3. RECOMMENDATIONS

3.1 Earlier Implementation of the Project

Considering economic and social effects of the Project not only in the regional level but also at the national level, it is recommended that the Project be implemented as early as possible in succession to the El Pozo Project. Because the Project involves various components, appropriate coordination among related public organizations is desired.

3.2 Project Implementation Agency

The INDRHI will be the leading agency in charge of construction works, but the Project should be implemented with a establishment of an organization integrated with the INDRHI, the IAD (farmer's settlement program) and the SEOPC (rural road construction).

3.3 Detailed Design

(1) Detailed soil mechanical test and topographic survey should be carried out before designing of major structures.

(2) A hydraulic model test will be useful in designing the outline of an emergency floodway.

(3) As for peat swamps in which considerable amount of embankment works are proposed, an embankment test should be conducted in advance so that the soil settlement might be estimated.

3.4 Construction Works

(1) Before the commencement of the Project, prudent coordination should be made in respect to land aquisition of proposed facilities' site.

(2) Aiming at the early realization of project benefits, construction works should be started on irrigation structures; nevertheless, in swampy areas, the priority in construction procedures should be given to drainage works in these areas.

(3) Farmers whose production activity is to be suspended due to the construction works should be given priority for being employed as construction workers.

(4) Since coastal features are sometimes changed by the construction of a training dike, it will be necessary to consider the phased implementation of construction works while changes in coastal features are observed.

(5) Information and data compiled in the course of implementing the El Pozo Project should be duly consulted for carrying out construction works in swamps and other areas.

3.5 Social Infractructure

(1) Constituting an essential factor for the consolidation of farmer's settlement projects within the study area, social infrastructures such as water supply and electricity should be adequately provided in coordination with other surrounding areas.

(2) It is recommended that an integrated farmer's settlement program combining actually settled farmers with newly settled ones should be formulated.

3.6 Cropping Technique

(1) Since the rice production depends greatly on the growth of seedlings, an appropriate cropping technique on seed management, seeding quantity, preparation of nursery, etc. should be extended.

(2) So as to enable the efficient introduction of double cropping with improved varieties of rice, it is advisable to establish a model field in a peat swamp, in which the selection of varieties, fertilization methods and crop cultivation management will be carried out by a public institution.

(3) With the implementation of the Project, it is expected that rice production would increase annually by approximately 50,000 tons; in the light of this, the expansion of actual rice storage facilities will be planned to meet the increase in rice supply.

3.7 Project Management and O/M Organization

(1) The success of the Project will depend largely on the management, operation and maintenance of facilities. For this purpose, an independent organization for the Project should be established with the participation of INDRHI - leading agency, IAD, and SEA.

(2) For the effective attainment of the Project objectives, it is advised that newly recruited beneficiaries should be publicly informed of the outline of the Project. They should also be trained with respect to the operation and maintenance system of irrigation and drainage facilities within the field.

3.8 Promotion of Farmers' Cooperative Association

Farmers' cooperative association is generally superior to the independent farmer in the context of such agricultural activities as crop sales, agricultural credit, mechanization of crop cultivation, etc., so it is recommended that this organization should be promoted within the Project.

3.9 Flood Alleviation Project

No flood alleviation project has been established within the Project with the flooding return period of 1:5 year established for the Project. Nevertheless, it is advisable that a long-term flood control program for the Yuna River be established to cover its entire catchment area including the lower area. For this purpose, it is recommended that hydrological observation should be continued more intensively.

3.10 Development of Peat Swamps

Peat swamps within El Guayabo area have been excluded from the development area, because urgent development of these lands are not recommended from the viewpoint of technical and economic feasibility.

In developing peat swamps, environmental aspects such as the conservation of mangrove and other forestal resources should be taken into account; furthermore, they should be evaluated with respect to the possibility of being developed for other uses, i.e., inland fishery, animal husbandry, etc.

In any case, the development of peat swamps requires high investment and longer period of construction works, a long-term development program to be coordinated with national development strategy should be prepared.

4. REPORTS

The actual situation and development plan of the study area and other information related with the Study are compiled in the following reports.

1. Volume 1: Main Report (English and Spanish versions)
2. Volume 2: Annex (English version - Supplementary Information to the Main Report)
3. Volume 3: Drawings (English version)

CHAPTER 1: INTRODUCTION

CHAPTER 1 : INTRODUCTION

1.1 Background of the Study

The territory of the Dominican Republic covers 48,442 km^2 with an elevation above sea level varying from 0 m to 3,000 m. About 20% of the national territory is classified as land of agricultural potential, where various crops are cultivated.

The agricultural production of the Republic is dominated by such exports as sugar, coffee, cacao, etc. and the development of these products have stagnated in recent years. Meanwhile, the producion of grains has not caught up with the growth of the population, which forces the country to import a great deal of foodstuffs.

The emphasis of the country's economic development plans is laid on the agricultural sector and development programs are implemented to achieve objectives of the national strategies: self-sufficiency in foodstuffs, control of rural-urban migration by means of creating more employment opportunities in rural areas and improvement in the balance of payment problem by increasing output of agricultural products and their derivatives. In line with this national strategies, the Government of the Dominican Republic has implemented various development projects for the extension and consolidation of farmlands and basic infrastructure for agricultural production; land reform projects have been carried out by the Agrarian Reform Institute (IAD) and irrigation facilities development projects by the National Institute for Hydraulic Resources (INDRHI).

Based on this understanding, the AGLIPO Agriculture Development Project which is aimed at increasing rice production by extending farmland and consolidating the agricultural infrastructures is being implemented in the north-eastern part of the Republic in which the country's granaries are concentrated.

The AGLIPO Project was started in May 1979 with the technical cooperation of the Japanese Government in response to a request made by the Dominican Government; taking its high priority for development into account a Feasibility Study was carried out by the Japan International Cooperation Agency (JICA) with respect to the El Pozo Area in June, 1980 thru January, 1982.

Based on the results of the said Feasibility Study, the Government of Dominican Republic requested economic assistance and cooperation from the Government of Japan. In response to this request, the Government of Japan has pledged economic cooperation amounting to Japanese Yen 8,825 million (equivalent to US$34.6 million) and the loan agreement for economic cooperation was signed by the Government of Dominican Republic and the Overseas Economic Cooperation Fund (OECF) of Japan on May 11, 1983. The detailed design of the Project was completed in 1984 and the construction works have been carried out since September, 1985.

The Government of the Dominican Republic, for the purpose of developing the project area, requested the Government of Japan for technical assistance to implement another feasibility study of the agricultural development in the Aguacate-Guayabo area which is located adjacent to the El Pozo area with similar socio-economic and physical conditions. The Japanese Government accepted the request and dispatched a preliminary study team headed by Mr. Masahiro Suzuki in November 1984, followed by the agreement on the Scope of Work for the Feasibility Study for the Aguacate-Guayabo Agricultural Development Project (hereinafter referred to as the "Study"). In accordance with the Scope of Work, JICA dispatched a study team to conduct field works Phases I and II between 1985 and 1986.

1.2 Scope of Work for the Study

The scope of work for the Study made and agreed upon by the Governments of Japan and the Dominican Republic are summarized as follows:

- Preliminary design of irrigation/drainage facilities
- Implementation schedule of the Project
- Estimation of cost and benefit of the Project
- Evaluation of the Project

1.3 Description of the Study

1.3.1 Objectives of the Study

The purpose of the Study is to formulate an optimum agricultural development plan after investigating and analyzing the actual situation of the Aguacate-Guayabo area and to evaluate its technical and economic feasibility, which should be made within the national development strategies of: contribution to the self-sufficiency in foodstuffs by means of achieving a stable and high agricultural production, and realization and consolidation of the farmer's settlement.

The objectives of the study are briefly summarized below.

- To investigate water and land resources in the study area which covers approximately 24,100 ha (8,400 ha in the Aguacate zone and 15,700 ha in the Guayabo zone) and to examine their development possibilities.

- To formulate an agricultural development project, to establish an optimum development area and plans, and to verify its technical, economic and financial feasibility.

- To undertake on-the-job training and transfer of technology to the Dominican counterpart personnel during the course of the study.

1.3.2 Outline of the Study

The Study is conducted in two phases, each of which comprises field works in the Dominican Republic and the home office works in Japan.

(1) Phase I Study

The Phase I Study is divided into two components: field works focused on the collection of information and data both within and without the study area, and formulation of basic development concepts in line with analysis and consideration of collected information and data.

1) Field Works (July 1 - September 15, 1985)

a. Collection of data and information necessary for the Study (climate, hydrology, irrigation and drainage, land use, soils, geology, agriculture and agro-economy) and field survey.

b. Topographic survey required to modify existing maps with a scale 1/10,000 and to prepare new maps.

c. Installation of hydro-meteorological equipment: automatic water level gauge (at the outlet of the Cano Gran Estero and La Jagua on the Yuna River), tide gauge (Sanchez Port), pluviometer (El Guayabo), and meteorological station (El Aguacate).

d. Preparation of the Progress Report (I)

2) Home Office Works

In Japan, based on the data and information collected in the course of the field work, the Study focused on:

a. a review and analysis of the data and information collected during the field survey,

b. the modification of existing topographic maps with a scale of 1/10,000,

c. formulation of the Basic Development Concepts, and

d. preparation of the Interim Report.

(2) Phase II Study

Field works in accordance with the basic development concepts formulated in the Phase I Study and preparation of the Report have been made.

1) Field Works (November 18, 1985 - January 31, 1986)

The Interim Report comprising basic development concepts was presented to the Government of the Dominican Republic for review and discussion. After an agreement on the contents of the Interim Report between the relevant parties, the following studies were carried out so as to supplement the Phase I Study.

a. Collection of necessary data and information (hydrology, irrigation and drainage, soils, land use, facilities plan, implementation plan, cost estimation, farming program, agro-economy and socio-economy) required to formulate the development plan.

b. Geological survey by means of a mechanical boring test at the proposed sites for main irrigation facilities (head-works, regulating reservoir, pumping station, tide gate, etc.).

c. Review of the basic development concepts and formulation of alternatives for the development area and water intake method.

d. Preparation of the Progress Report (II)

2) Home Office Works

By means of review and analysis of the data and information collected in the course of Phases I and II field works together with agreements between the Study Team and relevant Dominican authorities, a farming program, facilities plan and estimation of the costs and benefits of the Project have been prepared to make economic, financial and social evaluations of the Project; specific recommendations for the implementation and development of the Project have also been presented.

The results of the Study are summarized in the following reports:

1. Main Report (English and Spanish)
2. Annex [I] (English)
   Supplementary information for the Main Report.
3. Annex [II] (English)
   Drawings.

CHAPTER 2: BACKGROUND TO THE PROJECT

CHAPTER 2 : BACKGROUND TO THE PROJECT

2.1 Characterization of the Dominican Republic

The Dominican Republic occupies the eastern two-thirds of the Island of Hispaniola and is the second largest, next to the Island of Cuba, of the Greater Antilles. The territory of the country covers 48,442 km^2 and is situated in a tropical zone at 17°36' - 19°56' N latitude and 68°19' - 72°01' W longitude.

Four major parallel mountain ranges extend northwest-southwest; the Central Mountain Range extends from northwestern Haiti to near Santo Domingo boosting the highest peak of the Antilles (Pico Duarte: 3,807 m) and delimiting the three major valleys of the country, the most important agricultural regions containing the optimum agricultural soils.

The climate of the country is dominated by the tropical monsoon. Temperatures are high throughout the year with a mean monthly value ranging from 26.9°C in August and 23.3°C in January. The hot season is found between April and October, while winter falls during the months November-March when polar air masses push cool air over the Republic. Rainfall varies drastically in the country from 316 mm in Rendermas to 2,560 mm in Monseñor Nouel. The dry season usually occurs from December to January, due to the strengthening of the trade winds. The rainy season is from May to November in which hurricanes sometimes occur.

In July, 1981, the Dominican Republic had a population of 5,648 thousand (6th National Census) at an average density of 116 inhabitants per km^2. The growth rate since the last census (1970) had been 3.16% per annum.

The country is divided into 3 regions (Cibao, Southwest and Southeast), one National District and 29 provinces and 141 municipalities or municipal districts. The National District (Santo Domingo metropolitan area) accounts for 27.5% (1,550 thousand) of the total population with an annual growth rate of 6.04%.

2.2 National Economic Background and Agricultural Sector

2.2.1 National Economic Background

(1) Population and Employment

In July, 1981, according to the 6th National Census for Population and Living, the Dominican Republic had a population of 5,648 thousand, which had been growing at 3.16% per annum since 1970, when the last National Census was carried out. About 2.7 million (48% of the total) lived in rural areas, with an average growth rate of 1.06% a year, implying a strong trend in rural-urban migration (see ANNEX A, Table A.1.1). The National District (Santo Domingo and its surrounding urban area) accounted for 27.5% (1,550,739) of the total population with an annual growth rate of 6.04% a year.

Official estimates put the number of people economically active at 1,915 thousand (33.9% of the population) in 1981, of whom it is estimated that 351 thousand (18.3% of the labor force) were unemployed (see ANNEX A, Table A.1.2).

(2) Gross Domestic Product

In 1983, the performance of the Dominican economy improved modestly following the severe impact of a recession in the previous year; in 1982, the country's trade declined by more than 25 percent, and export earnings fell by one third due to the collapse of sugar prices to slightly more than half their level in 1981 and the weakening of the market for Dominican ferronickel.

