario Latin-Americano de Irrigacion, Santiago de Chile, 28 November-2 December, 1983, Tables 10 and 11.

The areas irrigated within the country have been surveyed by the Food and Agriculture Organization (FAO) teams, utilizing the methodology described in Resultados y Recomendaciones and Frias Informe Technico #1.[14] Their estimate of the area commanded by irrigation works is 206,518 ha as of 1981. However, part of this area is not actually irrigated for various reasons such as salt build-up in soils, water logging, fallow periods, water shortages, and so on. The number of water users estimated in the FAO studies (43,310) may be compared to the total rural population of 2,712,117 in 1981 (500,000 to 543,000 families). In other words, fewer than 10 percent of rural families benefit from state water.

The number of water users may also be compared with the total number of "exploitations" enumerated in the 1981 census of agriculture (385,060). An exploitation is not necessarily an entire farm; a given family might have several. These statistics suggest that many families classified as living in rural areas do not own land and must earn their living as farm laborers or in ways other than by farming. Some unknown but significant amount of irrigation is carried on without benefit of state water, i.e., water subject to tariff. Thus, irrigators probably account for about 30 percent of all active farmers.

The estimates shown in Table 2-9 have been developed by utilizing the percentages of actual land irrigated and planted, encountered in the FAO surveys of 73 systems.[15] These ratios suggest that the INDRHI estimates (see Table 2-8) of acres irrigated may not include some private developments and probably refer to areas commanded by conveyance features, even some features not in use.

b. Current status of irrigation development

After three years of study with the United Nations Development Programme (UNDP) funding, a recent FAO report recommended ways to improve existing irrigation systems in the Dominican Republic. All systems were studied to some degree and special surveys were

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[14] Food and Agriculture Council (FAO) and United Nations Development Program (UNDP). Estudio para el mejoramiento de los Sistemas de Riego Existentes: Republica Dominicana: Resultados y Recommendaciones del proyecto. Informe Tecnico. AG:DP/ODM/81/012. Preparado para el Gobierno de la Republica Dominicana (Rome: FAO and UNDP, 1984); and M.C. Frías, Metodología EMESIRE. Informe Tecnico No. 1, preparado para el Gobierno de la Republica Dominicana: AG:DR/DOM/81/012 Rome: FAO and UNDP, 1984.

[15] Estudio para el mejoramiento de los Sistemas de Riego Existentes: Republico Dominicana.

Table 2-9: Estimates of Actual Land Irrigated Within the Seven Irrigation Districts Served by State Water Developments

Irrigation District	Est. Area Served (ha)	Est. Area Being Irrigated (ha)	Est. Area Planted (ha)	Total No. Water Users	Coefficient Use of Actual Irrigated Area
Yaque del Norte	59,731	31,589	41,279	6,780	1.31
Yuna-Camu´	45,758	23,092	44,766	8,169	1.94
Ozama-Nizao	29,738	14,365	18,046	5,773	1.26
Valle de Azua	12,615	7,986	15,019	6,261	1.88
Yaque del Sur	36,178	15,802	21,862	8,077	1.38
Valle de San Juan	22,498	13,730	25,127	8,250	1.83
TOTAL	206,518	106,564	166,099	43,310	1.57

Source: Food and Agriculture Organization (FAO) and United Nations Development Program (UNDP), Estudio para el pejoramiento de los Sistemas de Riego Existentes: Republica Dominicana: Resultados y Recommendaciones de proyecto Informe Ag: DP/DOM/81/012, prepared for Gavinno de la Republica Dominicana (Rome: FAO and UNDP, 1984), Tables 1 and 5.

conducted in 73 of them. The experts' diagnosis of the current status of Dominican Republic irrigation development may be summarized as follows:[16]

- There is an incomplete understanding of the possibilities that could be obtained from existing irrigation works. The existing systems have certain infrastructure limitations (and to a lesser degree this applies to rural access roads). An "almost total lack" of drainage in some areas has become critical, causing the build-up of soil salinity;

- The limited availability of human and financial resources causes INDRHI to plan its goals in short-run terms. Operation and maintenance of irrigation systems is deficient and in places does not exist. Institutional coordination between the SEA, BANCO AGRICOLA (BAGRICOLA), and INDRHI appears confused and undefined. The water tariffs do not begin to cover operating costs of the Irrigation Districts;

- The rivalry between irrigated water demands and power generation has a negative impact on irrigated agriculture;

- With few exceptions, the technological level of irrigated agriculture is low or medium. There is minimal technical assistance to farmers in managing water and soils; and

- The hydrologic information necessary to manage systems is of dubious precision.

Similar comments can be found in the Country Environmental Profile[17] and in other sources.[18] It has been noted that at least 16 government agencies are involved in some way with water development and management.[19] Some policies and procedures lack clarity and definition. For example, there may be uncertainty about ditch

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[16]Ibid., pp. 20-21.

[17]G. Hartshorn, et al. Dominican Republic Country Environmental Profile. AID Contract AID/SOD/PDC-C-0247 (McLean, VA: JRB Associates, 1981).

[18]B. Anderson, et al. Project Paper: On-Farm Water Management Project. Draft. Prepared for USAID/DR with support of Science and Technology Bureau sponsored WMSII Project. (Sando Domingo: US Agency for International Development, 1983).

[19]Ibid., p. 9.

maintenance on agrarian reform lands within irrigation project perimeters. Clear-cut lines of authority have not been developed covering priorities of water use.[20]

The commitment of GDR to support agricultural sector development is illustrated by a steadily increasing allotment of funds to institutions such as INDRHI. In recent years, the government has invested over RD$ 500 million in the construction of dams and canals. Programs to settle farmers on irrigated lands owned by the Agrarian Reform Institute have been undertaken and, as mentioned earlier, special efforts have been made to increase rice production.

A result of all this effort has been a steady increase in irrigated area. Table 2-10 gives an indication of the rate of progress in state projects since 1978. At least 100,000 to 125,000 ha have been brought into more systematized networks backed by water storage structures and more regulated conveyances.[21]

There is a need for better management of existing systems and, more especially, better on-farm water management. Output from many irrigated lands is far below potential. According to one claim, it can be doubled.[22]

c. Future irrigation development plans

Between 1978 and 1982, about 6 percent of annual total public investment was applied to irrigation and drainage works.[23]

Currently, six projects are in various stages of execution at a cost of about US$ 150 million by the end of 1985. Of this, US$ 61.59 million has been externally financed.[24] These projects are designed to influence a gross area of 51,050 ha (45,416 net) and supplement current water deliveries by 85 m^3 per second through an additional 420 ha of canals and 73 km of drains. The number of agricultural properties expected to benefit from the new or supplemental water is 20,420 (17,116 users).

In addition, four new projects have been prepared at the feasibility level and are being considered for public financing. If constructed, they would add another 18,480 ha serving 8,700 users at a cost of about US$ 75 million.

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[20]Ibid.

[21]Anderson, PP; On-Farm Water Management, p. 1.

[22]Ibid., p. 11.

[23]Payos and Reynoso, "Situación del Riego," p. 16.

[24]Ibid.

Table 2-10: Trends in Areas Commanded by State Irrigation Systems
(ha)

Regions	1978	1979	1980	1981	1982
Yaque del Norte	38,100	38,100	41,764	41,764	44,683
Yaque del Sur	35,906	35,906	40,419	40,419	49,184
Yuna-Camú	40,230	43,013	43,013	43,926	43,973
Ozama-Nizao	15,051	15,051	15,910	15,935	20,925
Valle San Juan	24,696	24,696	25,375	27,814	28,195
TOTAL	153,980	156,763	166,480	169,856	189,659

Source: I. Pazos and G. Reynoso, "Situacion del Riego en Republica Dominicana," Documents B-5 presented at VII Seminario Latin-Americano de Irrigacion, Santiago de Chile, 28 November-2 December, 1983, Table 12.

Finally, another five irrigation and drainage projects are being studied which would incorporate a further 29,000 ha (net), affect 11,600 users and raise the incremental value of agricultural production by US$ 82 million.

According to Pazos and Reynoso, the overall respective goals for irrigation are to reach 234,350 ha (net) irrigated hectares by the year 1990 and 319,302 ha (net) irrigated hectares by the year 2000--targets that involve only irrigated areas within projects, or within irrigation or drainage districts, which are publicly constructed and managed.[25]

The expected total cost of all this possible construction is not reported by Pazos and Reynoso. However, Anderson et al[26] suggest that as much as has already been spent (i.e., US$ 500 million) could be spent again by early 1990s.

B. National Irrigation Administration and Policy

1. Organization of Irrigation Administration

a. Organizational structure

In terms of overall management of water resources, INDRHI and Cooperacion Dominicana de Electricidad (CDE) are the two most important and interconnected government agencies. INDRHI has statutory authority to manage stream flows from the watershed to the point of delivery on the farm (excepting hydraulic development for urban water supplies); CDE operates the dams that generate electric power. In terms of irrigation water users, SEA and Instituto Agrario Dominicano (IAD) are very important complements to INDRHI. BAGRICOLA and local rural development authorities such as Oficina para el Desarrollo Integral Agropecurio del Valle de Azua (ODESIA) and Instituto para el Desarrollo del Suroeste (INDESUR) also have a greater or lesser impact.

The chief executive of INDRHI must be a trained civil engineer, emphasizing either hydrology or hydroelectricity. Project planning, construction and operation dominate INDRHI's organizational arrangements.

INDRHI tends to centralize power over budget, supplies, and personnel as well as for programs in Santo Domingo. The agency's Planning Office sets policy and it is staffed mainly by civil engineers "who are oriented toward construction."[27] The Department of Irrigation

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[25]Ibid., pp. 17-18.

[26]Anderson, PP: On-Farm Water Management, p. 10.

[27]Ibid., pp. 116-117.

is a relatively new organizational unit.[28] It contains subdivisions for conservation and improvement; operations; and irrigation and drainage.

Irrigation Districts have been established to deliver water through the various systems. Individual farmers or water user groups interact with INDRHI mainly at the district or zone level. According to Anderson, et al, until recently, few of the INDRHI technicians have had formal training in irrigation water management.[29] Only recently have irrigation specialists and agronomists been placed in positions of authority, even for irrigation management functions. In order to obtain some expertise in effective water management at the district level, INDRHI fills many positions with people on interagency agreement with SEA.[30]

SEA is the lead agency for developing the agriculture sector in the Dominican Republic. In addition to having responsibility for coordinating the various activities of all the institutions dealing with the country's agriculture sector, the Secretariat monitors distribution of production inputs and outputs, manages the use of renewable natural resources and promotes production of animal products as well as crops. Other areas of responsibility include research, extension and training.

Although some of these responsibilities relate to water management, the agricultural use of irrigation water has been a secondary concern for SEA.[31]

IAD is responsible for agrarian reform activities. It is a semi-autonomous agency under SEA charged with redistributing land and improving the standard of living of the rural poor. Since its inception in 1962, IAD has had to reorient its operations several times in response to changing national politics and economic problems. A recent orientation has been toward collective asentamientos or farms.[32]

IAD staff have little expertise in on-farm water management and are unable to train, on their own, individual farmers in water management. In fact, many of the decisions on asentamientos are made by encargados (managers) hired by IAD. These specially appointed

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[28]Ibid., p. 117.

[29]Ibid., p. 118.

[30]Ibid.

[31]Ibid., p. 121.

[32]Ibid., p. 127.

people arrange credit, marketing of products, and other technical assistance. This span of duties excludes particular concentration upon water management.

CDE was established in 1955 and has responsibility for nationwide electrification. The agency's autonomous status and financial independence allow it to plan on a longer term, more stable basis than is the case for INDRHI.[33]

Most CDE hydroelectric projects are contracted to foreign or private sector consultants for feasibility and design studies. CDE forms a specific corporation to construct the selected dams. Upon completion of the project, the corporation is dissolved.

b. Responsibilities and functioning of irrigation agencies

For administrative purposes, INDRHI has divided the country into seven irrigation districts which include 17 irrigation zones and sub-zones. These divisions do not exactly coincide with those adopted by the SEA, which is based on eight regional districts covering 27 zones.

Unidades Regionales de Planificacion Economica (URPE) have been established in each of the eight SEA regions. These units are supposed to help increase the rate of agricultural growth, and to collect statistics at the zonal level. Regional or zonal offices of INDRHI tend to carry out such functions within the perimeters of the irrigation projects. IAD usually has some lands and colonists located inside the projects.

Other institutions including INESPRE, BAGRICOLA, ODC also maintain regional offices to help pursue agricultural goals and policies of the nation.

Of all its several legal functions, INDRHI has taken most seriously the planning and construction of dams and diversion works for irrigation purposes. In general, INDRHI acts to oversee the actual construction by engineering firms and only steps into the project after the main works have been fully or partially completed. In short, its bread and butter function is to operate the systems. But personnel of the agency have considerably more skill in engineering than in water management for agriculture. Directors of irrigation districts may be civil engineers without agronomic experience.[34]

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[33]Ibid., p. 128.

[34]Hartshorn, Environmental Profile, p. 42.

Writing in 1983, Anderson, et al saw the role of the ditch rider (cabo de agua) as a reflection of "the low priority placed upon water management by INDRHI."[35] Although such individuals stand at the interface between the agency and water users, they are poorly paid, corruptible (according to Anderson, et al) and lack technical irrigation skills and ability to relate to farmers.[36] Until recently, INDRHI did not push the idea of water user organizations although it has had authority to form such groups for some time. This is further evidence of lack of concern for water management.

Although INDRHI, in 1985, is forming water user groups, agency officials resist the idea of giving the groups power to collect water user fees or pay part of the salaries of the cabos de aguas. However, as Anderson indicates, "Unless user associations have some such authority, they are not likely to be effective."[37]

Various SEA functions or sub-secretariates get involved in irrigation activities although, as mentioned, SEA does not focus high level attention upon water management per se. Some of SEA's research centers study irrigated crops and one of the four centers concentrates solely upon rice. There is a small group of irrigation specialists which trains farmers living at higher elevations in methods of using small irrigation systems. There also are over 600 extension agents working throughout the country, and many are stationed in irrigation projects. These agents have little or no background training in irrigation techniques or water management to pass on to farmers. In early 1981, INDRHI agreed to begin to train some of SEA's extension agents in correct and modern irrigation practices. However, there are few people in INDRHI who could conduct such training and as yet the program has not been implemented.[38]

Inside the SEA's sub-secretariat for Research, Extension and Training is the Department of Rural Organization (DRO). Personnel of this department have been engaged in performing socioeconomic analysis in various irrigation districts for INDRHI. Their skills are available for organizing user groups. However, INDRHI may or may not want the development of rural associations to achieve effective participation and representation of members' interests to become the focus of DRO.

Some of IAD's functions within irrigation districts have already been described. A further point of interest, however, is that women, who do much of the work on farms, have poor access to training. Apparently this is due partly to the fact that few women are parceleras

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[35]Anderson, PP: On-Farm Water Management, p. 118.

[36]Ibid.

[37]Ibid., p. 119.

[38]Ibid., p. 112.

(female small farm operators) or actual members of the asentamientos with rights of representation. They are only connected via their husbands and families.[39]

The separate corporations created by CDE for each dam constructed are relatively short lived so they tend to ignore the condition of watersheds or fail to take any interest in watershed management. Money is not allocated for such purposes.

Lack of communication and even friction between INDRHI and CDE were sensed by Anderson, et al in 1983. Examples cited were lack of knowledge and indifference at the technical level as to the activities that each institution is involved in and the fact that maps locating future dams for one institution do not show the projected dams of the other.[40]

Some conflict exists concerning water releases from storage reservoirs. Normally, hydro-power production requires only 15 percent of water capacity, but extra water is released to meet peak demands or to replace power outages when other plants are off-line. Less storage is available for irrigation when needed. Since INDRHI does not have good control over its water management functions, its engineers do not know how much water is being put into the irrigation systems, or how much more or less is needed at a given moment. CDE's data on energy needs and supplies are much more exact. This situation puts INDRHI at a disadvantage in negotiations with CDE.[41]

2. Irrigation policies

a. Policy framework for irrigation development

(1) General

All water within the Dominican Republic belongs to the State. Only those uses may be made of the resource as are permitted by agencies having the authority to approve or disapprove, other than in instances expressly provided for by law or regulation prescribed by law. The priority accorded to utilization of public waters in descending order is as follows:

- To satisfy human drinking, washing, and other municipal requirements;
- To satisfy animal and poultry needs;

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[39]Ibid., p. 128.

[40]Ibid., p. 129.

[41]Ibid., p. 130.

- o For agricultural purposes;
- o For production of electricity and for industrial and mining use; and
- o For other purposes.

INDRHI is the highest national authority in terms of interpreting and executing all legislation pertaining to water law and custom. No other authority exists at the national level, other than the Office of the President, to deal with water resource questions. Certain aspects of water law application require cooperation on the part of SEA and IAD in the management of water resources and improvement of water use. Within geographical regions there are instances where mechanisms must be created to accomplish interregional cooperation among agencies to deal with certain aspects of irrigation and drainage. INDRHI officials are expected to provide the necessary leadership.

INDRHI was created in September 1965 to implement various existing laws concerning management and development of the nation's water resources. Since then, various refinements and regulatory changes have been introduced to delineate and clarify INDRHI's power and authority. Regarding irrigation system operation, INDRHI has the responsibility to propose tariffs and rates, rents and costs, for approval by the highest executive authority. The agency can suspend water service for failure of users to pay their quotas and the agency can dictate the regulations necessary to carry out its defined tasks.

(2) Specific laws (customs) related to water rights

In order to make private use of public water, it is necessary to obtain in advance a right or concession describing the approved (effective) use of the water, in accordance with underlying law.

Persons who rent land can obtain a concession if they have permission of the land owner who is entitled to the basic concession. Any rights granted the renter involve the land itself, they are not conferred upon the renter.

Water use concessions or rights are an inalienable part of the corresponding land parcel. Use is permitted for the purposes indicated in the actual concession (titulo). Each year, there is an obligation to explain in advance how the water is proposed to be used and to obtain approval (i.e., to switch from rice production to other crops).

However, INDRHI has the power to authorize transfers of water use rights between parcels of land if the shift is justified from a practical and technical standpoint. In all such cases, the transferred right becomes attached to the new parcel.

The water made available for a particular development cannot be used for something else without renegotiating a formal concession. Nevertheless, the water appropriated for irrigation can also be applied to industrial preparation or transformation of the products produced on the same irrigated parcel provided there is no attempt to increase the water volume permitted in the original allocation and that the water used as a prime transporter in the process is returned to the source.

Any concessions for use of water will not be effective if the conditions and deadlines are not met.

In order to construct ditches, or create storage for nurseries or make fish ponds, or for any effective use of water, the persons who hold the original rights (land owners) need INDRHI's approval. Requests for water utilization can also be made by users or renters of any parcel, as long as the parcels have established water concessions.

With respect to irrigation societies, the law makes provision for collective utilization of water. For public water to be used for irrigation, individual members must obey the rules and orders of their society or community dealing with such use. An association must be formed: a) when the number of co-irrigators is greater than ten and when the number of irrigable hectares is at least 200; and b) when the local agricultural situation demands a formal group. Outside of these cases, it is possible to form an irrigation society if a majority of the members of a community wish it.

The irrigation societies should have, as their goal, the common construction of canals, to achieve better distribution of water from the public source to the fixed points within the community's area where the water will be available for individual members' lands.

b. Functioning of current policies

Whether or not a particular plot of land receives the water to which it is entitled depends upon the specific situation governing the system serving it. If there is ample water or good user cooperation, tailenders get service, but nothing is guaranteed. New or revised conveyance systems may change established patterns with some farmers getting more than before, and others less. Equity issues are resolved at the zone or sector level, and there is no centralized or formalized way to force or require delivery.

One frequent complaint about the current status of irrigation administration has been that water tariffs have not been set at levels high enough to cover annual Operations and Maintenance (O and M). A related complaint is that many users do not pay.[42] Table 2-11 shows

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[42]The World Bank. Dominican Republic: It's Main Economic Development Problems (Washington, D.C.: The World Bank, 1978). Latin American and the Caribbean Regional Office.

Table 2-11: Trend in Water Tariff Receipts at National Level (1966-1984)

Year	Amount (DR$)	Area (ha)	No. Users Who Paid
1966	128,269.37	a	
1967	171,789.20	24,656	
1968	259,770.33	36,031	
1969	307,821.39	43,037	
1970	221,427.01	30,913	
1971	389,230.54	55,484	
1972	374,856.65	53,712	
1973	318,194.01		9,963
1974	496,785.58	71,391	18,711
1975			
1976	544,372.44		
1977	549,685.36		
1978	541,572.76		
1979	603,216.59		
1980	557,126.92		
1981	546,303.80		24,798
1982	507,453.78		26,116
1983	750,020.51		29,103
1984	1,168,623.96		35,885

[a]Blanks indicate data not available.

Source: Instituto Nacional de Recursos Hidráulicos (INDRHI), "Recaudaciones por Concepto de Usuarios en el Periodo 1966-1984," Santo Domingo, INDRHI Central Files, 1985.

that collections were quite low in the 1960s, but have risen both in quantity and in percent of payees, year by year. By 1984, for example, RD$ 1,168,624 was collected from 35,885 users. This represents an overall compliance rate of about 78 percent. The final report of the FAO irrigation survey reports a 1981 compliance rate of 100 percent in several of the 17 zones.[43]

By recent law and regulation, personnel of each irrigation district have begun to set water tariffs in relation to estimated upcoming operation and maintenance expenses. The 1984-85 tariffs were calculated in the late Fall of 1984 and are now being collected. The program is being phased in gradually. Fifty percent of the assessed tariff will be collected in 1985, and the remainder of the District budget will come from INDRHI. The percentage will be increased by stages until 100 percent is collected by the end of the decade. As the budgets are fixed annually, they are expected to increase with inflation and will reflect changes in the annual work program.

The question at this point is: How well will the rate of collection hold up? Although the old water rates were notoriously low, the 1985 levels are about seven to 15 times as high as in the past. The reason for the range is that a distinction is made in the fee charged according to whether rice is grown and whether the parcel is larger than ten hectares. Thus, a rice grower cultivating greater than ten hectares will pay a fee four times the base rate.

The new fees, when fully implemented, will equal RD$ 25/hectares in many cases. According to Poza and Reynoso the average cost for O and M per two hectares is running at RD$ 17 per hectare. At current price levels, RD$ 25 would easily cover current costs. However, it is possible, even likely, that the average of RD$ 17 represents a sub-optimal expenditure on O and M.

In Table 2-12, some information about past relationships between water tariff billings, collection and O and M expenditures is given. The available data permit only sketchy comparisons, but water fee collections as a share of budgeted O and M expenditures is not a very meaningful ratio unless it is based on amounts that are averages over periods of several years, or it can be assumed that O and M activities are normally at a good, adequate standard. In the two irrigation districts for which data are available, the ratio fell between 1981 and 1984, not because collections were low (indeed they rose) but because there was a dramatic increase in expenditures.

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[43] Estudio para el mejormineto de los sistemas de riego existentes, Table 4.

Table 2-12: Recent O & M Expenditures as Related to Water Fee Assessments and Collections

Yaque Irrigation District	Debited to Users 1985	Debited to Users 1979/84	Receipts from users 1984	Receipts from users % of Total in 1984	Receipts from users 1981	Budgeted O&M Expenditures 1985 Budget	% 1985 Budget for: Admin	Oper	Maint	1984 Budget	Receipts as a Share	1981 Budget	Receipts as a Share
Bajo Yaque del Norte	429,423	536,251	138,069	17.1	135,858	1,248,006	17	15	68	1,857,797	7.4	1,164,161	12.2
Alto Yaque del Norte	619,090	495,527	199,091	11.8	38,838	1,239,802	18	22	60	1,727,909	11.5	175,670	22.1
Yuna-Camú	1,514,261	1,604,732	408,786	34.9	197,260	2,672,122	10	17	73			528,180	37.3
Ozama-Nizao	379,714	389,989	106,593	9.2	41,957	939,765	15	35	50			311,897	13.5
Valle de Azua	230,188	380,056	77,346	6.6	23,436	477,179	16	35	49			252,000	9.3
Yaque del Sur	323,273	984,832	44,318	3.8	13,991	1,196,988	8	43	49			1,145,090	1.2
Valle de San Juan	372,606	376,562	194,420	16.6	37,569	1,007,065	14	35	51			308,186	12.2
TOTAL	3,868,555	4,767,949	1,168,624	100.0		8,780,929							

Sources: All 1981 figures from Food and Agriculture Organization (FAO) and United Nations Development Program (UNDP), Estudio para el mejoramiento de los Sistemas de Riego Existentes: Republica Dominicana: Resultados y Recommendaciones de proyecto informe Técnico AG:DP/DOM/81/012, prepared for the Government of the Dominican Republic (Rome: FAO and UNDP, 1984), Tables 1, 1a & 4; 1984 Receipts from Instituto Nacional de Recursos Hidráulicos (INDRHI), "Recaudaciones por Concepto de Tarifas de Aguas Recibidas por los de Riego en al año 1984," Santo Domingo, INDRHI Central Files, 1985; Debited fees from INDRHI, "Relacion de los Deudos de los Usuarios de los Distritos y Zonas de Riego por Concepto del Uso de las Aguas Publicas," Santo Domingo, INDRHI Central Files, 1985; 1985 Budgeted O and M from INDRHI, "Determinacion de factor de Pago por zona para Usuarios," Santo Domingo, INDRHI Central Files, 1985; and 1984 Budgeted O and M, from INDRHI, "Resumen Proyecto de Presupuesto de operacion, mantenimiento y administracion para el año 1985," Santiago, INDRHI Irrigation District Files, 1983.