GROSS DOMESTIC PRODUCT

Sector	RD$ Million at 1970 Constant Price						Growth Rate (% p.a.)				
	1976	1979	1980	1981*	1982*	1983**	1976 /79	1979 /80	1980 /81	1981 /82	1982 /83
Primary Sectors	570.0	608.3	608.8	644.3	617.6	673.8	2.2	0.1	5.8	-4.1	9.1
Agriculture	429.2	461.7	484.2	510.8	532.6	549.2	2.5	4.9	5.5	4.3	3.1
Mining	140.8	146.6	124.6	133.5	85.0	124.6	0	-15.0	7.1	-36.2	46.6
Secondary Sectors	610.6	688.4	727.8	741.0	761.4	799.1	4.1	5.7	1.8	2.8	5.0
Manufacture	457.4	504.8	530.2	544.5	572.6	582.4	3.3	5.0	2.7	5.2	1.7
Construction	153.2	183.6	197.6	196.5	188.8	216.7	6.2	7.6	-0.6	-3.9	14.8
Tertiary Sectors	1,256.3	1,441.5	1,567.3	1,634.5	1,691.9	1,720.6	4.7	89.7	4.3	3.5	1.7
Commerce	414.0	451.5	473.6	494.9	520.2	522.8	2.9	4.9	4.5	5.1	0.5
Transport	166.7	195.8	199.6	210.1	222.2	222.9	5.5	1.9	5.3	5.8	0.3
Communications	24.1	28.5	30.9	32.6	34.8	36.6	5.7	8.4	5.5	6.7	5.1
Electricity	30.9	43.7	49.0	53.4	48.4	50.5	12.2	12.1	9.0	-9.4	4.3
Finance	58.2	67.9	70.4	73.2	76.5	79.5	5.3	3.7	4.0	4.5	3.9
Housing & Real Estate	156.8	186.0	198.1	198.8	197.0	206.8	5.9	6.5	0.4	-0.9	5.0
Government	189.9	233.6	280.3	300.1	311.9	319.2	7.1	20.0	7.1	3.9	2.3
Other Services	215.7	234.5	265.4	271.4	280.9	282.3	2.8	13.2	2.3	3.5	0.5
Total	2,436.9	2,738.2	2,903.9	3,019.8	3,070.9	3,193.5	3.9	6.1	4.0	1.7	4.0

* Preliminary Figure ** Estimated Figure

Source: Banco Central de la Republica Dominicana, Boletin Mensual, January 1985

The preliminary estimates of the Central Bank put the GDP's growth rate during 1983 at 4.0%. This growth was mainly led by mining and construction. Agriculture, including livestock, silviculture and fishery expanded by more than 3 percent. Mining registered a growth rate of 46% in the wake of its 36% decline in 1982, as the nation's ferronickel operation resumed during the course of the year.

The manufacturing sector recorded only 1.7% growth in response to the increasing scarcity of foreign exchange for imported supplies and the lack of significant growth in consumption outlays. Construction activity, on the other hand, spurred by growth in public investment, also picked up (14.8%) after a 3.9% decline in 1982. The weak demand experienced by the manufacturing sector was reflected clearly in the service sector which showed almost no growth (0.5%) in 1983.

At the national level, the domestic economic problems can be explained by the movements in the distribution of Gross National Expenditure (GNE) categories, as shown in the following table.

DISTRIBUTION OF GROSS NATIONAL EXPENDITURE (%)

Year	Consumption		Capital Formation	Trade of Goods & Services			Total GNE
	Government	Private Sectors		Exports	Imports	Net	
1978	5.7	77.3	23.9	17.5	-24.4	-6.9	100
1979	7.6	73.4	25.4	20.6	-27.0	-6.4	100
1980	7.6	77.3	24.8	19.2	-28.9	-9.7	100
1981	9.6	71.0	23.6	21.0	-25.2	-4.2	100
1982	9.8	74.3	20.9	14.4	-19.4	-5.0	100

Since 1979, the poor economic performance is reflected in the declining portion of GNE spent on investment and the rising proportion of GNE spent on consumption, while there has been some success in cutting the level of imports in the light of falling export performance. The implication on investment and the balance of payments is discussed in the following section.

(3) Balance of Payments

The Dominican Republic is currently experiencing considerable balance of payments problems with a high trade deficit; the deficit on the current account rose considerably from RD$331 million in 1979 to RD$670 million in 1980 and it was maintained at a level between RD$400 million and RD$450 million from 1981 to 1983.

BALANCE OF PAYMENTS

Unit: In Million of RD$, Current Price

		1979	1980	1981	1982	1983
I. Current Account						
1. Exports (Goods & Services)		868.6	961.9	1,188.0	767.7	785.2
2. Imports (Goods & Services)		1,137.5	1,519.7	1,451.7	1,257.3	1,282.2
Commercial Balance	(a)	-268.9	-557.8	-263.7	-489.6	-497.0
Net factor service income	(b)	-268.2	-299.8	-335.2	-157.3	-139.1
Net transfer	(c)	205.8	187.8	193.0	205.0	215.0
Current Account Balance (a)+(b)+(c)		-331.3	-669.8	-405.9	-441.9	-421.1
II. Capital Accunt						
1. Long term capital		143.2	330.4	151.0	263.8	457.8
2. Short term capital		251.9	239.6	168.5	53.4	-236.7
3. Foreign investment		17.1	92.7	79.7	-1.4	48.2
Capital Flow (Net)	(a)	412.2	662.7	399.2	315.8	269.3
Errors & omissions	(b)	-73.2	28.6	42.0	0.4	22.8
Change in international reserves	(c)	-7.7	-21.5	-35.3	125.7	129.0
Capital Account Balance (a)+(b)+(c)		331.3	669.8	405.9	441.9	421.1

Source: Banco Central de la Republica Dominicana, Boletin Mensual, January 1985

Exports of the country have been dominated by seven agricultural and mining commodities i.e., sugar, coffee, cacao, tobacco, bauxite, ferronickel and "dore" an alloy of gold and silver. Among these commodities, sugar has been the most important export in terms of value and the total export value of the country is strongly affected by the international price of sugar (see ANNEX A, Table A.1.6).

INDEX OF UNIT VALUE FOR MAJOR EXPORTS (1980=100)

Unit: RD$/M.T

Year	Sugar	Coffee	Cacao	Tobacco	Bauxite	Ferronickel
1980	361.85 (100)	2,636.53 (100)	2,176.48 (100)	1,596.49 (100)	30.56 (100)	2,172.16 (100)
1981	605.60 (167)	2,320.51 (88)	1,645.54 (75)	1,674.96 (105)	34.39 (113)	2,252.60 (104)
1982	318.63 (88)	2,664.04 (101)	1,366.20 (63)	1,777.64 (111)	37.35 (122)	1,709.63 (79)
1983	287.19 (79)	2,567.75 (97)	1,611.97 (74)	1,616.96 (101)	-	1,550.78 (71)
1984	329.35 (91)	2,748.57 (104)	2,170.51 (99)	1,492.02 (94)	-	1,740.22 (80)

The table above illustrates the movement in the unit values of the major exports. As shown in this table, the unit values of major exports declined in real terms in 1984 as compared with those in 1980. This is reflected in the stagnation of the exporting activity of the country (see ANNEX A, Fig. A.1.1).

Crude oil and its derivatives constitute the major imports of the country followed by foodstuffs (corn, wheat, vegetable oils, etc.) and automobiles.

The U.S.A. is the Dominican Republic's largest trading partner and the contribution of the transactions between two countries to the total value in real terms of 1983 accounts is 64.1% for exportation and 34.5% for importation.

2.2.2 Agricultural Sector

(1) Recent Trend of the Sector

Agriculture is the mainstay of the national economy in view of two fundamental aspects: first, approximately 45% of the rural population directly depends on this sector; and secondly, it generates foreign currency earnings by means of producing export oriented crops and supplies commodities for domestic consumption.

The contribution of the agricultural sector to the GDP was next to that of manufacturing (17.2%) in 1983. Furthermore, it provides employment for 22% of the economically active population, generates 57% of export earnings (1984) and supplies many of the primary commodities for the agro-industries in the manufacturing sector (e.g. sugar, coffee, cigarretes, cacao, etc.)

In spite of its importance within the national economy, the pace of growth in the agricultural section has slowed noticeably in the last three years, with the real value of output increasing by only 0.9% in 1984 (preliminary estimation by the Central Bank). Faced with this situation, the Government has implemented measures and actions aimed at elevating the productivity of major national diet supplying crops and the creation of non-traditional exports.

(2) Agricultural Production

Agricultural production in the country is dominated by industrial exports (sugarcane, coffee, tobacco and cacao), which in 1984 accounted for 48% of total value added to the agricultural production. Cereal crops (rice, maize and sorghum) accounted for 16% of the value added (see ANNEX A, Table A.1.7).

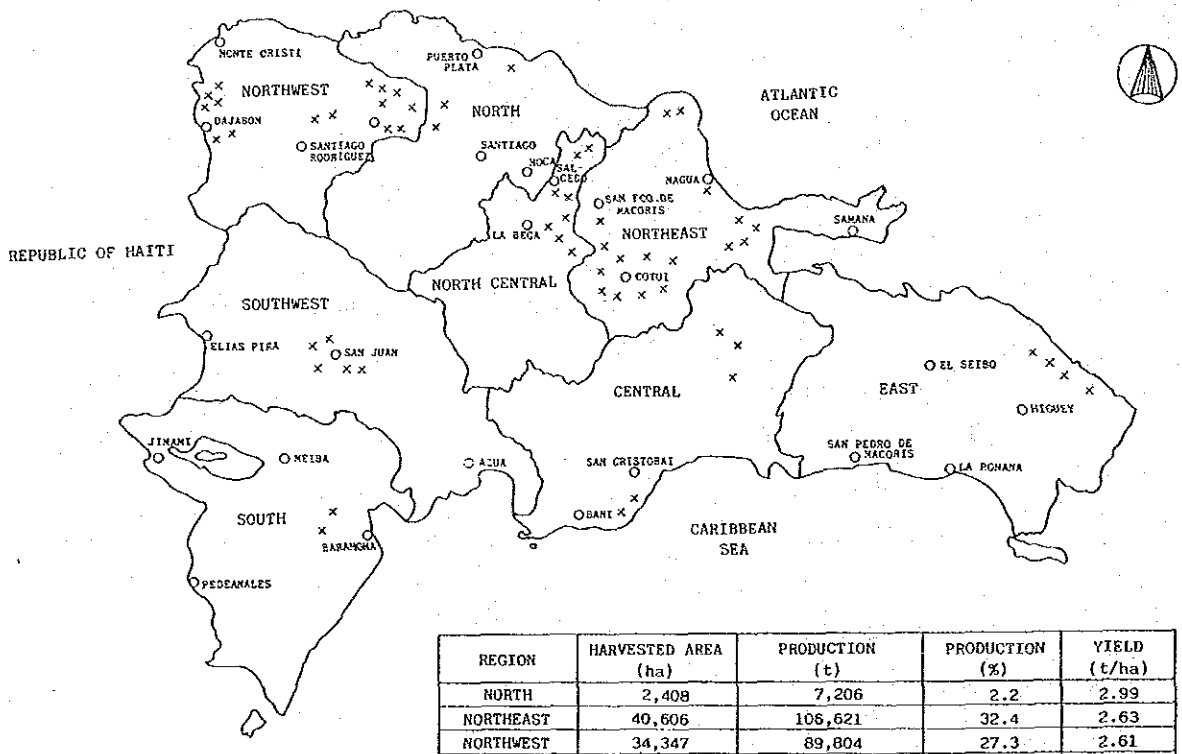
During 1984 the SEA, as a leading organization of the agricultural sector, focused its every effort to support and increase the production of basic grains as well as to achieve a higher production of exports. The results of the productivity activities on the principal agricultural products is indicated in Table A.1.8 in ANNEX A.

2.3 Production and Consumption of Rice

2.3.1 Actual Situation of Rice Production

In the Dominican Republic, rice is the third most important agricultural crop following sugarcane and coffee in the context of value added, cultivated area, consumption, employment, etc.

Furthermore, rice is the principal product for the domestic market: the endowment of irrigation and drainage infrastructures and storage facilities for the production of rice is greater than for that of other crops and institutional support by IAD, INESPRE, INDRHI and B.A. is rendered at the highest level (see ANNEX A, Table A.2.1).



REGION	HARVESTED AREA (ha)	PRODUCTION (t)	PRODUCTION (%)	YIELD (t/ha)
NORTH	2,408	7,206	2.2	2.99
NORTHEAST	40,606	106,621	32.4	2.63
NORTHWEST	34,347	89,804	27.3	2.61
CENTRAL	4,050	3,874	1.2	0.99
SOUTHWEST	9,342	36,199	11.0	3.87
SOUTH	333	656	0.2	1.97
EAST	2,884	5,078	1.5	1.76
NORTH CENTRAL	24,129	79,576	24.2	3.30
TOTAL	118,099	329,014	100	2.79

REGIONAL DISTRIBUTION OF RICE PRODUCTION IN 1984
IN THE DOMINICAN REPUBLIC

The production area of rice is distributed mainly over the northwest, north-central and northeast regions, which accounted for 84% of the total national production in 1984 (see Fig. 2.3.1). Of total crops produced in the IAD's agrarian reform projects, rice occupies 56% of the total cultivated area, and 79% of the total irrigated area in 1984. Furthermore, more than half of B.A.'s agricultural loan is destinated for this product.

2.3.2 Supply and Demand of Rice

Rice is one of basic grains in the Dominican Republic and the Government has given high priority to its production within the context of national strategies. In 1984, 329 thousand tonnes of rice was produced, implying growth rate at 54% since 1975. This growth was due to the increase of cultivated and irrigated area, which had been strongly promoted by public institutions.

On the other hand, the consumption of rice had been increased steadily to comply with the improvement of people's living standard in the decade of 1970; in 1982, a slight decrease was recorded because of deficiency in supply and, from 1983 on, more than 20% of increase in consumption has been made. The consumption per capita was at 60 kg in 1984.

In order to redress the disequilibrium between supply and demand, rice had been imported up to 1981 except for the year of 1979; starting 1982 the importation of rice was suspended due to the attainment of self-sufficiency together with the balance of payment problem. Nevertheless, the production of rice for the year of 1985 is estimated to have dropped by 17% and, in this regard, the Government has decided to import 92 thousand tons of rice for 1986.

The future projection for the production and consumption of rice has been estimated based on the information prepared by the ONAPLAN (Plan Nacional de Alimentacion y Nutricion, 1982).

PROJECTION FOR PRODUCTION AND CONSUMPTION OF RICE

Year	Production (t)1/	Consumption (t)	Balance (t)
1990	384,730	446,144	-61,414
1995	460,050	523,845	-63,795
2000	502,550	563,296	-60,746

Note: 1/ Increment of production expected in El Pozo Project is included.

As estimated above, the deficit in rice production will continue in the future, even though increase is envisaged after the completion of the El Pozo Project.