O and M budgets are clearly rising in a general way, although emphasis shifts from district to district according to the greatest need at any moment in time. One of the interesting aspects of the 1985 O and M breakdown shown in Table 2-12 is the relatively small share allocated to central administration in each district.

c. Planned policy changes

The new program of higher irrigation water charges and stricter collection mechanisms has been described. No changes in this policy are contemplated other than a staged implementation of all aspects of the program. A steady increase in the percentage collected of each year's calculated fee per hectare is planned. More important, starting in 1986, the money will be retained in the irrigation districts to be spent for the O and M planned for the year. Larger renovations proposed by a District's management will continue to be dealt with in separate budget requests.

To reiterate, the sum of planned physical maintenance expenses plus expected administrative costs for the upcoming year are utilized to calculate the actual tariff levels, by district. These levels will vary from year-to-year and from district-to-district. The next year's levels are announced in the Fall and are collected throughout the production year as plantings and harvests occur. Eventually, 100 percent of the annual calculations will be assessed and that share over and above certain administrative costs will be held in the separate districts to pay for the programmed maintenance.

At the present time, the Irrigation District Directors are not allowed to keep the water fees collected in their districts. Nevertheless, the Director in Yaque del Norte pointed out to the team that there is incentive to get behind the stiffer enforcement program: a) eventually the district offices will need accurate water delivery and parcel size records for all the land areas serviced; and b) it is an advantage to get all farmers used to paying the fees so that future collections can be processed smoothly.

C. Irrigation Projects

1. Yaque del Norte

a. Background

Development of the Rio Yaque del Norte in the area around Santiago began about 1936 with an "old" project finished in 1956. Along with the other areas of the Dominican Republic, an expansion and renewal of this "old" system was initiated in the late 1970s. Projecto Río Yaque del Norte (PRYN) is described in the AID project paper for On-Farm Water Management as follows:

> This project [perimeter] encompasses a total area of 45,000 ha along the margin of the Yaque del Norte River west from Santiago de los Cabelleros. The right margin is between Río Yaque del Norte and the Cordillera Septentrional, beginning from the head work of Santiago continuing west up to the stream Agua de Palma near Villa Elisa (Guayubín): the left margin is from the same head works to the Río Amina in the south of Esperanza. The PRYN project is divided into two stages: Phase I completed first and covering nearly the total right margin; Phase II, now in progress, and covering all the left margin and an amplification of the right margin.[44]

(1) Description

The main features of the project include twin storage reservoirs with combined capacity of 300 million cubic meters (mcm), a hydro-electric plant, main canals which are lined, farm turnouts and farm ditches. The effective capacity of the reservoirs is considered to be double because there are two rainy seasons in this region of the Dominican Republic.

One operational problem of the system concerns the conflict between power generation and irrigation demands. Hydro-electric plants are consistently used to provide peaking power. In addition, the power division wants to produce all the power it can. Both of these conditions produce a situation not in harmony with irrigation requirements. Irrigation supplies should be nearly consistent and not subject to the wide short term fluctuations that peaking power produces. Furthermore, the power releases from the reservoir may not agree with irrigation demands. Excesses will have to be bypassed at the irrigation diversions and shortages will require releases from the storage reservoir. What this means is that a small equalizing reservoir is needed to store one or two days supply and smooth out the power release fluctuations. INDRHI is now in the process of planning this equalizing reservoir.

In the design of the new project an attempt was made to salvage most of the delivery system of the old project with the result that the linkages between the old and the new are not always at the best location. In addition, the design was reported to have been made from aerial photos with the result that the designs did not always agree with the actual field conditions. However, water was delivered for the first time under the new project this year and these shortcomings will be corrected, along with other problems that always surface in the first years of operation.

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[44]Anderson, PP: On-Farm Water Management, p. 26.

The system is planned to deliver water to "rotation blocks" of approximately 40 ha with a unit stream of 40 liters per second with sufficient flexibility to increase the stream to 75 liters per second. The water is owned and controlled by the government, which manages the distribution system.

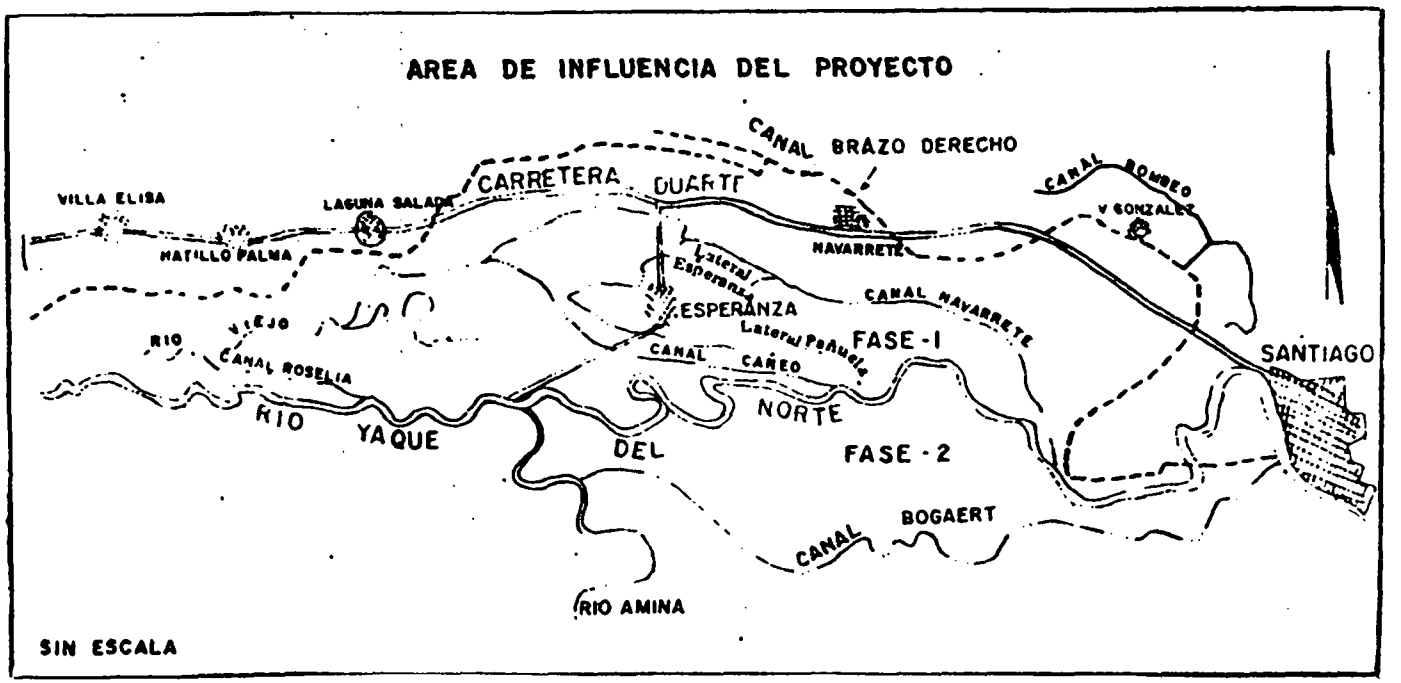
The team visited two areas of the project near Santiago to talk with farmers regarding water use: close to the diversion or upper end of the new project; and at the "tail end" of the old canal. The headend farmers disagreed among themselves as to the benefits of the new project in comparison to the old. Many farmers with small land holdings felt they were better off: water supply was more reliable and they did not suffer shortages. On the other hand, some farmers in the larger blocks said they were worse off. Their main complaint was that the new project cut off access to drainage water, a source of supplemental supply previously available to them. The farmers on the old canal feel that people upstream get more benefits than they do, and that they, the tailenders, must bear the shortages imposed by users upstream.

In response to the problem of differential water use on the old canal, a unique delivery pattern has been worked out which provides water to rice farmers at night and divides day time deliveries between sugar cane and other crops. Maintenance of the canal is a continual problem but has improved since water user groups were formed.

(2) Agriculture in project area

The PRYN project lies within the boundaries of Irrigation District Alto Yaque del Norte, and includes some new canals to irrigate additional land as well as to improve water supplies to some of the older canals (river diversions) already operated by the district. The district itself encompasses the three provinces making up the main drainage basin of the River Yaque del Norte. (See Figure 2-1.) Figure 2-2 illustrates the area influenced by PRYN. The district has been operating those parts of the project in Phase I, the right side of the river, for about two years. As mentioned, the project links in some older, existing canals, such as the Navarrete. Thus, there is a differential impact between areas that have a more established irrigation tradition and those where the practice is newer. In general, several more years will be required before full development of the system and conveyance structures will be achieved. Additional time will elapse before the ultimate pattern of multiple cropping is in place.

According to data provided by the District Director, the features of the project now can service about 22,200 ha of partially irrigated and un-irrigated lands. Allowing for the lands supplied by some other sources, FAO experts estimated a total of 27,650 ha commanded. This



IRRIGATION PRICING AND MANAGEMENT: DOMINICAN REPUBLIC

Figure 2-2: Area of Influence of the Proyecto de Riego Yaque del Norte (Phases 1 and 2)

total is scattered in three management zones: Santiago, Mao, and Esperanza. Of this latter sum, about 20,600 ha were actually irrigated in 1981. An estimated 22,790 ha were actually planted at the time.

For the Yaque del Norte irrigation district as a whole, the estimate of farm families using state (project) water is 3,401. About 50 percent of this number live in the Esperanza zone in an area that is served by the lower reaches of the Navarrete canal. Average landholdings in this zone are nine ha. In the Mao zone, which has about 1,000 irrigators using state water, holdings average six ha. Santiago zone irrigators (720) have average holdings of 19 ha.[45]

Nineteen ha is a high average relative to state irrigation systems in other regions of the country. When allowance is made for the fact that a substantial share of farmers actually occupy agrarian reform lands, and that the percent of holdings less than five ha in size averages almost 79 percent throughout the district, it is apparent that some of the private holdings must be relatively large. For example, the team visited one farmer who claimed to own about 500 ha, but his actual holding is estimated to be about 3,000 ha. If the Santiago zone is taken as an example of an area heavily influenced by PRYN-controlled water deliveries, we see that about 62 percent of the land is held in parcels larger than ten ha. (See Table 2-13.)

Alto (Upper) Yaque del Norte is the most important tobacco growing region of the country. The other important export crop is irrigated sugarcane. Farmers with good water supplies and suitable land location rely upon rice as a cash crop. About 3,600 ha of the irrigated area is planted equally to corn, beans and tomatoes, and another 3,000 ha is operated in the form of pastures.

As appears to be the case in other irrigation districts, a range of farming techniques is encountered: animal as well as mechanical traction; high and low inputs.[46] Rice yields of five mt per ha are a maximum, but 3.5 mt is an average. Some farms employ the retoño system with rice. This consists of obtaining a volunteer crop of much lower yield, following harvest of the initial planting. A low or medium level of inputs is involved and there is no expense for land preparation.

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[45]Estudio para el mejoramiento de los Sistemas de Riego Existentes, Table 4.

[46]Secretaria del Estado de Agropecuario, Costos de Produccion por Entrevista (Santo Domingo: Departamento de Estadisticas y Departamento de Planificacción, 1980).