PRINCIPAL INDEX FOR PRODUCTION AND COMMERCIALIZATION OF RICE 1975-1984

Item	Unit	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Cultivated Area	ha	86,185	113,500	106,062	108,687	112,500	111,312	114,502	100,617	124,912	120,750
Yield	Ton/ha	2.48	1.89	1.92	2.13	2.33	2.32	2.29	2.58	2.62	2.72
Production	ton	213,946	214,084	204,010	231,426	262,200	258,106	262,546	259,591	327,031	329,013
Credit											
- Area	ha	68,560	65,212	59,236	69,124	81,877	103,648	137,152	70,979	50,840	n.a.
- No.	-	13,065	15,111	10,819	11,406	12,435	12,079	11,379	10,488	8,8935	8,011
- Value	In thousand RD$	34,691	37,181	32,243	45,444	55,507	59,313	61,580	67,750	64,570	65,469
Commercialization by INESPRE											
- Domestic Purchase	ton	141,052	145,852	178,408	190,989	221,801	234,170	225,112	217,424	249,330	n.a.
- Sale	ton	200,746	206,334	218,467	195,517	256,394	264,884	240,352	227,383	255,421	265,238
- Importation	ton	50,209	32,373	65,384	10,621	-	41,174	63,837	-	-	-

Source: Plan Operativo del INESPRE, 1984
Resultados Agropecuarios, 1984

2.4 Agricultural Development Plan

2.4.1 General Consideration

As mentioned in 2.2.1(3), the external disequilibrium is the country's most pressing problem which calls for immediate measures of solution. The agricultural sector has emerged within the actual economic crisis of the country as one of the principal sectors in which development is required for the healthy economic progress of the Dominican Republic.

The development of the agriculture sector has been stagnated with a real growth rate since 1975 of only 3.1% per annum while the total GDP's growth in the same period registered 4.2%. The SEA analyzes the constraints on agricultural sector in their "Plan Operativo 1985" as follows:

- The Agricultural Sector including livestock has not contributed sufficiently to the equilibrium of the balance of payment due to peculiar factors of the international market as well as the failure to achieve an increase in export-oriented products and import substitutive foodstuffs.

- The Agricultural Sector has contributed to the financial deficit as a result of high expenditures currently existing within itself, together with the deficit of SEA and INESPRE.

- The development problems are associated with the lack of productive dynamism which had sustained the agricultural sector during the past 10 years as well as with the social, structural and institutional difficulties of the agricultural sector.

Consequently, the basic objectives of the agricultural policies were designed to increase investment which might permit the efficient use of natural resources and improvement of productivity by means of: incentive pricing policies, increase and diversification of exports and imports substitutive foodstuffs, strengthening of self-sufficiency in basic grains and deficit control of SEA and INESPRE.

2.4.2 Strategies of the Agricultural Sector

The principal objective of the Agricultural Sector for the year of 1985 was to increase the production of basic crops with a view to improving the people's nourishment level, and to eliminate the importation of foodstuffs.

To achieve this objective, guidelines and targets were formulated for the year of 1985 as described below:

(1) External Trade

The Dominican Center for the Promotion of Exportation (CEDOPEX) proposed to diversify and increase exportation of traditional and non-traditional products. In this context, the CEDOPEX planned to export about 125 thousand metric tons of non-traditional exports composed of: "yautia", pineapples, plantains and coconuts.

With respect to imports, on the other hand, the policy for no-importation of rice and legumes will be followed, and efforts will be made to diminish the importation of oil for cooking.

(2) Agrarian Reform

The IAD, with a view to elevate the proportion of its participation in the total production of the country, proposed to promote more efficient use of lands distributed by itself in the past and of new settlements. For this purpose, elevation of productivity, increase in cropping area and improvement of beneficiaries' income level will be required.

The most important emphasis of the IAD will be placed on the production of rice, which is expected to be 113,300 tons, 33% of the country's total production.

(3) Irrigation and Drainage

The target of the INDRHI regarding irrigation and drainage is to increase its participation in the agricultural activities by means of incorporating new irrigation and drainage areas. The benefitted area by introduction of irrigation and drainage systems will be increased by 6,500 ha in 1985 resulting in 227,811 ha of irrigated are at the national level.

2.4.3 Cibao Oriental Development Plan

Cibao Oriental is one of three sub-regions which form the Cibao Region. There are five provinces (Duarte, Maria Trinidad Sanchez, Salcedo, Samana and Sanchez Ramirez) with a total population of 639,630 (11.3% of the national total) in 1981, which had been growing at an average rate of 1.32% per year since the last census in 1970. The total area of the sub-region covers 5,298.64 km^2 occupying 10.9% of the national territory.

According to the 1981 National Census, the number of economically active people in the Cibao Oriental was estimated to be at 173 thousand (27% of the total population), of which about 40% were engaging in agriculture, forestry or fishing activities.

The Cibao Oriental sub-region is considered to be an area of great economic potential, capable of producing at a much higher rate than the national average based on its abundant physical resources. In this context, a regional development plan of the Cibao Oriental was elaborated by the National Planning Office (ONAPLAN) in association with the Organization of America States (OEA).

(1) General Description of the Plan

The Cibao Oriental Regional Development Plan was elaborated by a "Technical Unit" composed of the engineers, economists and officers of the ONAPLAN and the OEA. This Plan comprises such fields as: Social Sector, Transport, Agricultural and Animal

Husbandary Sector, Hydraulic Resources, Mining, Macroeconomy and the Environment and includes an analysis of the sub-region (Cibao Oriental), definition of development strategies and identification of the investment projects.

The Technical Unit emphasizes the study of the Agricultural and Animal Husbandary Sector as being the key to the development of the Cibao Oriental, in view of this sector's abundant natural and human resources.

(2) Analysis of Constraints on Development

The Cibao Oriental corresponds to the agricultural area within the Republic, with a population that is predominantly rural (79%). In spite of having excellent natural resources, especially with regard to soils, water and mineral resources, the economic activity of this sub-region has stagnated as compared with other sub-regions.

The problems which constrain further development of the sub-region are fundamentally associated with economic and social character. The principal problems are, among others, as indicated below:

- Insufficient use of existing natural resources
- Low level of technologization for principal productive activities
- Inadequate structure of the land tenure

(3) Objectives and Development Strategies

The objectives formulated for the economic-social development of the sub-region in the future are closely related with objectives and strategies of national development, viz.,

- The dynamization of the agricultural sector which serves as the core for the national development
- Increase in production

- Achievement of a better distribution of income
- Creation of more job opportunities

The strategies for the social-economic development of the Cibao Oriental were elaborated within the above-mentioned national objectives. These strategies comprised economic and social development of the sub-region in short and medium terms, which include: global level, agriculture, forestry, fishery sectors, hydraulic resources, mining, agro-industries, tourism, energy, education, health, housing and environmental aspects. The description of strategies connected with the Project is as shown in Annex A, Section 3.1.

(4) Development Projects

For the purpose of analyzing the actual situation and formulating investment projects, the Cibao Oriental sub-region was divided into eight zones as follows:

- Septentrional Range
- Samana Peninsula
- Eastern Plain of the Cibao
- Yuna Delta
- Nagua Plain
- San Juan and Boba Plain
- Cabrera Promontory
- Los Haitises Range

The Aguacate-Guayabo study area belongs to the Yuna Delta Zone, which is analyzed in the Plan as mentioned below:

> "Inundation and lack of a communication system for the transportation of production constitute the principal constraints of the zone on agricultural production.

The Yuna Delta has an excellent potential for agricultural development. Excepting peat soils and mangrove growing areas, it is possible to establish irrigation systems for the production of annual crops, rice and pasture.

Special attention should be paid to the mangrove growing areas, with rational management, this resource can be used permanently."

Based on this consideration various investment projects were proposed for the Yuna Delta Zone (see ANNEX A, Section 3.2).

CHAPTER 3: THE PRESENT CONDITION OF THE STUDY AREA

CHAPTER 3 : THE PRESENT CONDITION OF THE STUDY AREA

3.1 Characterization of the Study Area

The Aguacate-Guayabo study area, located in northeastern part of the Dominican Republic, extending over three provinces: Maria Trinidad Sanchez, Duarte and Samana. The total area covers 24,100 ha, 26 km east to west and 15 km north to west, represented by plain lands. The area is connected by surfaced highways with Santo Domingo about 200 km away.

The study area is situated in the Lower Yuna Basin and forms one part of the project area for the AGLIPO Agricultural Development Program, which is being conducted enthusiastically by the Dominican Government. The area is bordered in the northwest by the El Pozo area and in the south by Limon del Yuna; the Yuna River passes the southern limit, and runs meanderingly to the east and flows into Samana Bay. The old channels of the Yuna River, and ponds and marshes dot the study area and one part which forms the Caño Gran Estero, collects stagnated water within study area and drains into the Escocesa Bay.

The territory of the study area is classified by its ground elevation into three categories: 10,000 ha of humid plain below 2 m, 12,000 ha of alluvium in the range of 2 - 10 m, and 2,100 ha of hill land higher than 10 m. The greater portion of the area is covered by marshes and humid forests, in which peat soils, less capable for crop production, dominate.

Rice is the principal crop of the area, which is produced in the natural levee of the Yuna River and El Aguacate area. Apart from rice, cacao, coconuts, cassava and plantains constitute the major crops being cultivated in this area. Despite double harvest are viable to comply with the climate conditions rice production is presently carried out only once a year in most of paddy fields due to the lack of adequate irrigation and drainage systems.

Annual rainfall of the study area which faces the Atlantic Ocean to the north and Samana Bay to the east is around 2,000 mm constituting a high rainfall area in the country. The area is included within the tropical rain forest zone with an annual average temperature of more than 26°C and predominantly NE and SE winds.

According to the National Census for Population and Living carried out in 1981, the Aguacate-Guayabo area had a population of 17,000; 7,700 for El Aguacate and 9,300 for El Guayabo.

The physical infrastructure has not been improved in the study area; the rural trunk road connecting Nagua with Samana and its branch roads, as well as rural road passing along the right bank of the Yuna River are only major roads existing in the study area. Additionally, an abandoned railroad which had been used to transport sugarcane from La Vega to the Sanchez Port is found.

The in-farm road network is consolidated in neither El Aguacate nor El Guayabo; in case of the latter, there is no road inside the farmland.

With the exception of the river side area of El Guayabo and El Aguacate and the Rincon Molinillo area, no electric lines are supplied. The greater portion of the domestic water depends on rain and only a few members of the population are furnished with well.

Transportation methods within the area are represented by pick-ups and motorcycles. Agricultural machinery such as tractors are used for the preparation of lands with superior conditions, while other lands are prepared by animals.

The socio-economic level of farmers, as in other rural zones, does not catch up with that of national average. The enrollment rate for the primary schools is estimated at 60% (70% on average nationally) and very few people attend secondary or higher schools.

Neither physical facilities and equipment nor teachers are adequately provided in the schools of the study area. The illiteracy rate among people older than 10 years is estimated to be as high as 25%.

Agrarian reform projects conducted by the Dominican Agrarian Institutes (IAD) were started in 1969 for the El Aguacate settlement area and in 1974 for El Guayabo. The El Aguacate area is composed of two land settlement projects - El Aguacate and Cienega Vieja, comprising a total area of 6,145 ha, of which 2,424 ha has been allotted to 681 beneficiaries. In the case of El Guayabo, of the total settlement area of 6,856 ha, 3,873 ha has been distributed among 667 beneficiaries. A high rate of desertion associated with inferior working environments is commonly reported among originally recruited settlers.

The governmental organizations which support the farmer's activities in the study area are: the Ministry of Agriculture (SEA), IAD, the National Institute for Hydraulic Resources (INDRHI), the Institute for Price Stabilization (INESPRE) and the Agrarian Bank (B.A.). The SEA has located its sub-zone office (rural development agency) in Arenoso in which three agronomists are working to extend technical assistance both to private farmers and the beneficiaries of agrarian reform; the SEA also established its agricultural inputs and equipment sales center within both El Aguacate and El Guayabo. The IAD's local offices in El Aguacate (No. 101) and El Guayabo (No. 156) are responsible for the implementation and administration of agrarian reform projects; these offices supply machinery, support for beneficiaries to get credit, and offer technical assistance regarding land preparation and crop cultivation. The construction and maintenance of infrastructures such as irrigation and drainage works is conducted under the responsibility of INDRHI's local office situated in Nagua. The INESPRE, through its purchase center at Limon del Yuna, buys paddy rice directly from the farmers. The main function of the B.A., whose branch office near the study area is found in Arenoso, is to render financial assistance so that the farmers can achieve crop harvest.

3.2 Hydrometeorology

Hydrometeorological data related with the study area and its surroundings are obtained from hydrological stations at Villa Riva and El Limon and climatological stations at Sanchez, Nagua, Villa Riva and Barraquito. Using data collected from these stations, the hydrometeorological feature of the study area is described in the following sub-sections.

3.2.1 Climate

The study area is included within a tropical humid forest climate zone and is classified as a rainy area in the Dominican Republic with a mean annual rainfall of 2,034 mm. The wettest period is from May to August and from November to December, while the driest period occurs in February and March.

The Yuna River passes through the Yuna Valley which is formed to the left bank by the Cordillera Septentional and to the right bank by the Cordillera Central, the climate of its watershed being strongly affected by these two ranges. The trade wind prevails from north-east throughout the year and it is responsible for the water-shed of the Camu River with an annual rainfall in the range of 1,000 mm - 1,500 mm to the left bank and the upperstream basin of the Yuna River with an annual rainfall of 2,200 mm to the right bank.

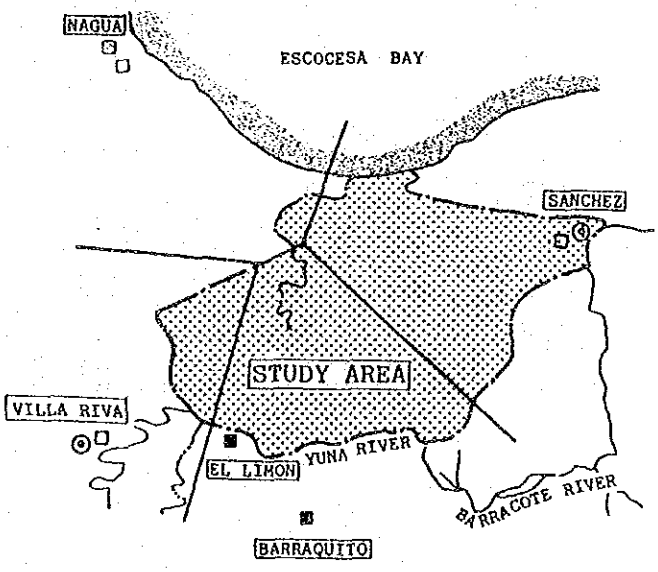
CLIMATOLOGICAL FEATURE OF THE STUDY AREA

(1) Division of the Area

The division of the area by the Thiessen method is shown in the figure below. The following table represents the dominated area and its coefficient.

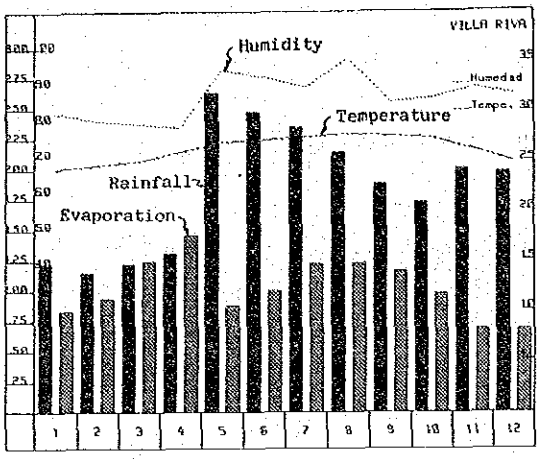
DOMINATED AREA AND COEFFICIENT

Station	Dominated Area (km^2)	Distribution (%)
Sanchez	9,160	39
Nagua	610	2
Villa Riva	2,600	11
Barraquito	11,730	48

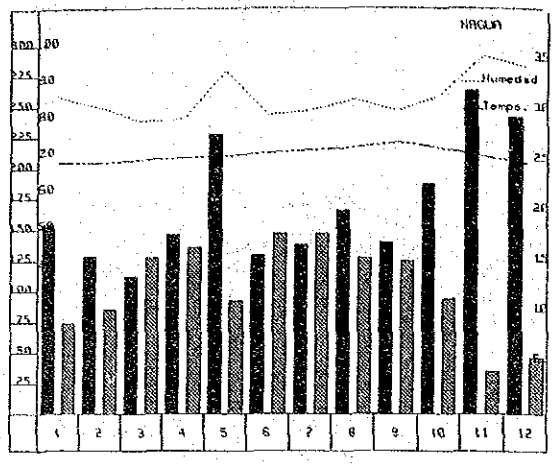


DIVISION OF THE AREA BY THIESSEN METHOD

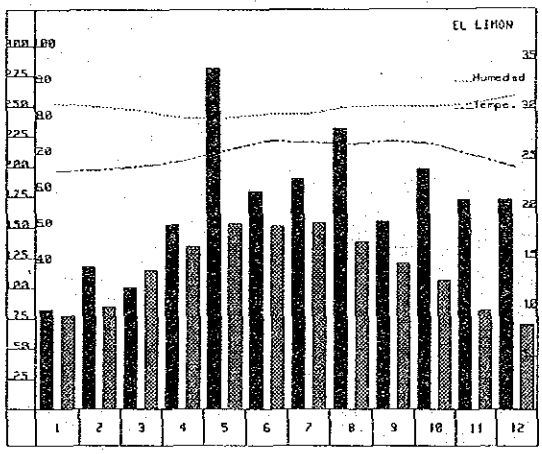
VILLA RIVA STATION



NAGUA STATION



BARRAQUITO STATION



SANCHEZ STATION

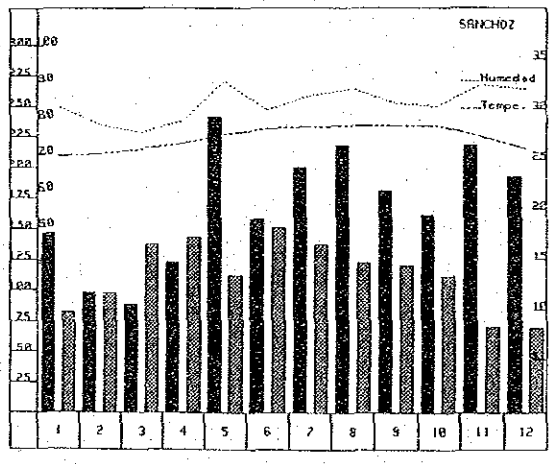


FIG. 3.2.1 CLIMATOLOGICAL CHARACTERISTICS

(2) Maximum Rainfall

The maximum daily rainfall at each station is shown in the table below.

MAXIMUM DAILY RAINFALL

(Unit: mm/day)

Return Period	Sanchez	Nagua	Villa Riva	Barranquito	Study Area
2	107.2	112.8	95.7	96.5	101.1
5	151.3	164.9	124.8	136.7	141.6
10	179.0	198.7	142.9	227.9	198.9
30	219.4	248.8	169.0	258.4	233.2
50	237.6	271.6	180.7		
100	261.5	301.9			

3.2.2 Hydrology

(1) General

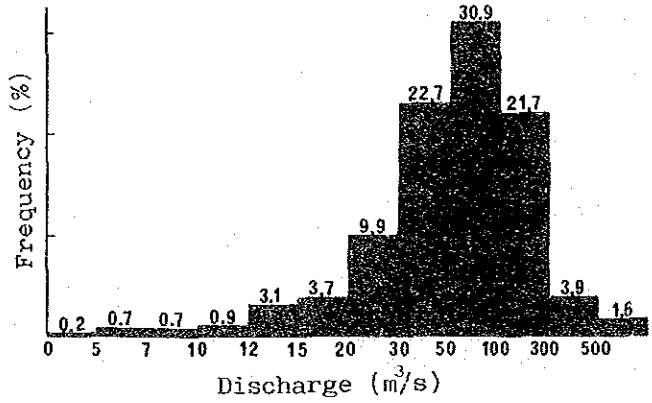
The study area is included in the Yuna River Basin which has a catchment area of 5,660 km^2. The Yuna River passes Villa Riva, located upstream within the study area with a catchment area of 4,680 km^2, Arenoso and then flows into Samana Bay running the length of southern part of the study area.

The Yuna River has a mean annual depth of run-off of 667 mm and the recorded mean annual rainfall of its basin is 1,700 mm. The basin of the Yuna River is divided into two sub-basins: the Camu River basin (catchment area: 2,336 km^2) with a mean annual rainfall in the range of 1,000 mm - 1,500 mm and the Yuna River basin with rainfall in the range of 1,700 mm - 2,200 mm.

The Yuna River Basin comprises approximately 40,000 ha of paddy field, to which 7.8% (52 mm) of the total depth of run-off is destinated to be used for irrigation water.

There are two water level gauging station on the lower reaches of the Yuna River, one at Villa Riva (established in 1956) and the other at El Limon (established in 1969).

The mean discharge of the Yuna River in and around the study area is 96.5 m^3/s, 4.9 m^3/s at a minimum and 877.5 m^3/s at a maximum. The figure below explains the frequency of flow at El Limon. The flow is more frequent between 50 m^3/s and 100 m^3/s, and 92.8% of the flows falls in the range of 50 m^3/s - 500 m^3/s, which is sound flows from a viewpoint of both irrigation and flooding aspects.



FREQUENCY OF FLOW AT EL LIMON

The flow probability for the return period of 2, 5, 10 and 20 years at the Villa Riva and El Limon stations is presented below:

DISCHARGE AT VILLA RIVA BY RETURN PERIOD (m^3/s)

Return Period	Droughty Discharge	Low Water Discharge	Average Discharge	Ninety-Five-Day Water Discharge	Maximum Discharge
2	17.61	36.79	55.93	92.84	520.16
5	10.84	26.12	38.94	65.12	630.88
10	8.21	21.17	32.54	55.21	697.85
20	6.42	17.38	28.23	48.75	758.30

DISCHARGE AT EL LIMON BY RETURN PERIOD (m^3/s)

Return Period	Droughty Discharge	Low Water Discharge	Average Discharge	Ninety-Five-Day Water Discharge	Maximum Discharge
2	20.25	39.27	61.16	96.13	542.39
5	13.57	27.40	43.07	73.31	643.72
10	10.53	21.99	35.60	66.04	704.02
20	8.24	17.90	30.29	61.62	757.89

(2) Available Discharge from the Yuna River

1) Water Resources within the Yuna River Basin

The total annual water resource of the Yuna River Basin is estimated to be 3,411 million m^3, of which 270 million m^3 is used and 3,141 million m^3 (99.6 m^3/s) is discharged into Samana Bay. The greater part of the water for public use is destined to irrigate about 40,000 ha of paddy field, the remainder going for industrial and living purposes.

With a view to making use of water resources efficiently and alleviating flood damage, the construction of the Rincon Dam in 1981 and the Hatillo Dam in 1984 was carried out by the Dominican Government on the upperstream section of the Yuna River. After the completion of these two dams, the downstream flow of the Yuna River has changed.

Taking the operation of the afore-mentioned two dams into account, the minimum discharge at El Limon has been calculated on the basis of division of the basin, irrigation system network and irrigated area, etc.

MINIMUM DISCHARGE AT EL LIMON (m^3/s)

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Natural Flow	26.3	15.8	18.6	7.1	23.9	5.6	20.2	17.4	22.0	40.1
Case 1	34.5	29.0	34.6	17.6	34.9	18.7	25.5	31.5	26.5	43.6
Case 2	28.4	25.5	27.2	26.6	29.3	25.1	25.5	25.3	25.2	44.3

Note: 1) Natural Flow: Gauging Record
2) Case 1: Constant discharges of 29.0 m^3/s (Hatillo Dam) and 4.5 m^3/s (Rincon dam) are secured for electric power generation.
3) Case 2: Discharge to meet irrigation requirements of downstream secured by operation of Rincon and Hatillo Dams.

Given the above calculation, the minimum possible discharge at El Limon is estimated as follows:

MINIMUM POSSIBLE DISCHARGE AT EL LIMON (m^3/s)

Return Period	Natural Flow	Case 1	Case 2
1/2	18.0	29.0	26.4
1/5	13.0	22.7	25.3
1/10	8.2	19.9	25.0

The return period for the study has been established at 1/5, therefore the drought discharges for the study are:

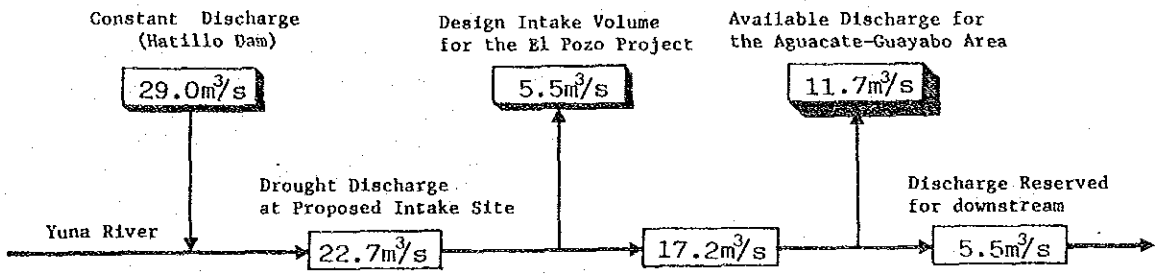
- In the event in which water is discharged at 29.0 m^3/s (Hatillo Dam) and at 4.5 m^3/s (Rincon Dam) ..... 22.7 m^3/s
- In the event in which water is discharged from the two dams at the rate necessary to meet the downstream requirements ..... 25.3 m^3/s

The drought discharge at El Limon fluctuates according to the operation program of the dams located upstream. In developing further studies, in compliance with an agreement with the Dominican counterpart organizations, the value of 22.7 m^3/s had been employed.

2) Available Discharge

The available discharge to be diverted from the Yuna River for supplying the Aguacate-Guayabo development area was calculated as follows:

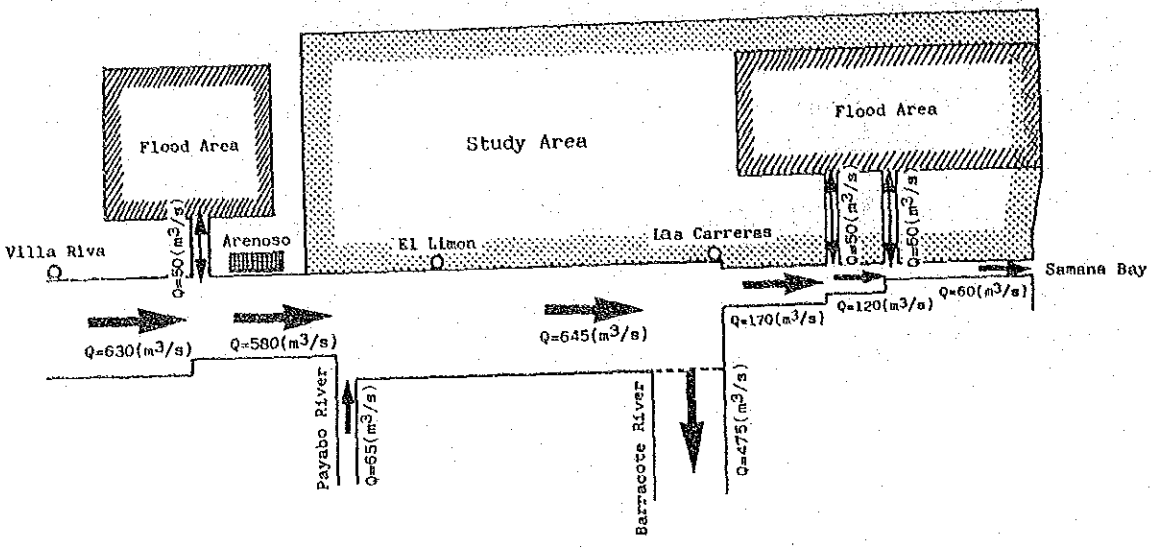
Drought discharge at El Limon	:	22.7 m^3/s
Design intake volume for the El Pozo Project:		5.5 m^3/s (-)
Discharge reserved for downstream	:	5.5 m^3/s (-)
Available discharge	:	11.7 m^3/s



AVAILABLE DISCHARGE OF THE YUNA RIVER

(3) Flow Capacity of the Yuna River

1) Having a small cross-section compared with the catchment area, the Yuna River Basin is subject to frequent and extensive flooding; flooding is more frequent (twice a year on the average) in the area located between Villa Riva and Arenoso. Meanwhile, the Yuna River within the study area has a sufficient cross-section to admit the passage of flooding flow for the five years' return period. In this regard, the overflow of the Yuna River within the study area is supposed to have an occurrence frequency of once in every five years or more. The flow of the Yuna River at the flooding for five years' return period is schematically shown in the following manner:



FLOOD AREA FOR 1/5 YEAR RETURN PERIOD

The topographic survey on the cross-section has disclosed the feature of the Yuna River as follows:

- A stretch part is located between Chiringo and Arenoso, in which overflow of the river is sometimes observed. A plain to which tributaries inflow is acting as flood storage basin.