Table 2-13: Distribution of Parcel Numbers and Land Areas by Size Class in the Santiago Irrigation Zone
(percent)

	P[a] (0<2 ha)	A[b]	P (2<4 ha)	A	P (4<6 ha)	A	P (6<8 ha)	A	P (8<10 ha)	A	P (>10 ha)	A	Total P	Total A
Rice	30.0	6.8	38.5	20.0	11.5	9.6	4.9	5.9	3.3	5.2	11.8	52.5	29.0	28.0
Other	28.0	3.7	31.8	10.0	11.3	6.3	11.1	8.0	2.9	2.8	14.9	69.4	61.0	72.0

[a] P = Parcels.
[b] A = Area in ha.

Source: Instituto Nacional de Recursos Hidráulicos (INDRHI), "Estadisticas de Distribución de Usuarios por Zonas," Santo Domingo, INDRHI Central Files, 1985.

Some relevant farm level statistics are summarized in Table 2-14. No revenue data are available for 1979. The water source and technique data are for small samples of procedures made in 1979 by SEA teams.[47]

In order to gain some impression of the range of small farmer income potentials we have assumed a basic plot size of 2.5 ha and two ways of managing the land:

- Two high yield crops of rice per year;
- Utilizing the plot as represented by the weighted average of land use in the district.[48]

These crude calculations suggest that as of three or four years ago, rice farmers could do fairly well if the farm plot was not too small (two full rice crops per year). Under the alternate assumption that 2.5 ha of land could have been farmed as an enterprise that produced a once a year crop mix in proportion to the way the majority of the district's irrigated land is used, the net income would have been enough to buy about 375 days of labor, half as much as under the rice assumption. The level of income that amount of purchasing power suggests does not appear to be especially high, but it might represent the lower range of the possible income scale. While these results are purely indicative, they do suggest the need for multiple cropping, especially if the plot sizes are small and/or families have to depend 100 percent upon farming for their annual incomes.

As part of its study of ways and means to improve existing state irrigation systems in the Dominican Republic, FAO experts analyzed expected costs/benefits, additional land to be brought under irrigation, number of jobs to be created, investments per ha and per job created for 56 proposed projects. They concluded that the amount of additional investment necessary to bring the Yaque del Norte project up to its potential, relative to the other 55 projects studied, put it in 17th place for profitability, first place for the amount of new land and for job creation, 29th place for investment cost per ha and 17th place for cost per job created. Thus, considerable, relatively expensive investment is still necessary.[49]

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[47] Ibid.

[48] INDRHI. "Recaudaciones por zonas en 1980, 1981, 1982, 1983, 1984, and 1985" (Santiago: INDRHI Irrigation District Files, 1985).

[49] Estudio para el mejoramiento de los Sistemas de Riego Existentes, Annex III, Table 1.

Table 2-14: Estimates of Annual Economic Value of Main Crops and Enterprise Potentials, PRYN (Yaque del Norte), 1979 and 1981

(RD$; 2.5 ha)

Crop	Yield[b] (qq/t) 1981	Yield[b] (qq/t) 1979	Total Revenue/t 1981	Total Cost/t 1981	Total Cost/t 1979	Net Rev/t 1981	Est. of 1981 Farmer Income[a] 2 Crops Rice	Est. of 1981 Farmer Income[a] Weighted Use	Unit Cost of Production 1979	Water Fee/t 1979	Av. Area Seeded (t)	Water Source	Level of Tech. Inputs	Land Prep	Land Quality[c]
Rice	8.00	5.77	98.48	62.50	54.03	35.98	2,878	762.78	0.094	0.16	63.8	Gravity	High	Mech	A
Retoño		4.64	55.68[d]	37.04	32.06	18.64[d]			0.069	0.08	27.2	Gravity	Med	None	A
Tobacco	2.5	126[e]	100.00	62.00	65.00	38.00		106.40	0.526	0	28.0	Spring	Med	Mech/ Animal	A
Pastures			16.50	8.00	N.D.	8.50		57.80							
Tomatoes	35.00		92.75	56.75	N.D.	36.00		28.80							
Beans	1.75	1.43	61.25	33.75	21.71	37.50		30.00	0.152	0	44.6	Spring	Med	Mech	A
Maize	4.00	4.03	32.63	20.00	11.95	12.63		5.63	0.030	0	50.7	Spring	Low	Mech	A
Bananas	42.40		212.00	77.00		135.00		324.00							
Cane	5.75		80.50	31.75	N.D.	53.75		193.50							

Total (1981 prices) RD$/Year	2,878	1,503
DR$/Year	1,439	751
DR$/Month	119.92	62.60
# Days Labor Net Income Could Purchase	720	376

[a] Calculation of income from assumed 40 t (25 ha) made by Devres Team.
[b] qq = quintales (100 lbs)/t = tarea (0.63 ha).
[c] Generally 'A' stands for class I, II or even III level.
[d] Estimated by team.
[e] Bunches.

Sources: B. Anderson, et al., Project Paper: On-Farm Water Management Project (Draft), prepared for USAID/DR with support of Science and Technology Bureau sponsored WMSII Project (Santo Domingo: US Agency for International Development, 1983), Table 1 for 1981; and Secretaria del Estado de Agropecuario, Costos de Producción por Entrevista (Santo Domingo: Secretaria del Estado de Agropecuario, Departamento de Estadisticas y la Departamento de Planificación, 1980), Summary for 1979.

b. Project management

Alto Yaque del Norte District is organized according to the standard INDRHI model. It has a central office in Santiago and three zonal offices in the field, all of which report upward, eventually to the national headquarters in Santo Domingo. The district office sets programs and oversees the activities of the zones. With the advent of the new tariff regulations, maintenance budgets are developed in the zonal offices, which also collect the tariffs and supervise the irrigation field staff. The district manages a maintenance budget, but any expenditures in excess of RD$ 5,000 must be processed in Santo Domingo.

According to INDRHI policy, user groups are expected to participate in discussions which set the annual zonal work program and budget. This participation may materialize this year as District staff try to implement the policy seriously. Until now, however, INDRHI staff have prepared plans and budgets themselves, without any systematic consultation with farmers.

INDRHI is responsible for virtually all maintenance of the irrigation systems. Farmers clean field channels, but have no other maintenance obligations. Emergency maintenance is executed by the District office, utilizing special appropriations from Santo Domingo.

Water is allocated according to land area and crop, not by volume. Charges are also levied on the basis of landholding and type of crop (rice or other). The zonal office is responsible for water distribution, which is managed by the distributors in each sector. The distributors open and close the turnout gates but farmers themselves manage distribution within turnout units, which average 40 ha on the new canal. This internal distribution pattern may be informal or highly formalized, depending on the sector.

In the area where field inspections were made by the team, the field ditches and laterals were in good repair and fairly clear of water weeds and vegetation that would impede water flow. This is indicative of good maintenance considering the fact that tropical conditions usually produce abundant, fast and luxurious growth of vegetation along waterways.

c. Farmer participation

Except for the articulate large landowners who interact frequently with irrigation authorities as well as other authorities, there has been very little farmer participation in the PRYN systems in the past. Farmers were not consulted during the design or construction of the new system, and they continue to have minimal maintenance responsibilities. As in most other irrigation systems in the Dominican Republic, INDRHI paid little attention to the collection of tariffs, thus indicating that farmers could not be expected to contribute, however minimally, to the O and M of the system.

However, the situation is starting to change dramatically in PRYN, which is in the forefront of implementation of the new laws relating to tariffs and water user organizations. During the last year, the District Director has traveled throughout his territory to discuss the new laws and their implications. Meanwhile, he has instructed his zonal directors to establish water user groups in their respective zones. The group formation effort suffers from a number of weaknesses which illustrate basic conceptual problems in INDRHI's approach, as well as the limited time that inexperienced staff can devote to the task. Nonetheless, given real institutional limitations, the effort has been surprisingly effective in a short time.

The team had extended discussions with representatives of several user groups in two zones: Santiago and Esperanza. The farmers from each zone identified a broad spectrum of irrigation problems they faced, from water shortages to conflicting water demands for a wide variety of crops. In general, farmers in Esperanza have a more favorable environment now that the new canal has been completed, whereas those in Santiago are served by an old canal which is inadequate for the demands made on it.

Although the groups in the two zones ostensibly were formed for the same purpose, they each have distinct, different styles, and they will probably produce different results. More than any other factor, the personality of the zonal director accounts for differences in the quality of the two sets of groups. As this question has important implications for the outcome of the group formation effort, the groups will be described briefly below.

The group organizers employed a similar model for the group structure. The basic unit of the groups is a "nucleus," a small turnout group consisting of perhaps 15 people. These units were mentioned in meetings with the team, but it is clear that they have informal status, rather than a recognized structural role. In practice, group formation occurs at the level of the sector, and each group has direct contact with the ditch rider, or cabo de agua, INDRHI's lowest level employee. In Esperanza, the sector groups are autonomous; in Santiago, the presidents of right bank and left bank sectors belong to a confederation in their respective areas.

To create the groups, the zonal directors called meetings in each sector at which they discussed new INDRHI policies regarding tariffs and user organizations. They then invited farmers to elect a five-person executive committee consisting of a president, secretary, and three other members. From this point, the outcome in the two zones began to diverge somewhat.

Most obviously, group leaders ended up with varying definitions of their roles and their relationships between themselves, their constituents and INDRHI. The group leaders in Esperanza see themselves as local representatives of INDRHI, but without adequate power to make

their members follow their directives. They are enforcers who feel the need to be legitimized by being recognized officially by INDRHI so that they can get their members to listen to them. In contrast, leaders in Santiago describe themselves as representatives of farmers to INDRHI. They are advocates who approach INDRHI on behalf of their constituents to articulate the problems and needs of their fellow farmers.

In the field, both sets of group leaders have attempted to improve water distribution patterns. The leaders from Esperanza have done so by substituting unofficially for the ditch riders, merging technical and traditional authority. This has met with some success, depending on the strength and forcefulness of individual leaders. In Santiago, group leaders have attempted to establish ongoing dialogues with the distributors, sometimes individually and sometimes with groups of farmers, in order to improve cooperation within the sector and between sectors. Leaders claim that ditch riders now listen more attentively to the farmers and respond to their problems more rapidly than they did before they were organized.

Farmers in both zones indicated that since becoming organized they have assumed maintenance responsibilities which previously fell between INDRHI and individual farmers, but were undertaken by neither. Both farmers and INDRHI officials in Santiago point with pride to the fact that user groups even participated in a major maintenance program on the main canal, one which was clearly INDRHI's responsibility.

Each zone has a unique situation which deserves special mention. In Santiago zone, the old canal serves a diversified area with a broad range of irrigation needs. Part of the command area is planted in sugar cane, part in rice, and part in fruits, vegetables and grains; each requires a different irrigation pattern. In addition, there are a number of private pumps which lift water from the canal to upland tracts outside of the command area; this use decreases the already inadequate supply of water to the command area. In order to balance competing water demands, the Santiago zonal office has developed a complex rotation system. Rice is irrigated at night because the water can flow from paddy to paddy without constant surveillance. Sugar cane gets the daytime water from Monday through Thursday, at which time pumps are allowed to draw water. Other crops are irrigated on Friday, Saturday and Sunday. Farmers claim that the rice area is decreasing, and the time for "other" crops is inadequate, thus it may be opportune now to review the current pattern to see if it can be fine-tuned a bit. In any case, farmers appreciate the rotation system as a visible indication of INDRHI's responsiveness to their problems. Surely this arrangement helped to establish a framework for the collaborative relationship which is becoming institutionalized between INDRHI and the new water user groups.

The collaborative spirit evident in Santiago user groups has not yet materialized in Esperanza. However, the new canal and conveyance system were utilized for the first time this year and offer a good opportunity to foster such a spirit, to the benefit of both users and INDRHI, if INDRHI manages the shakedown period properly. Until now, the new system has been designed and introduced from the top down, in a manner reminiscent of the authoritarian nature of the new user groups in Esperanza. In order for the new system to function properly, a number of things will have to happen: structural changes will be required to get water where it is needed; new distribution patterns will have to be developed to ensure that all plots can get water as needed; and new relationships will have to be established to enable the distribution to proceed smoothly. Ultimately, it would be possible to complete this shakedown process using traditional authoritarian or technocratic approaches, but this would be neither expedient nor efficient. Rather, what is needed is a collaborative effort between technicians, farmers and administrators, one in which all groups share their knowledge and experience with the other groups, articulate their assessment of the consequences, and together choose alternative solutions to problems that emerge.