- The discharge of the River downstream from Arenoso is estimated to be 640 m^3/s, which suggests flooding will not occur with return period of 1:5 or more.

- The the flow capacity becomes deteriorated in the course between the confluence with the Guayabo River and the outlet, therefore the river basin situated along this course is subject to frequent flooding.

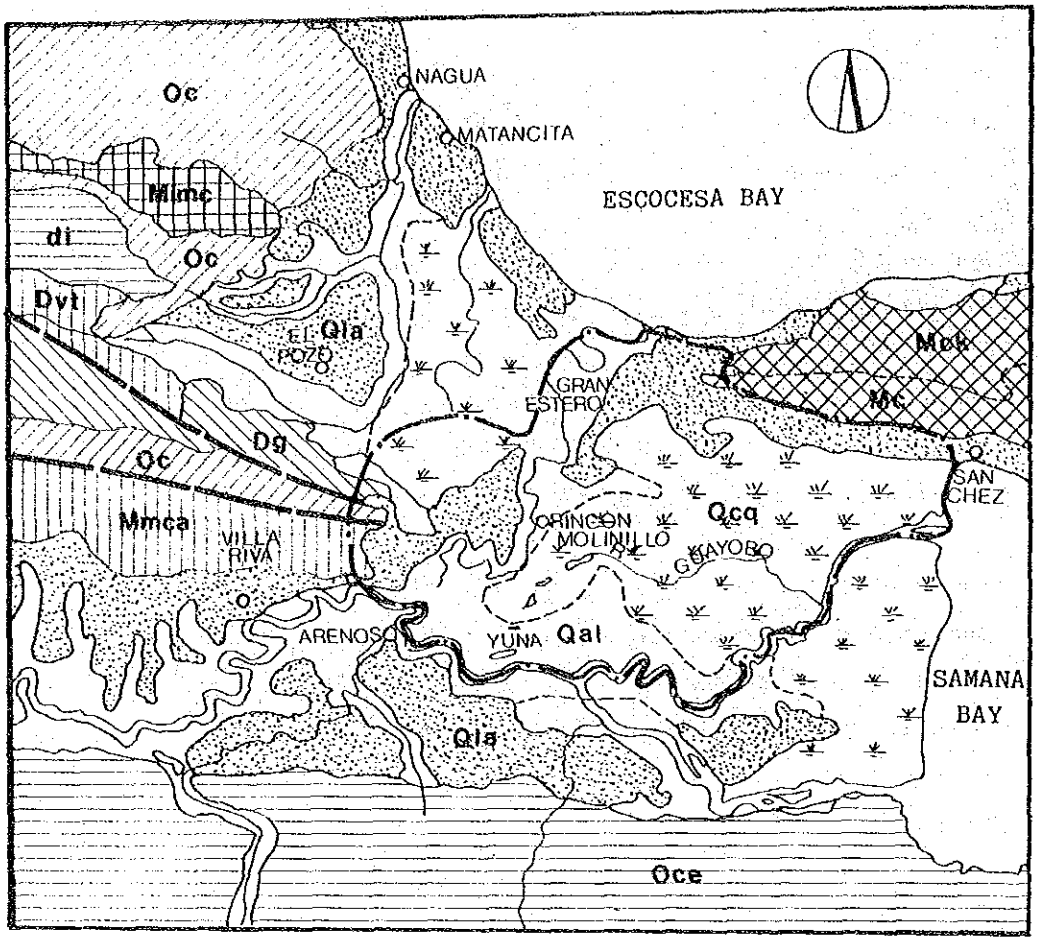
3.3 Geology

The study area, formed by the flooded plain of the Yuna River, extends to a total area of 24,100 ha with ground elevation in the range of 0 - 10 m. The watershed of the Lower Yuna Basin is limited to the north by the Escocesa Bay and to the east by the Samana Bay. The Basin is formed to the northeast by the Loma la Cordillera composed of Tertiary Miocene Indivisible limestone, to the south by the Cordillera Haitises composed of Tertiary Oligoceno Indivisible and to the west by mountains composed of Tertiary Miocene-Oligocene Indivisible Gonglomerate, limestone and mudstone. Two faults are extended to the Samana Bay passing through the study area.

The central part of the study area lies on Alluvium which consists of Quarternary Sedimentary deposits such as peat, clay and lacustrine and marine deposits (principally clay with sand and gravel) supported by Diluvial deposits (clay silt, sand, sand with gravel, etc.); a stratum extended from the western mountains constitute a foundation for this area.

The Loma la Cordillera is composed of Tertiary Miocene indivisible limestone of the Las Angosturas and Las Salinas Formation. The Haitises mountains consist of indivisible limestone and calcareous sand stone corresponding to the El Sambrerito, La Lemba and El Florentio Formations of the Tertiary Oligocene.

Mountains located to the west of the study area are covered by a conglomerate of the Las Mismas Formation of the Tertiary Oligocene, limestone of La Tabera Formation and limestone, mudstone and conglomerate
of Tertiary Miocene El Gurabo Formation; these Formations are connected with two faults which strike from east to west (see Fig. 3.3.1). For more detailed information on geological feature of the study area refer to Annex C.



STRATIGRAPHY OF PROJECT AREA

QUATERNARY	RECENT		Qal	ALLUVIUM
			Qcq	MARSH
			Qla	LACUSTRINE AND MARINE DEPOSIT PRINCIPALLY CLAY WITH SAND AND GRAVEL NEAR THE COAST, FREQUENTLY OCCUR THIN DEPOSITS ABOVE BEACH LIMESTONE,
TERTIARY	MIOCENE INDIVISIBLE		Mck	LIMESTONE
			Mc	LIMESTONE OF LAS ANGOSTURAS AND LAS SALINAS FORMATION
	MIOCENE MIDDLE		Mimc	LIMESTONE
			Mmca	LIMESTONE, MUDSTONE AND CONGLOMERATE OF LA GURABO FORMATION
	OLIGOCENO INDIVISIBLE		Og	CONGLOMELATE OF LA TABELA FORMATION
			Oce	LIMESTONE, CALCAREOUS SAND STONE AND CLAYEY SLATE INCLUDE PART OF LAS SOMBRERITO FORMATION
			Oc	LINESTONE, INCLUDE PART OF LAS SOMBRERITO FORMATION
NON-DATES			dvt	VOLCANIC ROCK, PRINCIPALLY TUFF
			di	METAMORPHIC ROCK

GEOLOGICAL SYMBOLS

FORMATION BOUNDARY

FAULT , DASHED WHERE APPOXIMATELY LOCATED

FIG. 3.3.1 GEOLOGICAL FEATURE

3.4 Soil

3.4.1 General Properties of Soils

A greater part of the alluvial lowland area is occupied by peat or peaty soils. The peats are mostly fibrous with some wooden tissues, varying in decay rate. The pH is low ranging from 4 to 5 with a low base saturation. Consequently, these groups have problem for arable development.

Soils distributed on the natural levees along the Yuna River and inland alluvial plains are almost neutral in reaction and rich in exchangeable bases (pH 6 - 7), assuming a very fertile status. They are rather clayey and in some parts crack upon drying; soils of the levee have a good structure and those of the coastal areas are sandy and slightly saline.

On the piedmont and remnant hill areas in which a soil survey has been made for the first time by the study team, most of the soils are formed residually from weathered limestone materials. These are medium to fine in texture and acidic in reaction, revealing a pH of around 5 with a base deficiency.

3.4.2 Soil Classification

(1) Classification in Higher Categories

Soils of the study area are divided into five soil orders, nine sub-orders and their associations.

Inceptisol is one of the dominant soil orders. It lies scattered over almost the entire study area. The diagnostic horizons vary widely from cambic to histic depending on the topographical conditions. Except for coastal terrace and some undulating areas, soils are in general clayey and neutral in reaction with a low EC value and high base saturation. These are devoted to paddy fields bearing the majority of the rice production.

Soils derived from weathered limestones on piedmont and remnant hill areas are included in this order corresponding to a sub-order of Tropet according to the present soil survey.

Molisol distributes broadly along river levees. These are used for cacao and plantain plantations owing to the adequate organic matter content and favorable structural development of the profile.

Histosol has the largest distribution occupying more than half of the study area when totalled with soil associations which mostly consist of series of this soil order. Histosol is divided into three sub-orders.

Fibrist, Hemist and Saprist, depending on the decomposition grade of the peat substances. Vegetable materials of the peat are dominantly fibrous grasses and scarcely thick roots or woody timbers presumably of mangrove origin. The peat lands are partially cultivated for rice or pipiota. A greater part of Histosol lands, however, has been left unused since the thick peat layers assume an acidic nature with low nutrient base saturation in addition to the unfavorable drainage condition due to the low elevation of the area.

Vertisol occurs on the low lying alluvial plains. The profile is characterized by surface cracks and gleization caused by montmorillonite clay of a swelling nature. Alfisol has the smallest distribution along the river levees. These order lands are planted with rice or plantains.

The hectarage of each soil group is summarized in the table below:

HECTARAGE BY SOIL ORDER

Soil Order	Sub-order	Area (ha)	Percentage (%)
Vertisol	Udert	1,690	7.0
Inceptisol	Acuept	1,000	4.1
	Tropept	4,240	17.6
	Sub-total	5,240	21.7
Molisol	Acuol	490	2.0
	Udol	2,390	10.0
	Sub-total	2,880	12.0
Alfisol	Acualf	550	2.3
Histosol	Fibrist	1,985	8.2
	Hemist	7,960	33.0
	Saprist	85	0.4
	Sub-total	10,030	41.6
Associations	-	3,650	15.2
Lagoons	-	60	0.2
	TOTAL	24,100	100.0

Fig. 3.4.1 presents the distribution of these soil orders and sub-orders in the study area.

(2) Classification in Lower Categories

The FAO's soil survey (1976) reported the existence of 44 soil series within the study area. Based on the present profile investigation, the location and boundary of these soil series have been revised. The revision covered over 11 soil series.

Four series of Piedmont and remnant hill areas have been newly established this time. One of them (Yab-Yabacoa Series) belongs to Eutropept which has base-saturated horizons. The others (LM-La Majagua Series, AB-Agua Buena Series and ECa-El Catey Series),

Dystropept are strongly acidic in reaction with low base saturation and characteristic horizon sequences which are different from each other. Acid sulfate soils have not been found within the study area.

Totally 48 soil series are listed taxonomically in Table 3.4.1 with 14 soil associations in terms of topographic division of the area. A new map of soil series has been thus delineated as shown in Fig. 3.4.2. Detailed profiles of the new soil series are described in Annex D with area in hectares of all soil series.

Most of the EC values are very low ranging from 0.2 to 0.6 mmhos/cm at 25°C with soil and water samples except for those taken from the soil series distributed on a small scale near the coastal zone suggests there is no serious salinity damage in the developable areas.

3.4.3 Land Classification

Land classification, as with the soil classification in the Dominican Republic is commonly described by use of the USDA system; according to this system, lands suitable for upland crops are divided into three classes from 1 to 3; those suitable for rice and pasture are rated as 4A and 4P, and those ranked as classes, 4S 5 and 6 are not recommended for arable use. Referring to this system, all of the soil series in the study have been evaluated and mapped in Fig. 3.4.3 by grouping together lands of the same class. The area of each class and sub-class is summed up in the upper column of Table 3.4.2. The study results indicate that it is not technically feasible to enlarge the arable development area since the amount of suitable land for rice is only 10% of the whole study area while that of 4S/5 exceeds 60% which would be left undeveloped.

In view of the fact that the primary concern with respect to agricultural use in the present study is to assess the possibility of developing the peat lands which prevail over the study area it is essential to have an appraisal of land capability for rice cultivation at a detailed level.

To this end,, new specifications for the irrigation of rice have been prepared as shown in Table 3.4.3. The key point here is how to rate organic soils which are different in appearance and thickness of the peat layer. Referring to the research results obtained in both the torrid and the temperate zones, specifications for the suitability of peat soil have been defined with reference to the limitations caused by the presence of peat that is considered quite detrimental when it appears to be shallow or is thicker than 60 cm. In this classification system, lands of the study area are classified in 6 classes and groups of same class as mapped in Fig. 3.4.4. The area of each class and sub-class are also summarized in the lower column of Table 3.4.2. The amount of arable land for rice field has increased because several soil series of peat origin (4S/5) have been upgraded to the marginally suitabile class (A4).

TABLE 3.4.1 LIST OF SOIL SERIES CLASSIFIED BY TOPOGRAPHIC DIVISION

Topographic Division	Vertisol	Inceptisol	Molisol	Alfisol	Histosol	Association
I. Savanna Remnant Area of East Cibao						
1) Monadnock and mountain slope area		Eutropept tipico (Yab) Dystropept tipico (LM, AB, ECa)				
2) Upper terrace area	Cromudert ácuico (CA)		Argiudol ácuico (NA)			
II. Alluvial Plain and Delta Ara of Rio Yuna	Cromudert acuéntico (Pa, Ya) ácuico (EG)	Eutropept fluvacuéntico (LCo, LCol) fluvéntico(RNi) Tropacuept aérico (CV) Halacuept aérico(BoM) vértico(BoG)	Hapludol fluvéntico(JR) fluvacuéntico (LCr) típico(RM,"2) Argiudol vértico(LBj) ácuico(LGa) Argiacuol vertico (ERi)	Tropudalf vértico (Re) típico (Av) ácuico (LB) Albacualf vértico(Pr) Tropacualf vértico(Rfl)		As BE:Tropacuept, Tropohemist As BoEs:Halacuept Sulfacuept, Acuept As D: Eutropept, Tropacuept, Tropohemist
III. Marsh and Peat Area		Tropacuept histico (AS,MU) Halacuept histico (BCh)	Argiacuol histico (Mo) Haplacuol histico (PN)		Tropofibrist térrico(Pe) típico(MCt) Tropohemist fibrico(Bo, MSa, MOch, MS, MT) térrico(Be) típico(EAg,MCc) Saprico (LBY) Troposaprist térrico (Na)	Be-MCt, Bo-MT, Mo-MOch, MOch-EA MT, MT-Bo-MS, MT Be, MT-MCt-Be, Na-Pe, BCh-MSa-P
IV. Recent Coastal Terrace Area		Eutropept fluvacúentico (PAr) típico (LYa)	Hapludol ácuico(Mch)	Tropacualf aérico (LGu)		As Bo Es: Halacuept, Sulfacuept, Acuept Mch-AS, LGu-AS-Pa

Note: Refer to "Los Suelos del Bajo Rio Yuna (1976).

TABLE 3.4.2 HECTARAGE OF LANDS CLASSIFIED FOR CROP SUITABILITY

1) Upland Crops and Others (USDA Method)

Class	Sub-Class (Limitation)*	Suitability	Area (ha)	Percentage (%)
1	-	Very suitable	980	4.1
2	w	Suitable	2,590	10.7
2	s	Suitable	150	0.6
3	w	Marginally suitable	1,810	7.5
3	ws	Marginally suitable	280	1.2
3	ts	Marginally suitable	450	1.9
4A1	-	Very suitable for rice	2,070	8.6
4A2-3	-	Suitable - m. suitable for rice	160	0.7
4A2/4P	-	Suitable for rice/pasture	260	1.1
4P	-	Suitable for pasture	1,180	4.9
4S/5	-	Not suitable/5	13,180	54.7
5	-	To be further surveyed	810	3.3
6	-	Non-arable use	180	0.7
Total			24,100	100

2) Rice (Method revised for the Study)

Class	Sub-Class (Limitation)*	Suitability	Area (ha)	Percentage (%)
1	-	Very suitable	5,870	24.4
2	w	Suitable	1,640	6.8
3	ws	Moderately suitable	1,930	8.0
3	ts	Moderately suitable	370	1.6
4	ws	Marginally suitable	2,440	10.1
4	ts	Marginally suitable	90	0.4
5	ws	Not suitable	1,520	6.3
5	ts	Not suitable	180	0.7
6	-	Non-arable use	10,060	41.7
Total			24,100	100

* : Limitation
w : Drainage
s : Soil
t : Topography

TABLE 3.4.3 LAND CLASSIFICATION SPECIFICATIONS FOR RICE UNDER IRRIGATION

Characteristics of Soil or Land	Class A1	Class A2	Class A3	Class A4	Class A5	Class A6
Land suitability	No limitation	Some limitation	Serious limitations	Marginally suitable	Not suitable	For non-arable use
1. Soil texture						
Upper 30 cm	SiL - C	SiL - permeable	SiCl - C	SiL - SL	SL - S (gravel)	*
Subsoil	SiL - permeable C	SL - C	SL - C	SL - gravel	SL - S (gravel)	*
2. Available soil (until sand or gravel)	>75 cm	75 - 50 cm	50 - 25 cm	<25 cm	<25 cm	<25 cm
3. Soil acidity or alkalinity						
pH (1:2.5)	5.0 - 8.0	5.0 - 8.0	5.0 - 8.2	<5.0 - >8.5	<4.0 - >8.5	*
Exchangeable sodium (PSI, %)	<5% throughout the profile	<10% throughout the profile	<15% throughout the profile	>10% throughout throughout the profile	>15% throughout the profile	-
4. Soil salinity						
Electrical conductivity of saturation	<4 mmhos throughout the profile	<4 mmhos throughout the profile	<4 - 8 mmhos throughout the profile	>8 - 16 mmhos throughout the profile	>16 mmhos throughout the profile	**
5. Base saturation	>50%	50 - 35%	<35%	<35%	*	*
6. Cation exchange capacity (Upper 30 cm)	>20 me per 100 g soil	20 - 10 me per 100 g soil	<10 me per 100 g soil	10 - 5 me per 100 g soil	<5 me per 100 g 100 g soil	**
7. Slope and relief	<2%, flat	<2%, flat	2-5%, slight undulating	>5 - 8%, undulating	>8%, undulating - rolling	-
8. Organic layer (peat)						
Organic matter content	<30%	<30 - 50%	>50% (peat)	>50% (peat)	>50% (peat)	-
Depth of appearance	<30 - 60	>30 cm	<30 cm	<30 cm	<30 cm	<30 cm
Thickness of layers	<30 - 60 cm	30 - 60 cm	<30 cm	30 - 60 cm	60 - 90 cm	>90 cm

NOTE: * No need to describe. ** Not applicable - Any values are included.

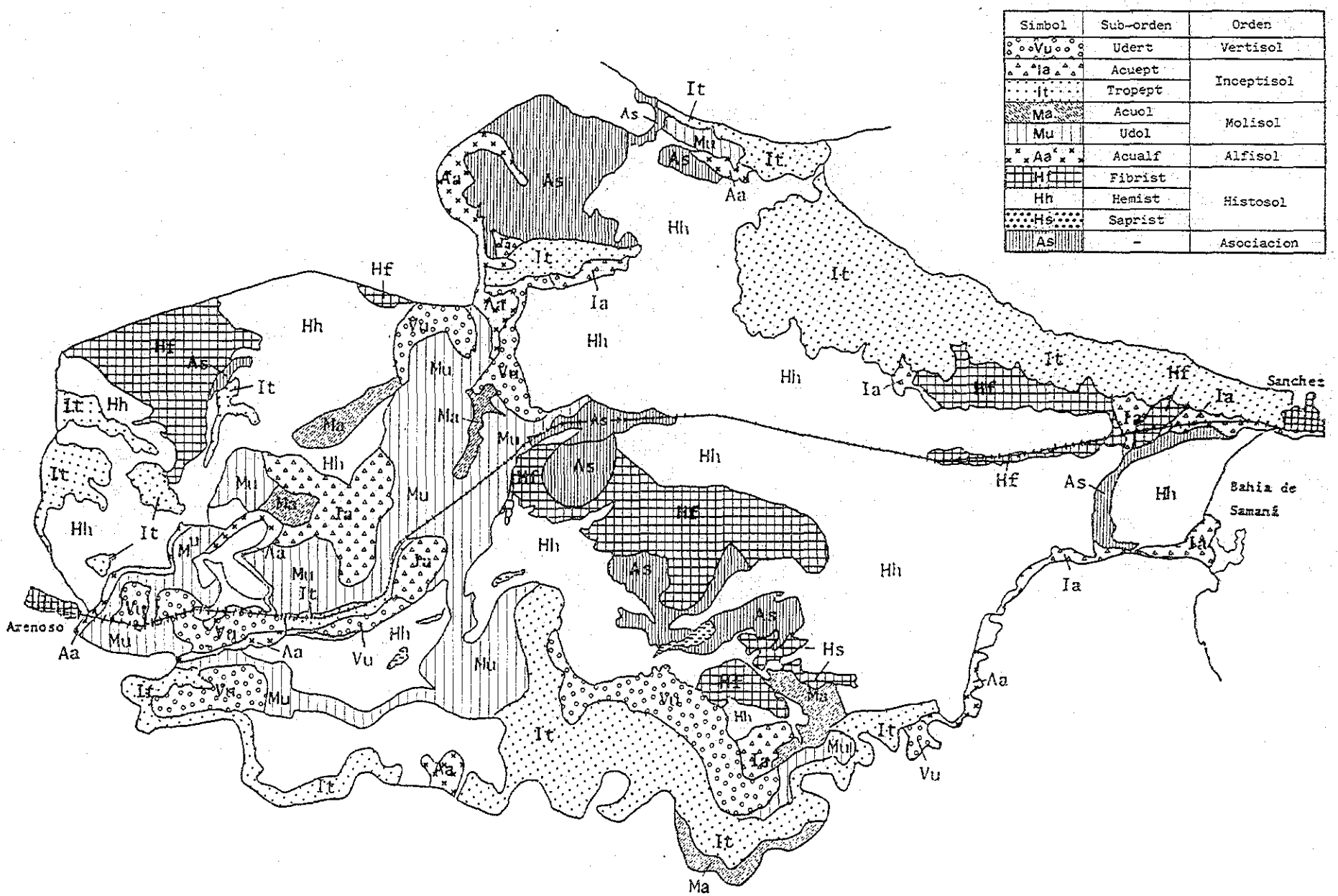
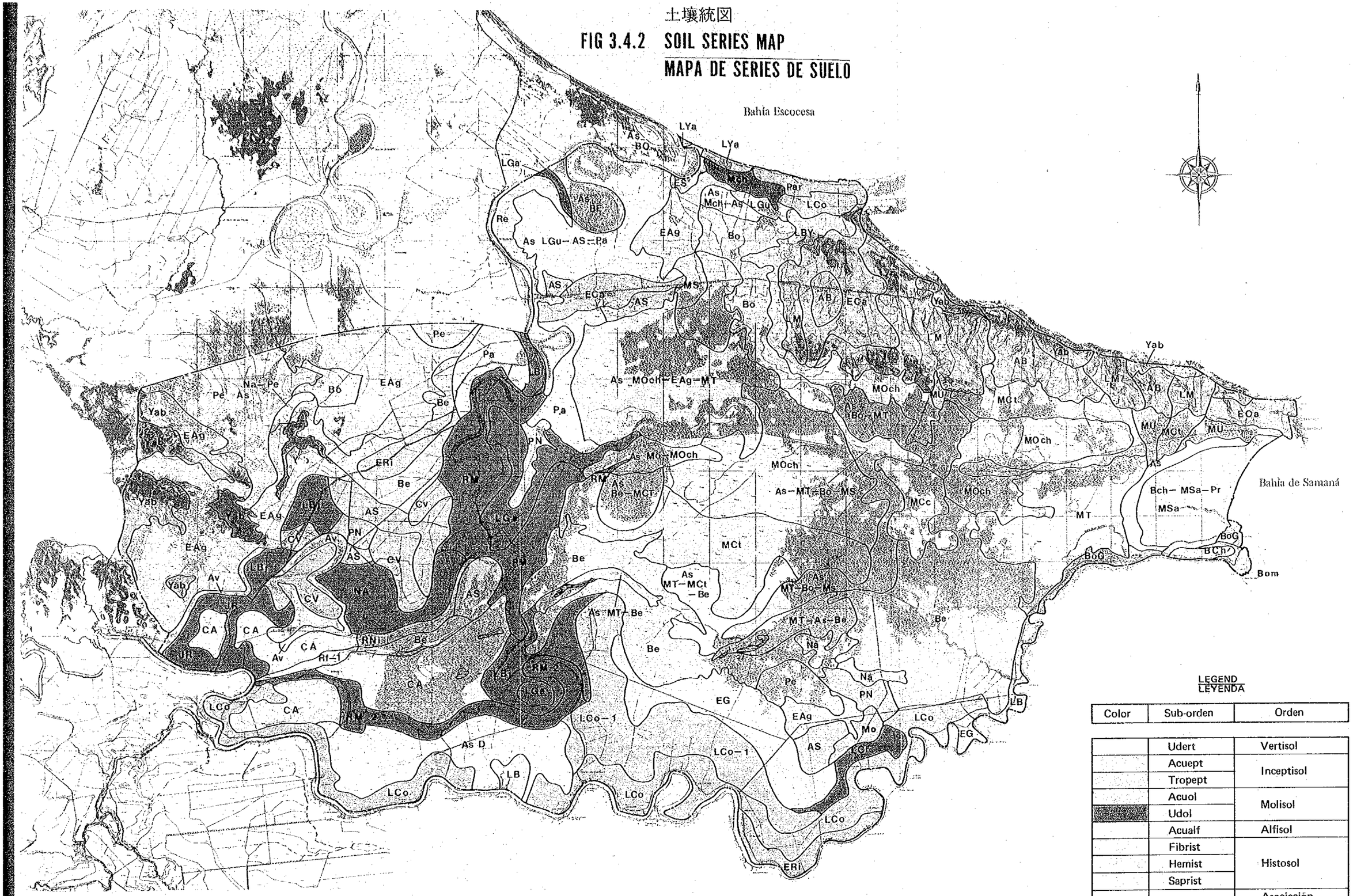