If water user groups are identified as partners in this process, and if their role is defined as that of mobilizing members to contribute actively to the creation of a new system, instead of merely executing INDRHI's directives, a new type of group may emerge, based on a stronger, more democratic foundation. This is an important opportunity in which the interests and needs of both farmers and INDRHI coincide perfectly.

To make the best of the current situation, INDRHI should prepare its staff to function in the collaborative manner indicated above. This would require a reorientation of some of the people responsible for group organizing and minimal training of other relevant staff in ways to relate to farmers in the field. Most critically, INDRHI should establish clear procedures for collaborating with user groups to set detailed, equitable water distribution patterns in each sector. This reorientation will require a new understanding of INDRHI's possible role vis-à-vis farmers and user groups, but no staffing changes. Fortunately, the District includes a very good role model, the director of Santiago zone, who should actively participate in preparing the orientation training program. Given the responsiveness of farmers, as demonstrated in the success achieved so far, this reorientation program should produce concrete benefits in a very short time with virtually no commitment of resources.

d. Cost recovery

The new, general policies for making water fee collections have already been discussed. As near as can be ascertained, Yaque del Norte Irrigation District personnel are implementing the directives.

Implementation of the new water charge directives is forcing the District personnel and the farmers they serve to come together to create better records, especially those related to land ownership or to areas serviced by state irrigation water. For example, in the Yaque del Norte District, farmers who pay water assessments in person have started to bring in maps or drawings of their plots in order to try to reduce the actual fee to be levied upon them.

District personnel recognize a natural tendency to irrigate more land than indicated by the drawings. On the other hand, in some cases, farmers are able to argue that zone records show that past charges imply larger areas than actually held. If there is disagreement and a resolution cannot be achieved by checking against aerial photos, etc., it may be necessary to survey the plots and prepare new drawings.

The system works as described earlier: charges vary according to size of land holding and whether rice is the crop to receive water. Various methods are utilized to notify farmers of the need to pay fees. At present, there is no plan to recover investment costs of the Tavera dam, diversion and canal works. During the past few years, more and more money has been collected in the form of water charges, but none of it has been directly applied to district O and M expenditures. For the present, the district competes for operating and maintenance funds as its share of INDRHI's general budget. The only annual amount it can be certain of is the administrative costs of salaries and district and zone office management for permanent employees. (Indeed, all this is paid directly from Santo Domingo, even the district telephone bills). In the mind of the District Director, therefore, "O and M" stands for his budget needs over and above administrative/operating costs and he would be happy to have the water fees reach that level.

The levels of O and M disbursements from INDRHI headquarters during the past few years are shown in Table 2-15. The annual increases recorded there appear to be greater than the rate of inflation, although the annual totals fluctuate. In the past, receipt of budget allocations may have been sporadic but, since 1982 some money has been disbursed to the district at least by February. Listed across the bottom of the table are the totals of annual water fee collections which have been forwarded by the district to INDRHI Headquarters.

It will be noted that in 1980 more in water fees was returned than was received for O and M. When a comparison is made between receipts and the water user fees collected, it is easy to see why the current District Director is looking forward to holding the fees in the district. During the early months of 1985 the fees collected are keeping up with the budget disbursements.

Table 2-15: Pattern of Receipts of Central Budget Funds for O and M Work in the Irrigation District Alto Yaque del Norte by Month vs. Annual Water User Fees Collected and Passed to Headquarters (1980-1985)

Budget Receipts From Santo Domingo

Months	1980	1981	1982	1983	1984	1985
January	--	--	--	--	28,581.08	23,169.56
February	--	--	45,422.42	9,515.69	21,787.89	59,385.54
March	--	--	28,818.35	9,652.94	29,059.30	47,002.23
April	30,000.00	14,105.14	38,337.85	27,407.62	43,928.78	2,945.26
May	--	--	12,008.01	--	31,602.87	--
June	--	13,184.96	42,163.52	36,229.35	31,930.02	--
July	--	4,202.54	34,368.47	50,696.13	24,814.30	--
August	--	25,560.05	36,360.67	68,871.77	34,889.25	--
September	--	30,000.00	28,349.41	62,507.49	22,957.95	--
October	10,174.28	53,848.73	9,433.75	35,304.36	42,758.32	--
November	--	27,507.86	52,011.16	72,062.87	39,780.70	--
December	--	67,940.33	31,265.23	43,333.06	28,318.69	--
TOTAL	40,174.28	236,349.61	358,538.84	415,581.28	380,409.15	132,502.59

Collections Forwarded to Santo Domingo

TOTAL	105,278.56	82,277.43	87,830.10	134,689.73	223,122.33	114,870.19[a]

[a]Through March 1985.

Sources: Instituto Nacional de Recursos Hidráulicos (INDRHI), "Recaudaciones por zonas en 1980, 1981, 1982, 1983, 1984, and 1985," Santiago, INDRHI Irrigation District Files, 1985; and

INDRHI, "Registro Asignaciones RD al Distrito/mes-1980-1985," Santiago, INDRHI Irrigation District Files, 1983.

Data that compare water fee collections with specific budgeted total O and M are hard to obtain. In Table 2-12 we saw the relation for 1984 for the two northern irrigation districts. The 1984 data involve collections made before the new rates went into effect, but both budgeted expenditures and collections had begun to rise. The comparisons shown for 1981 are adapted from FAO calculations.[50]

Some feeling for the on-farm economic impact of the level of water fee assessments can be obtained from further inspection of Table 2-14. Based upon 1979 cost of production data obtained by sample survey, SEA estimated that the unit cost of production of rice was RD$ 0.094 per pound. The yield per tarea would have been about 600 pounds. The water user fee per tarea at that time was RD$ 0.16 for rice. Thus about 1.7 pounds (out of 600 total) would have paid the low level fees of that era.

For 1985, the water fee per tarea for growing rice has been increased to about RD$ 1.25 as long as the total area dedicated to rice by one farmer does not exceed 159 tareas (ten ha); beyond that size the cost per tarea jumps to about RD$ 2.43. This is a fee jump in nominal terms of seven to 15 times. Continuing with the rice examples, but in the absence of any up-to-date hard cost of production data, we might suppose that the cost of rice production is RD$ 700 per ton in 1984-85. This would imply a unit cost of RD$ 0.15 per pound (say 0.20). The real cost of the new fee in terms of rice would be 6.25 pounds of rice per ton (12.5 per tarea for parcels > 10 ha). Thus, the real jump in fee may be about 3.6 times to 7.15 times.

Due to the fact that available 1979 data do not cover the same crops, or the fee was zero due to a non-state controlled water source, other examples cannot be computed with available data.[51] However, the rice case conveys an adequate feeling for the new situation imposed by the current fee formula. The new fees are still low but they are scheduled to increase by at least 100 percent in the next few years. At that 'final' level they may represent about 2 percent or more of the production cost of rice and 1 to 3 percent of the production cost of other crops.

e. Summary

Alto Yaque del Norte District is undergoing a number of major changes at the moment. The new conveyance system is just beginning to operate on approximately 5,000 ha of an ultimate command area of about 20,000 ha to be developed in stages. At the same time, the new tariff regulations are being enforced, and an effort has

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[50]Ibid., Tables 1, 1a and 4.

[51]Secretaria del Estado de Agropecaurio, Costos de Produccion por Entrevista, (Santo Domingo: Departamento de Estadisticas y Departamento Planificaccion, 1980), Resumen.

groups are authoritarian and mechanistic, little more than extensions of the INDRHI bureaucracy. In the other zone, the groups sense their strength in solidarity, and see themselves as partners with INDRHI staff. The two sets of attitudes are clear reflections of the attitudes and personalities of the INDRHI staff who organized the respective groups. As might be expected, the groups which emphasize collaboration and solidarity have taken a much more active role in O and M than the others.

2. Valle De Azua

a. Background

(1) Description

During the 1950-1960 period, agricultural activity in the Azua Valley was dominated by two large agricultural companies, the Dominican Sisal, C. por A. and the Dominican Fruit Company, which provided most of the employment for the people of the area. In the early 1960s these two companies ceased their activities. By the end of 1960, some vegetable production began to be developed, initiated by an Israeli group. By mid-1970, the Dominican government identified the lack of irrigation water as the major constraint to agricultural development and started work on the Yaque del Sur-Azua (YSURA) project.

The main features of the project include the following: the Sabana Yegua storage dam on the Rio Yaque del Sur with a capacity of 401 mcm and usable capacity of 368 mcm; a diversion dam at Villapando to a feeder canal linking to the Rio Tábara; and a diversion dam at Tábara to a concrete lined main canal which supplies water to the project. Six concrete lined laterals take off from the main canal and provide water to approximately 11,000 ha under the project. The capacity and area to be served by each lateral is shown in Table 2-16.

Each lateral is equipped with a control gate at the turnout from the main canal to regulate the flow. Below the gate is a Parshall measuring flume so that the flow to the lateral can be accurately metered. Turnouts from the lateral to the farm ditch consist of constant head double orifice control gates following the design of the US Bureau of Reclamation. These gates not only maintain a near constant flow to the farm ditch but also provide for water measurement and control. The farm ditches below the turnout are unlined but fairly well maintained.

Although storage is provided above the feeder canal, the fluctuating flow of the Río Tábara makes the water supply to the canal more or less like a "run of the river" system. At this stage of development only 7,038 ha, 64 percent of the command area, is being cropped. There is more than ample water, as evidenced by the fact that farmers do not irrigate at night. At the end of the day the ditch turnout is closed and the water is left in the lateral or main canal. At this stage of the project's evolution farmers can have water

Table 2-16: Capacity and Area Served by Laterals of the Yaque del Sur Project - Azua

Lateral	Capacity (m^3 sec)	Area (ha)
1	3.77	2,500
2	2.34	1,000
3	0.75	200
4	2.96	1,300
5	1.50	2,000
6	6.20	4,000
TOTAL	17.52	11,000

Source: Azua Project Office.

essentially when they want it and the YSURA project virtually functions as a demand system. Except during shortages, water is rotated within laterals during the daytime. The six laterals are each divided into smaller units, called sectors. A ditch rider located in each sector manages allocations within his sector. The rotation period varies by crop, but farmers can request water as needed. The rotation for sorghum is 15 days; maize is about 12 days; tomatoes, four to seven days; and peppers and melons are watered more frequently. Outside of the regular schedule, a farmer must request water from the ditch rider about two or three days before it is needed.

The team visited with farmers on both the head end and tail end of lateral number two in order to determine whether or not water is distributed equitably. It was found that inequity is not a problem because capacity and supply are more than adequate for the area now developed. As the development expands from the present 7,000 ha to the expected maximum of 11,000 ha, more stress will be put on the system, probably requiring round the clock operation and more rigid scheduling. At present, farmers seem to be doing a fairly good job of water management on their farms. The excesses, however, due to non-use of water at night and the luxurious use of the available supply are causing serious drainage problems in the lower parts of the valley. The project was put in service in 1978 and by 1982 drainage problems were already becoming serious, with more than 900 ha having a water table at less than 0.50 meter and an additional 4,000 ha with the water table at between 0.50 and 1.00 meter. The original project design did not include an adequate drainage network, but work is now underway to build drains which will carry excess water out of the valley.

(2) Agriculture in project area

Irrigated lands lying within the Azua District are concentrated in the Valle de Azua which is a relatively small area lying between the city of Azua and the sea. Some small water sources have been developed for irrigation for some time, but pumping the local aquifer formed the real basis for agricultural development during the 1960s and 1970s. This development was based on a concentration of production of vegetable crops. Beginning in 1978, about 4,500 ha began to receive water from the Sabana Yegua dam as part of the planned 12,000 ha YSURA (Phase I) project. As of 1984, about 7,300 project ha receive water. The remaining 10,000 plus ha in the valley continue to be irrigated on a catch-as-catch-can basis.

The most up-to-date estimate of farm families receiving State (project) water is 6,261. About 400 of them occupy lands in a sub-zone outside of the project. For the project as a whole, the average irrigated holding is two ha, but this varies somewhat according to whether a plot holder is settled in Instituto Agrario Dominicano lands that lie inside the project perimeter. IAD plots appear to average no more than 1 to 1.5 ha per family. Remaining project lands

which are classified as "private" average 2.5 ha in size. Slightly over 27 percent of the project area is divided into private holding of greater than five ha.[52] (See Table 2-17.)

According to parcel size distribution data shown in Table 2-17, project YSURA has far, far fewer large holdings than anywhere else in the entire country. About 67-68 percent of all farm plots within the project are less than two ha in size. (Although the data are identified by the valley as a whole, it is possible that the percentages refer mainly to the project YSURA. Some larger holdings (over 100 ha) exist outside the project perimeter.)

A wide range of crops are grown in the Valle de Azua: tomatoes, beans, maize, sorghum, peanuts, rice, cantaloupe, cassava and others. The most important cash crop is tomato. In a given year, 8,900 ha in the project will be seeded in relation to 7,580 ha actually receiving water. This suggests overall land use efficiency of 1.17.[53] One estimate is that about 30 percent of the seeded area would be in tomatoes. The next largest percentage (15) is for red beans.[54]

Some unknown percentage of small farmers manage three harvests per year. A typical rotation might be maize-beans-tomatoes. Farmers arrange in advance to sell the output of one trimester harvest--melons, peppers or tomatoes--to "The Company". Thus, they are assured of a cash market and can sell or consume the small grains they produce during the other seasons. "The Company" provides seed, credit and some degree of supervision of the specialty crop production process.[55]

According to FAO experts, the level of technique employed in the YSURA project could be much improved.[56] However, relative to the rest of the Dominican Republic, the level of inputs used plus reliance upon mechanical land preparation and on good soils, represents good technique. By national standards, income per tarea is high, and the

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[52]Estudio para el mejoramiento de los Sistemas de Riego Existentes, Table 4.

[53]Ibid., Table 5a.

[54]INDRHI, Recaudaciones por Zona.

[55]A. Espaillat, L.S. and H.H. Melo A., "Funcion de Producción del Agua en Interaccion con Nitrogeno en el Cultivo del Tomate Industrial, Lycopersicon esculentum" (Azua, Republic Dominica: Facultad de Ciencias Agronomicas y Veterinaries, Universidad Autonoma de Santo Domingo, 1984), p. 21.

[56]Estudio para el mejoramiento de los sistemas de riego existentes, Azua Section.

Table 2-17: Distribution of Parcel Numbers and Land Areas by Size Class in the Valle de Azua Irrigation Zone
(percent)

	P[a] (0<2 ha)	A[b]	P (2<4 ha)	A	P (4<6 ha)	A	P (6<8 ha)	A	P (8<10 ha)	A	P (>10 ha)	A	Total P	Total A
Rice	88.6	67.4	9.4	21.4	0.8	3.3	0.8	4.6	-	-	0.3	3.3	5.7	2.3
Others	63.3	26.3	20.8	24.1	12.4	21.1	1.6	4.3	0.5	2.0	1.3	22.2	94.3	97.1

[a] P = Parcels.
[b] A = Area in ha.

Source: Instituto Nacional de Recursos Hidráulicos (INDRHI), "Estadisticas de Distribución de Usuarios por Zonas," Santo Domingo, INDRHI Central Files, 1985.

amounts of land worked on average, keeps a single farmer busy. Hired labor would be required if average land holdings increased very much (and were cropped three times per year).

Table 2-18 suggests a range of income possibilities. These estimates are based upon the assumption of 25 tareas (1.57 ha) as the enterprise base and two different ways of working the land:

- o Three crop annual rotation: corn-beans-tomatoes; and
- o Cropping according to the weighted average of the cropping pattern for the whole project area.[57]

The apparently better income opportunities for small farmers relative to Yaque del Norte (Table 2-14) and La Vega (Table 2-20) zones show up in the assumption of 25 tareas for the Azua calculations in comparison to 40 tareas and 30 tareas in the other two; nevertheless more income can be obtained from the smaller parcel and the more valuable vegetable crops grown in Azua.

Unfortunately, the 1981 and 1979 data sources did not contain comparison estimates of all crop yields. Nevertheless, as in the Yaque del Norte example (Table 2-14), there seems to be substantial variation in yield estimates quoted from one study to another. Thus, considerable caution must be exercised when drawing conclusions from such data. The reported maize yields appear to be very low (3 qq per tarea = about 40 bushels per acre) for irrigated conditions (90 to 130 bushels per acre is not uncommon).

Table 2-19 supplies some indication of the historic economic impact of the District's water tariff. One pound of tomatoes out of a yield of 3,000 pounds (per tarea) could have paid the per tarea fee.

b. Project management

Four government entities are involved in the Valle de Azua irrigation district: INESPRE, BAGRICOLA, SEA and INDRHI. INDRHI controls the water supply, and provides the ditch riders as well as maintenance of the main conveyance features. The remaining three entities support farmers by providing technical assistance and a machinery backup. Farmers are responsible only for maintenance of channels which service their own fields. If the farmers are delinquent, they are warned by the ditch riders, who ultimately can cut off water until the work is performed.

Peak water demand occurs in December and January, and the water supply is shortest in June and July. When shortages occur, about one year in five, farmers must also irrigate during the nighttime. Given the abundant water supply, farmers seem satisfied with the irrigation

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[57]Anderson, PP: On-Farm Water Management.

Table 2-18: Partial Estimate 1979 Economic Value of Main Crops and Enterprise Potential, La Vega

Main Crops	Yield (qq/t)[b] 1979	Total Revenue/t[a] 1979	Total Cost/t 1979	Net Rev/t 1979	Est. of 1979 Farm Income[b] (RD$; 1.92 ha) 2 Crops Rice	Unit Cost of Production (lb) 1979	Water Fee/t 1979	Water Source	Level of Inputs	Technique Land Prep.	Land Quality
Rice	8.25	86.63	58.30	28.33	849.9	0.071	0.13	Gravity	High	Semi Mech.	A
			Retoño	18.00 est.	540.0	0.209	0	Spring	Low	Animal	B
Beans	0.90	29.70	18.88	10.82		0.065	0	Spring	High	Animal	B
Potato	16.96		67.65				0	Pump	High	Semi	B
Garlic											

TOTAL:		
	Year	1390
	US$/Year	927
	US$/Month	77
	# Days Labor Net Income Could Purchase	397

[a]Prices used: RD$ 10.5/qq rice; RD$ 33/qq beans.
[b]Range of farm income calculated by Devres Team.
[b]qq = quintales (100 lbs)/t = tarea (.63 ha).

Source: Secretaria del Estado de Agropecuario, *Costos de Producción por Entrevista*. (Santa Domingo: Secretaria del Estado de Agropecuario, Departamento de Estadist y la Departamento de Planificación, 1980).

Table 2-19: Estimates of Annual Economic Value of Main Crops and Enterprise Potential, Valle de Azua, 1979 and 1981

Export Crops	Yield (qq/t)[a] 1981	Yield (qq/t)[a] 1979	Total Rev./t 1981	Total Cost/t 1981	Total Cost/t 1979	Net Rev./t 1981	Est. of 1981 Farm Income (RD$; 1.57 ha) Rotation	Est. of 1981 Farm Income (RD$; 1.57 ha) Weighted Use	Unit Cost of Production (1b) 1979	Water Fee/t 1979	Water Source	Level of Inputs	Land Quality
Tomato	36.33	29.47	96.28	55.60	119.49*	40.68	1,017.00	355.95	0.040	0.05	Gravity	High inputs/Mech	A
Melons	2.50	—	215.00	37.25	—	177.50	—	443.75	—	—	—	—	
Hot Peppers	12.28	—	158.41	90.35	—	68.06	—	85.08	—	—	—	—	
Maize	3.00	2.04	27.50	19.00	16.95	8.50	212.50	31.88	0.083	0.05	Gravity	Low inputs/Semimech	A
Red Beans	1.36	—	61.12	26.55	—	34.57	864.25	172.95	—	—	—	—	
Cassava	—	6.87	—	—	27.87	—	—	—	0.041	—	Gravity	No inputs/Semimech	A
Peanuts	2.01	2.28	40.17	22.00	25.60	18.17	—	—	0.112	0.130	Gravity	Low inputs/Semimech	A
Rice	—	3.12	—	—	47.67	—	—	—	0.153	0.160	Gravity	Med inputs/Semimech	A
Sorghum	5.50	4.64	43.50	17.00	11.37	16.50	—	61.88	0.025	—	Spring	Med inputs/Mechanical	A
Bananas	75[c]	—	112.50	84.00	—	28.50	—	—	—	—	—	—	
Plantains	4,000[d]	—	200.00	95.00	—	105.00	—	100.00	—	—	—	—	
Other						40.00 est.							
TOTAL (1981 prices): RD$/Year							2,093.75	1,296.80					
US$/Year							1,046.86	648.40					
US$/Month							87.25	54.03					
# Days Labor Net Income Could Purchase							465[a]	288					

[a] qq = quintales (100 lbs)/t = tarea (.63 ha).
[b] Each.
[c] Measured in hands.
[d] Range of farm income calculated by Devres Team.

Source: Anderson, B. et al. Project Paper: On-Farm Water Management Project. (Draft), prepared for USAID/DR with support of Science and Technology Bureau sponsored WMSII Project. (Santo Domingo: US Agency for International Development, 1983), Table for 1981.

administration. The team visited the lateral which said by many to be the best in the system, but other observers have confirmed that the generally favorable situation prevails even in the less advantaged parts of the system.

Although the irrigated area in Valle de Azua project is neither large nor small by INDRHI standards, the average parcel size in the district is the smallest of all districts and many farmers are involved. As a consequence, the nominal number of INDRHI personnel stationed in the district is greater than anywhere else. The total breaks down as follows: Professional (five), mid-level technicians (five), sub-administrators and secretaries (15), special laborers and chauffeurs (four) Laborers and ditch riders (99).

SEA stations 35 professional and technical personnel in the valley. These people are responsible for extension of technical assistance and operation of tractor and equipment pools. (One person for every 182 irrigation families.) IDA handles its activities with 12 persons (one for every 522 families). The number of INESPRE employees is unknown.

BAGRICOLA spends about RD$ 5 per hectare per year and uses four vehicles. SEA provides 20 tractors and 15 vehicles and spends about RD$ 13 per hectare per year in the irrigation district. INDRHI spends at least this much again annually. Such support services may approximate 5 to 10 percent of net farm income per hectare per year.

According to the FAO technical investigations, the irrigation situation in the entire valley would require increases in both heavy earth handling and canal cleaning equipment. These experts suggest that INDRHI, SEA and BAGRICOLA personnel be reduced, and O and M expenditures be increased in the future.[58]

The YSURA project only commenced operation in 1978, and the cement lined canals and laterals are generally in good repair. Ditches leading off the laterals are unlined and must be kept free of weeds. Five to ten families appear to be served by each such ditch, so some coordination of cleaning is required. From the general appearance of the ditches seen by the team, a fairly good job of cleaning is being done.

The current operation of the system works to keep the laterals full two or three days per week. The farmers do not irrigate at night and the team noted that there was plenty of water in the laterals for all users. There was no tail end problem. Any lack of productivity is therefore due to management of other inputs.

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[58]Ibid.

c. Farmer participation

INDRHI has not started to form water user associations in Azua, as prescribed by the new law. Land reform farmers are organized in credit groups which continue to provide a local framework for contact with land reform and irrigation officials even if they lose their credit function. As the groups frequently consist of people who operate adjacent plots, they sometimes also serve as coordinating mechanisms for water distribution and field channel maintenance. In such cases, it may be superfluous or even counterproductive to insist on creating the official organizations. Rather, the existing associations should be utilized as much as possible.

Farmers outside of the land reform areas are not organized in the same fashion. However, it was not clear to the team whether this lack of organization impedes the smooth operation of the irrigation system. If so, INDRHI should direct its efforts in such areas, rather than undertake a general, system-wide campaign to organize water users.