FIG. 3.4.1 SOIL ORDER AND SUB-ORDER MAP

土壌統図

FIG 3.4.2 SOIL SERIES MAP

MAPA DE SERIES DE SUELO



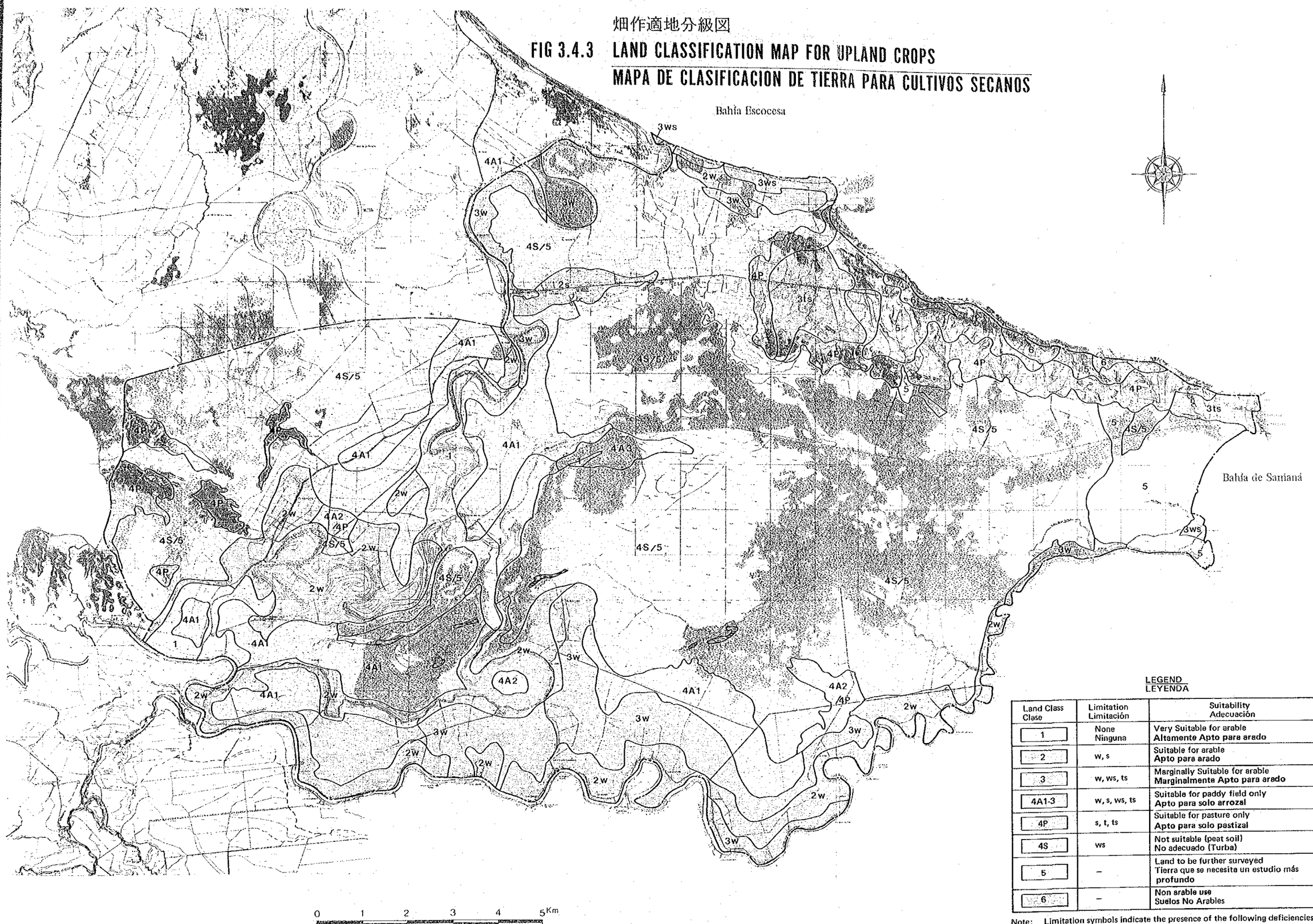
LEGEND
LEYENDA

Color	Sub-orden	Orden
	Udert	Vertisol
	Acuept	Inceptisol
	Tropept	
	Acuol	Molisol
	Udol	
	Acualf	Alfisol
	Fibrist	Histosol
	Hemist	
	Saprist	
	—	Asociación

畑作適地分級図

FIG 3.4.3 LAND CLASSIFICATION MAP FOR UPLAND CROPS

MAPA DE CLASIFICACION DE TIERRA PARA CULTIVOS SECANOS



LEGEND
LEYENDA

Land Class Clase	Limitation Limitación	Suitability Adecuación
1	None Ninguna	Very Suitable for arable **Altamente Apto para arado**
2	w, s	Suitable for arable **Apto para arado**
3	w, ws, ts	Marginally Suitable for arable **Marginalmente Apto para arado**
4A1-3	w, s, ws, ts	Suitable for paddy field only **Apto para solo arrozal**
4P	s, t, ts	Suitable for pasture only **Apto para solo pastizal**
4S	ws	Not suitable (peat soil) No adecuado (Turba)
5	–	Land to be further surveyed Tierra que se necesita un estudio más profundo
6	–	Non arable use Suelos No Arables

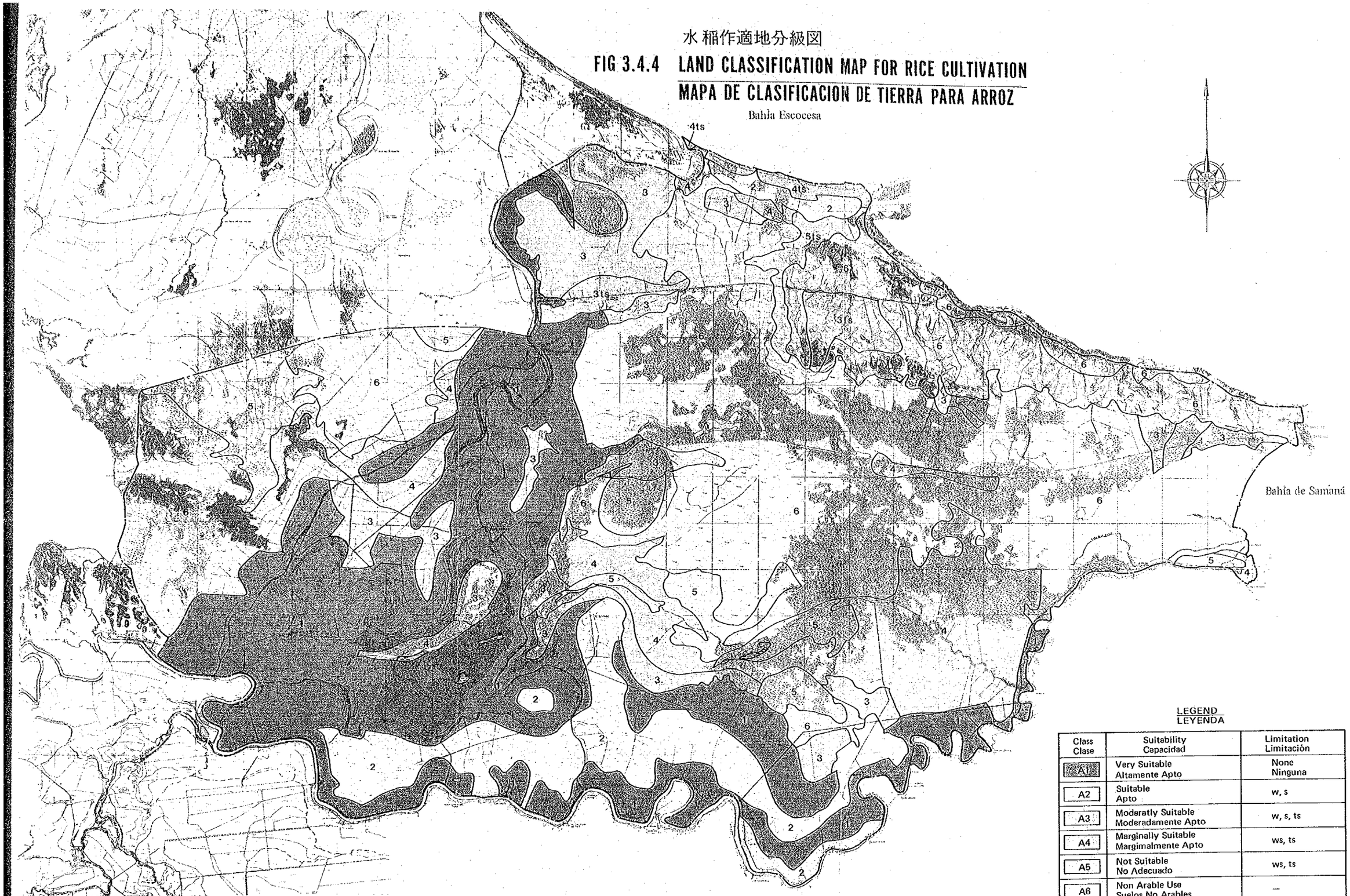
Note: Limitation symbols indicate the presence of the following deficiencies:
w = drainage; s = soil; t = topography

Nota: Las letras significan la presencia de las siguentes limitaciones:
w = drenaje, s = suelos, t = topografía

水稲作適地分級図

FIG 3.4.4 LAND CLASSIFICATION MAP FOR RICE CULTIVATION

MAPA DE CLASIFICACION DE TIERRA PARA ARROZ



LEGEND
LEYENDA

Class Clase	Suitability Capacidad	Limitation Limitación
A1	Very Suitable Altamente Apto	None Ninguna
A2	Suitable Apto	w, s
A3	Moderatly Suitable Moderadamente Apto	w, s, ts
A4	Marginally Suitable Margimalmente Apto	ws, ts
A5	Not Suitable No Adecuado	ws, ts
A6	Non Arable Use Suelos No Arables	—

Note: Limitation symbols indicate the presence of the following deficiencies: w = drainage; s = soil, t = topography

Nota: Las letras significan la presencia de las siguientes limitaciones: w = drenaje, s = suelos, t = topografía

3.5 Irrigation and Drainage Systems

3.5.1 Development of Farmland

The farmlands within the study area are underdeveloped and are outstripped by the neighboring areas of Limon del Yuna and El Pozo due to the complexity of the topography in the El Aguacate area (8,400 ha) and the extensive existence of marsh in the El Guayabo area (15,700 ha). The greater part of the farmland has been developed into paddy fields without any regulated land partition. Furthermore, there are many paddy fields which, once had been cultivated but have now been left as grazing and inundated lands due to the lack of irrigation water, poor drainage and flooding damage, etc. Comparatively well developed paddy fields are found in the following zones:

- Central Part of El Aguacate Area:
  Irrigation water is regularly provided by the pumping station installed on the Yuna River

- Riverside Zone of the Yuna River:
  Topographically favorable and irrigation water is easily available from the Yuna River

With the exception of the central part of El Aguacate, no in-farm road accessible by vehicles have been consolidated.

3.5.2 Sources of Irrigation Water and Intake Facilities

(1) Sources of Irrigation Water

Water for irrigation within the influential zone of the Study area may be obtained from one or more of the following sources:

- Yuna River
- Caño Gran Estero
- Caño Ponton

- Guayabo River
- Caño Moreno
- Swamps and Groundwater
- Small streams in the Loma La Cordillera

Of above-mentioned sources, the Yuna River will be the primary source qualified to act as a stable supplier of irrigation water; in the meantime, the others will be considered as supplementary irrigation sources accompanied by the disadvantages summarized in the table below.

SOURCES OF IRRIGATION WATER

Observation	Caño Gran Estero	Caño Ponton	Guayabo River	Caño Moreno	Swamps and Ground-water	Small Streams in the Loma La Cordillera
Deficiency of Water in the Dry Season	o	o				o
Inferior Water Quality for Agricultural Use	o (salinity)				o (acidity)	
Topographically Unfavarable for Canal Installation		o	o		o	
Water is to be irrigated by pumping which constitute disadvantage in terms of O/M		o	o	o	o	o
Poor Foundation to Construct Pumping Station	o	o	o	o	o	

Note: "o" means pertinent observation.

(2) Water Intake Facilities

Except for the small-scale reservoir installed at Arroyo El Catey, irrigation water is totally obtained through pumps. The existence of a total of 63 pumps (55 on the Yuna River, 2 on the Caño Gran Estero, 3 on the Caño Moreno, 2 on the Guayabo River, 1 on the Cano Ponton) was confirmed during the field survey.

The Aguacate pumping station, the largest one in the study area, is equipped with two vertical suction pumps, one (ϕ: 24 inches) was installed by IAD in 1962 and the other (ϕ: 14 inches) was installed by INDRHI in 1984 in responce to an urgent need.

Besides having troubles very often , the wornout equipment cannot pump water up when the river flow is at a low level. Aside from this station, IAD supervises three stations, one on the Caño Gran Estero and two on the Caño Moreno. The rest of the pumps installed in the study area are privately owned and operated.

Most of the pumps except those installed in the Aguacate pumping station are engine driven, single suction, volute type with a diameter of less than 300 mm. The pump head of these pumps is 10 m or less with an average height of between 5 and 6 m. The pumps which are for the most part made in Japan, the U.S.A., Taiwan, and Czechoslovakia are not working well due to deterioration and poor maintenance. Pumps with a diameter more than 200 mm are enclosed in a shed, but the others are exposed to the air. The location as well as the capacity of these pumps is as shown in Annex E.2.2.

3.5.3 Irrigation Canal System

(1) Irrigation Canal

A canal installed to conduct irrigation water from the El Aguacate Pumping Station to the central part of the El Aguacate area is apparently almost the only one that is in service for irrigation purpose. This canal, which extends for about 3 km, is earthen in structure with an irregular cross-section.

The other canals are used for the dual purposes of irrigation and drainage; the capacity of these canals has deteriorated due to the thick growth of weeds. No irrigation canal is found in zones located along the Yuna River, because paddy fields in these zones are directly irrigated by means of pumps installed on the Yuna River.

(2) Related Facilities

Diversion facilities with small-scale steel sliding gates, check gates, bridges and road crossing box culverts are typically related facilities attached to the irrigation canal. At present, these facilities are already wornout and improvement of them is required to attain efficient functioning.

3.5.4 Drainage Canal System

(1) Drainage Canal

Drainage within the study area mainly flows out to the Escocesa Bay thru the Caño Gran Estero and to the Yuna River thru the Guayabo River. The drainage capacity of these systems has deteriorated due to the topographic conditions and the extensive growth of water plants. Artificial facilities have been constructed to connect up with these systems; the poor drainage of natural systems sometimes causes overflow at the confluence even with only a small flooding. The drainage canals are more developed than the irrigation canals, though they are not working adequately having to do with the growth of weeds. The flow of the Guayabo River was observed to move upstream on account of the tidal influence at the confluence with the Yuna River.

(2) Related Facilities

There is only one drainage outlet facility with a gate installed upstream of the confluence of the Yuna and the Guayabo Rivers. The gate is a sluice type made of steel and its size is 800 mm in width and 600 mm in height. There are also two concrete type outlets on the left bank of the Guayabo River and three on the right bank of the same river. The diameter of these outlets is about 800 mm.

3.5.5 In-farm and Access Roads

With the exception of the central zone of El Aguacate settlement, the network of roads within farms has not been developed in the study area. It is supposed that the thick peat layers distributed in the paddy fields do not permit the construction of in-farm roads.

A useless railroad could be used as an access road subject to some rehabilitation work. Equally, the earthen embankments resulting from the drains excavations could be used for the same purpose.