Overall, farmers have a limited role in the operation and maintenance of the system. Farmers and INDRHI personnel seem to have a good rapport, and information flows well between the various governmental and private entities working in the area, and the farmers. Once the remainder of the planned command area is brought into the system, however, the stress on available water supplies will require both farmers and officials to change their practices somewhat. Officials will need to establish less flexible rotation schedules and farmers will need to achieve higher levels of cooperation within turnout units and between sectors. Both ends can be served by gradually transferring responsibility for the management of sector units to the farmers themselves.

d. Cost recovery

There are a number of irrigation district zones where water fee collection rates have reached 100 percent, but they do not include the YSURA project. In 1981, the FAO survey of water system improvement possibilities found that collections were made from 55.9 percent of the users in the project zone. From the standpoint of the district, there is automatic collection of fees from those families settled on agrarian reform lands, at last to the degree that such settlers do business with BAGRICOLA (water fees are collected in the credit/repayment process). Fruit and vegetable processors or marketing companies which offer credit also include the water tariff and make certain the district gets paid. Actual fee collection is somewhat hampered because there are a relatively large number of plots and farmers inside the project perimeter.

Farmers who do not receive credit through the bank or marketing institutions tend to ignore the tariff because paying it is a nuisance, not because they object to it in principle or because they think it is too high. Indeed, by all accounts farmers in Azua have no problem with the tariff. They can afford the current tariffs and will have no difficulty meeting future increases.

Until now, the Azua District office has limited its collection efforts to the credit-giving channels; it has not attempted to collect tariffs from individual farmers. Consequently, any deficiencies in cost recovery reflect collection problems and policies, not the recalcitrance or delinquency of farmers.

However, it may be assured that the irrigation district personnel will implement the new directives that already have been described in detail. Under the new procedures, the tariffs will be set at levels seven to eight times higher than in the past. Not much rice is grown in the project (see Table 2-17) and the plot sizes are small, so the great bulk of water users will be asked to pay the same rate per hectare. Again, nothing in the new water fee procedures suggests any intention to recover the investment cost of the Sobana Yegua dam, the two diversion structures or the conveyance works.

Little information was available showing the historic relation between amounts budgeted to the district for its cash O and M outlays and amounts collected and forwarded to INDRHI headquarters. In 1981, however, the FAO survey mentioned at several points previously, created an estimate of total INDRHI expenditures in the Valle de Azua District of RD$ 20 per hectare. The collection for the same year averaged about RD$ 1.55 per hectare. About 9 percent of the total O and M expenditures were collected from water users. (Estimates of the overall amounts for the whole project are shown in Table 2-12 for 1981.) In 1981, a 9 percent recovery was one of the lowest of any zone or district in the country.

In the future, if the new procedures are fully implemented, collections will equal programmed expenditures plus expected administrative and operating outlays. Eventually, the districts will retain the programmed expenditures.

e. Summary

At present, the Valle de Azua is a smoothly working system with abundant water supplies being used for high value crops. Moreover, it benefits from a well-articulated support structure which provides inputs, credit and technical assistance for crop production, as well as markets. The new On-Farm Water Management Project will undoubtedly benefit farmers, but it will do so by refining an already favorable situation, not by qualitatively changing the irrigation environment.

INDRHI's cost recovery program is feasible in Azua. Farmers will be able to pay the increased water charges without difficulty. Indeed, the collection mechanism is so mechanical that most farmers will never know they have done so.

Previous cost recovery efforts were plagued by deficiencies in the collection program, more than anything else. Now that it is clear that INDRHI intends to apply its policies seriously, it should encounter no opposition from farmers. Cost recovery in Azua has been unrelated to any important element of system operation and maintenance, especially application efficiency. In the future, payment levels may begin to reflect levels of service, but that remains to be seen.

The abundant water supply determines current irrigation practices, rather than any other factor. Water charges will increase irrespective of water use, thus any changes will not affect water use. The current drainage problems are only partially related to farmers' water use, because water flows through the system whether or not it is applied to crops. The drainage situation might be relieved somewhat if water were used around the clock for agriculture, but such use does not correspond to the farmers' present needs. Increased cost recovery will not affect this problem.

Farmer participation in irrigation management is not formalized in Azua, and this does not seem to affect either cost recovery or the O and M situation to date. In the future, however, farmer participation should be encouraged, especially because farmer associations, formal and informal, can be used as mechanisms to resolve problems which will undoubtedly arise when the command area is increased and the resulting stress on water supplies becomes evident.

3. La Vega

a. Background

(1) Description

La Vega is located on the upper tributaries of the Rio Camú approximately 125 km northwest of Santo Domingo and 30 km southeast of Santiago. The irrigation of this region is some of the oldest in the Dominican Republic and problems of drainage are the most advanced. The area was originally developed as pasture land but is now devoted almost exclusively to rice, with 6,966 ha reported to be cropped. A 1984 FAO report noted that drainage problems exist on approximately 80 percent of the area, with more than 5,700 ha having a water table at less than one meter. This partially explains the predominance of rice.

The field inspection covered both head and tail areas of the system. INDRHI is responsible for the cleaning of the main canals and laterals and machines are used. Hand cleaning of laterals and field ditches is also accomplished. The system appeared to be fairly well maintained and not overgrown with vegetation, indicating that the cleaning of canals was not neglected.

The water delivery schedule is on a 24-hour basis and the water supply was said to be short almost every year. Under normal conditions rotation is up the lateral, especially when the supply is critical. In extreme stress conditions the farmers request water and are able to obtain it. The normal period between turns is from six to eight days.

In one area, the farmers said they jointly hired a member of their credit group to distribute the water and irrigate for the group. The farmers of the group rotate the position among themselves; all pay their share amounting to RD$ 2.50 per year. The irrigator is instructed to give priority to lands needing water.

(2) Agriculture in the project area

The Irrigation District Yuna-Camú covers one of the largest areas of all seven irrigation districts and is extensively devoted to rice cultivation. This is the region where much of the private development of small systems for rice production occurred prior to 1960. Based upon INDRHI estimates, the overall land utilization ratio for the entire irrigation district is about 1.50.

The La Vega Zone, the largest of the five included in the district, was the area visited by the team. Land utilization is the most complete in this zone. According to adjusted FAO survey data, the land use efficiency ratio for lands actually receiving water is 1.90.[59] This drops to 1.39 when allowance is made for fallow, or waterlogged lands or for areas that for some reason are not serviced.

About 2,980 families receive water from state irrigation systems. The average parcel size is five ha (79.5 tareas) but 81 percent of all parcels are under five ha in size. Due to restrictions on the maximum plot size allowed to agrarian reform farmers, we may assume that at a minimum, all the larger plots (roughly 22 percent of the holdings in the area) are in private ownership. Table 2-19 illustrates the pattern of land utilization in some detail. Production is overwhelmingly centered on rice and is concentrated in larger parcel sizes. Although the team saw some irrigated pasture during its visit, this land use is not mentioned in the statistical sources available.

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[59]Ibid., Tables 1 and 5.

If a full rice crop can be grown twice a year, a single family can do fairly well even on a small plot, but many farmers do not have adequate water for a second crop. Thus, considerable reliance is placed upon the retoño practice, already described.

In the La Vega Zone, the river diversions are from the Camú, which has no storage. Thus, the bulk of the irrigation is on a run-of-the-river system. The actual water that can be diverted varies according to runoff from the watershed and annual rainfall. The risk of low water supplies during the second rice crop is the basis of the retoño system. Rice yields for the main crop average 3,500 to 4,000 kg per ha (which is not outstanding by world standards). The yield under the retoño system is about 50 to 60 percent of a regular crop.

All rice is purchased by local mills which in turn sell the polished grain to INESPRE, the state agency that controls pricing and marketing of this important product. Farmers large and small thus have a steady market for their output and will try to grow rice if they think they can be successful, rather than other small grains.

Table 2-20 contains some abbreviated production cost estimates for 1979. Unfortunately, more up-to-date price and cost data could not be located by the team. The table shows that a parcel size of 1.92 ha (30 tareas) would produce net income of RD$ 1,390 per year from one regular and one retoño rice harvest. The amount of net income under these assumptions would have been enough to hire about 400 days of ordinary labor.

Two pounds of rice out of 825 pounds per tarea could have paid the 1979 district water tariffs under the previous collection system.

b. Project management

La Vega is one of five zones in the Yuna-Camú District. The district contains over one-fourth of the total state irrigated land in the Dominican Republic, and La Vega includes about one-fourth of the district total.

On the surface, the Yuna-Camú District has an organizational structure which resembles other districts: a district administration, five zonal offices, and individual irrigation systems divided into sectors, as appropriate. The official hierarchy is also the same, going from a District Director to Zonal Directors to ditch riders on the sector level. In the field, however, one would expect to find a qualitatively different management situation than those found in Azua or Yaque del Norte. Yuna-Camú contains a number of systems of different sizes, located all over the area, drawing water from a number of different sources; thus the logistics of maintaining contact with each of the systems, let alone managing them directly, must be formidable. Moreover, a number of the systems are small, technically unsophisticated systems which serve paddy lands and do not present special scheduling problems, such as those found on the old canal in

Table 2-20: Distribution of Parcel Numbers and Land Areas by Size Class in the La Vega Irrigation Zone in Percent

	P[a]	A[b]	P	A	P	A	P	A	P	A	P	A	Total P	Total A
	0<2		2<4		4<6		6<8		8<10		>10			
Rice	32.0	6.4	45.4	23.3	7.5	6.0	4.6	5.3	1.7	2.5	8.9	56.5	95.5	97.8
Other	62.8	21.1	24.4	25.2	5.1	9.4	2.6	6.6	1.3	4.5	3.8	33.2	4.5	2.2

P = Parcels
A = Area in ha.

Source: INDRHI, Estadisticas de Distribucion.

the Yaque del Norte, described above. Such systems do not need as much administrative attention as the other ones visited. In such a diffuse situation, one would therefore expect INDRHI to spread its manpower unevenly in the zone, as was stated to be the case although this point was not verified by field visits.

As regards maintenance responsibilities, tariff rates, water allocation priorities, distribution mechanisms, and so on, the zone is not unusual. Other than the fact that the Yuna-Camú District is very large and contains a hodge-podge of systems as a whole, the biggest difference between it and other districts is the high level of tariff collection, which may be less real than apparent, as indicated below.

c. Farmer participation

The number and varying size of systems within the La Vega Zone--41 systems ranging from 15 ha to 7,000 ha--suggests that the amount of farmer participation probably also varies from one system to another. It is likely, for example, that farmers participate actively in most decisions which affect the smaller systems, yet it is clear that INDRHI controls the largest system, Camú. Even in Camú, however, where INDRHI is responsible for O and M, including water distribution, farmers do distribute water to plots within the turnout units except during drought periods. There is no indication, however, that water users participate in decisions affecting system design, O and M budgets, water allocation priorities, tariff levels, or INDRHI personnel.

INDRHI staff in the La Vega Zone started to organize water user associations in late 1984, and about eight of the 41 systems in the zone now have user groups. District staff claim that the groups will be helpful in two ways. First, they will participate in zonal planning sessions to identify problems and maintenance priorities and to set INDRHI's annual work program. Second, they are expected to organize and oversee minor maintenance activities.

As in Yaque del Norte, the zonal offices are responsible for organizing the groups. The standard organizational model is used, which consists of a nucleus group at a turnout on a lateral, which may be as large as 200 has, and an association with an executive committee at the sectoral level. In forming the groups, staff have approached existing Farmers' Associations, (Asociaciones de Agricultores), inviting them to establish Irrigators' Associations (Asociaciones de Regantes. Thus the associations are sub-groups of existing groups, or re-groupings, not entirely new creations. The team visited Camú, a system which has yet to be organized, so it was not able to assess the structure, strength or impact of the official organizations. However, in Camú the team encountered one Farmer Association, and one informal group, both of which are active and viable.

The informal group is the remnant of a land reform credit group, consisting of 15 farmers located on a 750-tarea (47 ha) land reform plot. Each year, the group appoints one of its members to manage water distribution within the plot, for which he is paid RD$ 250 per year by each of the other members. Rice is the principal crop; although farmers rarely have enough water for a second crop, they usually try to start a ratoon crop after the rice harvest until the water situation becomes clearer. This group is interesting because it illustrates two important points. First, informal water management groups exist in the system, and presumably in other systems, which should be incorporated in any organizational effort rather than ignored. Second, farmers understand the value of water so well that they are willing to pay considerably more than the prevailing water charge to have it managed properly.

The second group is a Farmers Association which was established as part of the land reform program. Essentially a cooperative, the Association operates farm machinery, provides inputs and markets some crops. There are 50 members, most of whom seem to be land reform parceleros. The members operate 9,000 tareas (563 ha), which indicates either that they obtained unusually large land reform parcels, or that the membership includes a number of large landowners. The discussion with members of the group brought out two main points. First, located at the tail of the system, they are acutely aware of the limits of the irrigation system. Their lands inevitably suffer when water shortages occur. They estimate that they lose their second rice crop in seven out of ten years, at an annual loss of about RD$ 3 million. Credit is easily available for rice, so most farmers invest in a second crop, lose it, and remain in debt. Last year, the Agricultural Bank cancelled many debts, but the cycle continues. Second, the members are aware of alternatives and want to contribute to improving the system. For example, they described a proposal which would take water from a point 8 km downstream from the existing diversion weir and lift it six or seven meters into a canal that would connect to the current distribution network. The farmers said they would gladly share the cost of such an investment with other beneficiaries.

The team was not able to discern how prevalent such groups are in Camú, or to what extent the two are typical of existing groups. In particular, it was not made clear whether non-parceleros also participate in farmer associations, formal and informal, or if they have their own groups. Additionally, it was not possible to determine the nature of the relationship between parceleros and non-parceleros in mixed areas. If, for example, non-parceleros are not well organized, or easily organizable, or if they tend to be dominant in their interactions with parceleros, rather than egalitarian, it will be difficult to establish a system-wide network of functional water user groups without investing considerably more attention to the effort than is now possible, and without calling upon organizational skills which are not currently available in INDRHI. However, if such groups are

prevalent in the system, and if the two examples are typical, then it appears that the district has adopted a promising organizational strategy.

d. Cost recovery

As part of their survey of Dominican Republic irrigation systems, FAO teams calculated that 100 percent of the farmers in two of the five zones of the Yuna-Camú Irrigation District paid irrigation fees in 1981; the payment rate for the La Vego Zone was 87 percent that same year. These results support the opinions of INDRHI technicians who told our team that the rice regions were the most faithful in paying the water tariffs presumably because the fee is paid as part of the input credit package for rice. The volume of money collected in 1984 was about double that of any other district.

As in the case of other projects visited, the local district and zone personnel are implementing the new directives concerning water fee imposition and collection. Farmers interviewed by the team realized the fees were rising and were concerned because rice profits are being squeezed at present. However, their main interest is in increasing and stabilizing water supplies, because they know that over the long pull the domestic demand for rice will be steady and growing. One user group association is pressing INDRHI to establish a new intake in order to divert water which currently is discharging into the river below the present intake.

Although precise figures are not available, the central budget allocations for O and M have been rising in recent years, just as in other districts. In the 1985 budget, for example, the Yuna-Camú District will receive more than double the amount of any other district in the country and is the only district that allocates nearly 75 percent of its budget for maintenance (27 percent for administration and operations).

These figures suggest the importance of the district in INDRHI's overall operation. In addition, historically, it seems that the district has done far better on collections as a share of O and M. In 1981, for example, when the district O and M budget was far higher than that of any other district, the receipts from water users equalled 37.3 percent of O and M. In that same year, the next highest collection ratio was 22.1 percent. (See Table 2-12.)

If the 37.3 percent figure is related to just the part of annual budget expenditures that is actually handled in the district, as opposed to the share administered directly from Santo Domingo headquarters, it is probable that the collections represented at least 50-60 percent of the former. As the water fees rise, under the new program, covering 100 percent of the "discretionary" O and M budget should be achieved easily. The only dark spot in this picture is the price cost squeeze rice producers are in at present and the uncertainty of how long it will continue.

e. Summary

Camú was designed to irrigate pasture lands, but is being used primarily for rice, with frequent problems of water shortage. The system seems to be maintained adequately and farmers are felt to use the water efficiently. However, the combined efforts of farmers and INDRHI staff cannot overcome real system limitations.

If farmers could be sure to receive adequate water for a second rice crop, then INDRHI's plan to recover the full cost of O and M through water charges would be perfectly feasible. However, such assurances cannot be made under current circumstances: the water supply is ultimately too short at some time during most years. When the shortages appear, some farmers always seem to get a second crop, and others virtually never do. A program which expects all farmers to share the cost burden equally will exaggerate the inequities which already exist. Although the same could be said for other systems, the impact is greater for rice than for other crops, in terms of both the yield impact of short-term drought stress, and the value and marketability of the crop. Consequently, if INDRHI intends to recover full O and M costs, it should consider revising the calculation schedule to cover each rice crop separately. A reasonable formula could be derived, using average cropping figures for the last five years as the base. When so applied, the charges would fall equitably upon beneficiaries. If the cropping base is formulated properly, the resulting levy should cover full costs during normal years and generate a surplus during good years.

The tariff payment rate in La Vega is higher than the other systems visited, but there are no indications that this is due to farmer participation, water supply, water measurement, or any other factor relating to system operation. Nor does it seem to reflect the farmers' perception of the value of the water, as INDRHI officials claim. The team noted no attitudinal or behavioral differences between La Vega farmers and farmers in the other systems. Rather, the high payment rate in La Vega is the clearest indication of the success and limitations of INDRHI's standard collection policy. That is, INDRHI tries to collect tariffs unobtrusively, through credit packages from companies and institutions, rather than directly from farmers. Credit is easily available to rice farmers. Most of them take credit, thus most of them pay their tariffs without special effort and without much choice in the matter.

Increased water charges are necessary for continued or improved O and M, as in other INDRHI systems. As in the other systems, it is unlikely that increased charges will improve application efficiency. The critical elements in Camú, as elsewhere, is scarcity. When water is short, people use it carefully, steal it, or try to ingratiate themselves to the distributor to get extra water.

To what extent increased participation will improve O and M remains to be seen. Much of the impact of organizing farmers will depend on the organizational strategy used, as well as the ultimate role and responsibilities assigned to the user groups. In La Vega as elsewhere, INDRHI still needs to clarify this question.

D. Summary and Conclusions: Study Issues

1. To what extent is cost recovery through direct and indirect charges a feasible goal in irrigation systems?

In the Dominican Republic, a program is underway to raise irrigation fees and to enforce collection, to make each irrigation district self-sufficient over the next few years. There seems to be little opposition to the program, but it is clear from discussions in the field that farmers have not been informed about the whole program. They may know that irrigation rates have doubled over the last year, but they do not know what will happen next.

Fortunately for INDRHI, the rates are not seen by farmers to be high. Indeed, many farmers pay their irrigation fees essentially without knowing about it: fees are routinely included in the credit package issued by the Agricultural Bank, as well as fruit export companies, which then make payments to INDRHI. Moreover, the low cost recovery rates which have prevailed in the Dominican Republic are attributable not to the reluctance or refusal of farmers to make payments, but to the low level of the fees and INDRHI's reluctance to enforce collection. Thus, although the evidence is not complete within the above case studies, it does appear that recovery of O and M costs via direct and indirect charges is a feasible goal in the Dominican Republic.

2. Do increased farmer participation and control contribute to improved cost recovery?

INDRHI has recently begun to implement a program to organize water users and involve group leaders in planning discussions. Groups have been formed in some areas, and formal consultation may become routine this year in such areas. The program assumes that water user associations will help improve cost recovery rates and reduce maintenance costs, but the mechanisms for achieving these ends do not seem to be thought out clearly. Indeed, discussions about water user associations usually include references to mechanisms to enforce water charge payment. Thus, if the organizational effort succeeds, it will be difficult to separate the impact of the carrot (associations) from that of the stick (sanctions). Although this may not be a problem for INDRHI, it does make it difficult to predict the outcome of the change.

3. To what degree does improved cost recovery depend upon reliable water supply, adequate water supply, water delivery and measurement technology?

a. Reliable water supply

In the Dominican Republic, as in Peru, there is a clearer link between the reliability of water charge collection and cost recovery, than between the reliability of water supply and cost recovery. In only one instance in the Dominican Republic did farmers say that they previously did not pay the fee because their water supply was irregular. If INDRHI continues to emphasize the collection of tariffs indirectly through institutional means, rather than directly from farmers, the reliability of water delivery may never become a clear issue.

b. Adequate water supply

As above, the tariff levels have been too low, and collection patterns have been too closely related to the use of institutionalized production credit to indicate a relationship between cost recovery and the adequacy of water supply. Once tariffs increase, some linking pattern may appear, or protests may increase from farmers who regularly get short supplies. Although the data available do not indicate a link until now, INDRHI should consider adopting provisions to reduce water charges for farmers who do not receive enough water, such as those at the tail end of the Camú System.

c. Water delivery and measurement technology

None of the systems we visited has measurement technology which is applied at the farm turnout level. In Azua, measurement is possible at turnouts on the main laterals, but not below. Consequently, in no system is it possible to do more than estimate the amount of water which may reach a farmer. In any case, there is no indication the level of cost recovery is affected by the presence or absence of reliable measurement devices.

4. Are increasing water charges a necessary and sufficient condition for improved O and M? To what extent does efficiency of water use vary with the cost of water?

a. Are increased water charges a necessary and sufficient condition for improved O and M?

The situation in the Dominican Republic resembles Peru to the extent that individual systems and districts are expected to become self-sufficient with respect to O and M in the near future.

However, the Dominican Republic's low water charges and the reluctance of INDRHI to collect fees has sometimes led to less revenues being collected than expenditures being made for O and M for specific irrigation systems. As explained earlier, to date, water charge revenues from each system are not retained for O and M as O and M self-sufficiency is sought, however, increased water charges will be necessary to attain the same or improved O and M in many cases.

Such increased fees alone will not be sufficient to achieve improved O and M. However, given the low costs for irrigation administration at the system level and the beginning labor contributions of some farmers groups, adequate water charges are likely to lead directly to improved O and M, especially where meagre central budgetary allocations have constrained local official's ability to provide additional O and M effort.

The relationship between increased water charges and improved O and M will be influenced by the degree of farmer participation in both fee setting and O and M, especially where water charges need to increase substantially. At present, INDRHI officials set the tariff levels; farmers now have no say in the matter. There are plans to allow farmers to participate in the formulation of annual maintenance plans, which will in turn affect tariff levels. Presumably, the user associations will be vehicles for such input, but the situation is too new to predict how the process will be established, or what will be the ultimate impact of this policy.

The Yaque del Norte system illustrates the possible utility or irrelevance of water user groups, depending on the premises upon which they are formed. The INDRHI official who formed the groups on the old canal fostered an attitude of collaboration and cooperation by establishing a clear problem identification role for the groups, and then by attempting to resolve the problems that were identified through the groups. In contrast, the official who formed groups along the newer canals fostered a more authoritarian attitude among group leaders, who understand their role to be that of enforcing INDRHI directives. In the first instance, farmers have started to take an active part in maintenance, supplementing INDRHI's traditional role and even substituting for it. In the other, group leaders have assumed a more passive, regulatory function. Their groups have had more limited impact on O and M, and offer little promise for the future unless they are significantly reoriented.

b. To what extent does efficiency of water use vary with the cost of water?

The systems we visited did not constitute appropriate situations in which one could generate data to determine possible links between water prices and application efficiency. In none of the systems is water cost related to water use in such a way as to

encourage farmers to use less water than they have available. There are any number of instances in which application efficiency is affected by water scarcity, but not by the level of water charges.

5. Do institutional arrangements whereby farmers participate in and control irrigation systems improve O and M?

The Dominican Republic has not encouraged participation until recently, but the example of the old canal in Yaque del Norte indicates a possible link between participation and improved O and M. Given a proper orientation and minimal institutional encouragement and support, farmers started to take an active hand in maintenance.

Participation may be informal or highly formalized. The Dominican Republic has recently decided to establish formal participatory mechanisms, but the level of implementation varies considerably from one situation to another. Moreover, the level of nascent, informal organization also may vary. In general, the degree of formalization required for effective participation can be expected to be related to the size and complexity of the irrigation system, the magnitude of financial input necessary to carry out O and M (vs. in-kind, labor inputs), and the size and degree of centralization of the irrigation authority.

INDRHI is urged to proceed by engaging in a two-step exercise. First, it should clarify more precisely and concretely the proposed functions of the associations, and the desired outcome of the organizational effort. Second, instead of promulgating a standardized organizational model, INDRHI should allow districts and zones to establish locally specific associations, based on existing formal and informal groups wherever possible. Until the objectives and rationale are clear, the effort is not likely to succeed over the long run. Even if associations are formed, they are not likely to last long unless their existence is meaningful. Once the rationale and objectives are clear, INDRHI should not attempt to dictate organizational forms or formats.

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