3.6 Land Use

3.6.1 Present Land Use

The study area consists of the alluvial plains extending to the left bank basin of the Yuna River and hills at the foot of a mountain range called "Loma La Cordillera". The distribution of lands according to the ground elevation of the land is shown below. Lands with a ground elevation less than 3 m are covered mainly by marshes and humid forests and those of more than 10 m by hills.

DISTRIBUTION OF LANDS BY ELEVATION

Elevation Above Sea Level	Area (ha)	Ratio (%)	Remarks
Rivers and Lakes	470	2.0	
0 - 3 m	13,760	57.1	Distributed mainly marshes and humid forests
3 - 10 m	7,870	32.6	
More than 10 m	2,000	8.3	Distributed mainly hills
Total	24,100	100.0	

Substantial areas are allocated to the cultivation of such crops as rice, cacao, coconuts and yautia; upland crops like maize are cultivated on very small plots. The present land use is illustrated in Fig. 3.6.1.

現況土地利用

FIG 3.6.1 ACTUAL LAND USE

SITUACION ACTUAL DE USO DE TIERRA

Bahía Escocesa

Bahía de Samaná

	LEGEND	LEYENDA
	Paddy Field	Arrozal
	Cacao	Cacaotal
	Coconut	Cocal
	Upland Crops	Campo Secano
	Pasture	Pastizal
	Swampy Land	Pantano
	Swampy Forest	Bosque Pantanoso
	Residential Area	Area Poblado

0 1 2 3 4 5 Km

Estimates of areas devoted to agricultural purposes are given below:

PRESENT LAND USE (ha)

Crops	El Aguacate	El Guayabo	Total
Rice 1/	2,000	2,100	4,100
Cacao	1,300	400	1,700
Coconut	-	1,400	1,400
Upland Crops	-	500	500
Rough Grazing	3,100	2,700	5,800
Swamps	1,200	3,700	4,900
Forestal Swamps	600	4,700	5,300
Alienated Land 2/	200	200	400
Total	8,400	15,700	24,100

Notes: 1/ includes land previously allocated for rice production.
2/ includes residencial areas, roads, etc.

Rice is grown on the low terrace beside the Yuna River and in the settlements of El Aguacate. Paddy fields in the latter are irrigated with water pumped from the Yuna River, but frequent troubles with pumps and the inadequacy of their capacity result in an insufficient supply of irrigation water. At present, most of the rice production is carried out depending on return flows and rain water. Flood damage is reported in these fields.

The summary of paddy field in the study area is as follows:

PADDY FIELD IN THE STUDY AREA (ha)

	Cultivated Area	Irrigated Area	Planted[2] Area	Harvested[2] Area
El Aguacate				
Agrarian Reform				
(Aguacate)	1,270	420	1,570	1,150
(Cienega Vieja)	320 [1]	110 [1]	400 [1]	260 [1]
Private Land	410 [1]	310 [1]	510 [1]	370 [1]
Sub-total	2,000	840	2,480	1,780
El Guayabo				
Agrarian Reform	1,130	850	1,110	980
Private Land	970 [1]	730 [1]	950 [1]	840 [1]
Sub-total	2,100	1,580	2,060	1,820
Total	4,100	2,420	4,540	3,600

Notes: 1) Estimated
2) Average figure for 10 years, 1975-1984

3.6.2 Land Tenure

Of the total study area of 24,100 ha, the IAD's agrarian reform area comprising the three projects of El Aguacate, El Guayabo and Cienega Vieja occupies approximately 6,700 ha. The rest of the land is composed of lands privately owned or without ownership. Farmers with holdings of below 25 ha represent 94.4% of the total number of farms in the study area but only 31.7% of the farmland.

Particularly, small farmers with a farm size of less than 1 ha occupy 43.6% of the total number of farmers. About 10,000 ha of land (41.5% of the total) is held by only 5.6% of the total land owners.

LAND TENURE BY FARM SIZE

Farm	Area		Farm		Average Farm Size (ha)
	ha	%	Nos	%	
Less than 1.0 ha	312	1.3	1,054	43.6	0.3
1.0 - 2.0 ha	352	1.5	249	10.3	1.4
2.0 - 4.0 ha	1,014	4.2	365	15.1	2.8
4.0 - 6.0 ha	909	3.8	197	8.2	4.6
6.0 - 12.0 ha	1,961	8.1	241	10.0	8.1
12.0 - 25.0 ha	2,873	11.9	175	7.2	16.4
More than 25 ha	10,003	41.5	136	5.6	73.6
IAD	6,676	27.7			
Total	24,100	100.0	2,417	100.0	100

Source: Informes de la Division de Catastro Rural

3.7 Agriculture

The Aguacate-Guayabo area is a part of the northeast granary of the country where rice fields cover about 50 percent of the total cultivated area. Besides rice production, coconut plantations are concentrated at the foot of the northeast mountain range and other crops like cacao, bananas, cassava, etc. are cultivated on the natural levee of rivers. One part of the marsh is allocated to the production of "yautia" and grazing lands.

About fifty percent of the rice producing farmers are beneficiaries of agrarian reform. These farmers have very limited financial resources available for crop production. Therefore, agricultural credits for rice production are provided by the government financing bank (B.A.). However, the repayment of these credits have been made at a very low level and their debt is increasing.

3.7.1 Crop Production

The total production of paddy in the study area is estimated at about 8,400 ton, of which 5,200 ton is produced in the IAD settlement areas. The total production of other major crops is estimated at about 8,800 tons of yautia pipiota, about 210 tons of cacao (dry bean) and about 2,000 tons of coconut (desiccated nut).

Cropped and harvested areas of rice are as summarized below.

CROPPED AND HARVESTED AREA OF RICE

(Unit: ha)

Item	El Aguacate		El Guayabo		Total		
	IAD	Private	IAD	Private	Total	IAD	Private
Rice Field	1,590	410	1,130	970	4,100	2,720	1,380
Cropped Area	1,970	510	1,110	950	4,540	3,080	1,460
Harvested Area	1,410	370	980	840	3,600	2,390	1,210

3.7.2 Crop Production Technology

(1) Rice

1) Variety

There are two types of rice varieties which are grown in the study area, namely (1) non-photo-sensitive improved varieties (Juma 57, ISA 40 and Tanioka), which have a short plant height; (2) local varieties (Mingolo and Ingles Largo).

The former group is usually planted in the area where gravitational drainage of rice fields is effective and irrigation water is available. The latter group is tall and usually grown in the poorly drained fields where organic soils dominate. The growth period from sowing to harvesting of Juma 57 is 150 to 160 days when it is transplanted. Therefore, the growth period is too long to allow rice grow under optimum weather conditions in the double cropping. ISA 40 has a growth period of 130 to 140 days, but it is susceptible to one of the prevailing diseases (Narrow brown leaf spot). The rice quality of Tanioka is the best but it is also sensitive to diseases.

2) Cropping Calendar

There are a few rice double cropping areas in the IAD land settlement area where production is practiced depending on weather conditions. The main reason for the comparatively large area of rice double cropping in the private land area is that pump irrigation from the Yuna River may be carried out more easily than in other areas.

As for the present cropping calendar of rice double cropping, the first crop is usually sown from January through February, transplanted from February through March and harvested from June through July, while the second crop is sown from June

through July, transplanted from July through August and harvested from November through December. The said cropping calendars vary year by year, depending upon rainfall and the availability of irrigation water.

3) Farming Practice and Farm Inputs

a. Nursery

It is generally found that the seedling raised using the existing raising method are extremely spindle and weak. When these seedlings are transplanted, late and poor tillering arose, resulting in low yields. Related to the existing method of raising seedlings, the three problems in need of being solved have been pointed out.

- Few quality seeds are used, without applying selection, disinfection and pre-germination of seeds.

- The seedbeds are usually not prepared properly and have poor irrigation and extensive drainage.

- The extension services for rice cultivation are inadequately rendered.

b. Land Preparation

Plowing by four-wheel tractors on a contract basis is common. Recently, a number of power tillers have been introduced by the government. Usually puddling work is carried out by draft animals after plowing and soil breaking by four-wheel tractors or power tillers. Regarding preparation, the following problems have been reported.

- It is difficult to prepare land adequately in the prevailing poor ground areas.

- There were many fatal accidents during the operation of tractors in the said poor ground areas.

c. Transplanting and Direct-seeding

After raising seedlings for about 30 to 40 days, the seedlings which have a height of more than 30 cm are usually transplanted deeply in the soil, with a spacing of 20 cm to 30 cm between hills. The number of seedlings may be as many as 10 to 15 per hill and straight row planting is not applied.

Recently, the cultivation method has been changed from transplanting to direct seeding in a considerable area where plot-wise water control in irrigation and drainage is easily practiced. The rice fields where the direct-seeding is practiced, are usually developed on the natural levee. In the IAD settlement areas of El Aguacate and El Guayabo, the direct seeding is rarely applied because of the poor irrigation and drainage conditions.

d. Water Control

Water control is very difficult as the intensity of irrigation and drainage canals is very low in most of the study area, except for the limited rice fields adjacent to the Yuna River. In most of the IAD Guayabo settlement areas paddy fields located at about one kilometer from the Yuna River have poor drainage, where it is difficult to distinguish the irrigated fields from the rainfed fields. Water control in the IAD Aguacate settlement area is also poor since the irrigation and drainage canals are not separated.

Plot-to-plot irrigation is generally practiced; such irrigation technique as intermittent irrigation and mid-season drainage are not applied.

e. Fertilizer Application

The applied amount of chemical fertilizers are distinctly different among rice producing areas which have different production conditions. The highest average rate of application is found in the private land area in El Aguacate. The ingredient weight per hectare of the three elements - nitrogen, phosphate and potassium are 33 kg, 25 kg and, 20 kg, respectively. The lowest rate is 8 kg, 3 kg and 2 kg of respective ingredients in the IAD El Guayabo settlement area. It is considered that there are many farmers who do not apply fertilizers in most of the lowland rice fields of the area. The application is practiced in the range of 20-40 days after transplanting or direct seeding.

No split application of fertilizer are used by most farmers.

f. Weeding and Pest Control

Herbicides are generally used by farmers in the study area. Two applications of liquid herbicides (Stam and 2, 4D-D Amine) are recommended as a standard cultivation practice for the study area. There are two problems associated with the herbicide application; the low effectiveness of both herbicides in the prevailing rice fields where drainage conditions are poor, and the other is the existence of side-effects which are induced by contamination with various kinds of pesticides.

Manual weeding is usually done twice after transplanting or direct-seeding. However it is known that there is a large area of rice fields where weeding is impossible due to the prevailing poor ground of the fields.

Insecticide application is made by only one fourth of the sample farmers. Special attention should be paid to the organic soils in El Guayabo area where rice plant suffer severely from such diseases as helminthosporium leaf spot and blast diseases.

g. Harvesting

Immediately after cutting the paddy with saw type sickles, threshing is done by hitting the panicles. The threshed rice is carried out to roads after being packed in sacks.

The harvests are collected by the INESPRE or middlemen and transported to the rice milling factory where drying and husking of the rice are carried out. It is reported that considerable amount of rice is damaged due to a delay in drying the threshed raw rice. Harvest by combines is carried out in some favorable paddy fields.

4) Productivity of the Study Area

The paddy yield based on the harvested area in the study area is estimated below according to the results of the survey and the statistical data for past ten years in the IAD settlement area:

ESTIMATED PADDY YIELD ON THE HARVESTED AREA BASIS

Area	Yield (ton/ha)
1. El Aguacate	
- IAD Settlement Area	2.4
- Private Land Area	2.7
2. El Guayabo	
- IAD Settlement Area	2.3
- Private Land Area	2.7

5) Productivity of Other Regions

The high yields are attained in the IAD settlement areas of Jarabacoa, Bonao (Juma) and El Pozo (collective farming area) which are located in the said Yuna-Boba-Camu River basin and its vicinity:

PADDY YIELD IN THE DEVELOPED IAD SETTLEMENT AREA

Area	Yield (ton/ha)
Jarabacoa	5.6
Bonao (Juma)	4.5
El Pozo (Collective)	4.7

Source: IAD Boletin Informativo Anual (1980-1984)

A high level of production technology is applied under an adequate irrigation and drainage system. Aside from the irrigation and drainage conditions, there are two factors which contribute to the highest yield in Jarabacoa where Japanese settlers grow rice: (i) advanced production technology especially in seedling raising, transplanting, water control, fertilizer application and plant protection is applied, and (ii) the favorable of climatic conditions like low humidity and lower night temperature. Thus, quality seeds are sown with a low seeding rate to raise healthy and vigorous seedlings. The seedlings are transplanted to a shallow depth of the soils and intensive weeding, pest control and water control are applied.

(2) Cacao

The main cacao plantation area covering about 1,700 ha is limited to the natural levee along Caño Gran Estero and the Yuna River. The price of cacao has gone down and farm credit by the B.A. has been decreased.

The following problems are pointed out regarding the existing cacao plantation:

- Most cacao plantations are cultivated with traditional varieties, the unit yield of which is as low as 100 to 150 kg per hectare.

- The cacao trees are grown in the greater part of plantation under excessive shading without the introduction of proper shading trees like leguminous trees which bring about the merit of supplying naturally fixed nitrogen.

- No preventive measures are taken for rat and woodpecker damages.

According to the SEA's "Plan Operativo" (1985), an increase in cacao production is envisaged by means of rehabilitation of the existing plantations and introduction of new crop varieties.

(3) Yautia Pipiota

Yautia pipiota is rather suited to even swampy and shaded lands with organic soils as long as the water is not stagnant. At least about 700 ha of swampy land is planted with this crop, most of which is located outside the IAD settlement area. The cultivation of yautia is very extensive with an average estimated yield of at 12 tons per hectare.

In the SEA "Plan Operativo", the yautia cropping area for the El Aguacate and Limon del Yuna areas is up to 2,500 ha. The production of Xanthosoma sagittifolium is a major kind of yautia crop to be increased but yautia pipiota may be also included in the plan. Yautia is one of the most promising substitute crops for plantain, because its price has increased recently. Moreover, the yautia including yautia pipiota is exportable.

(4) Coconut

The coconut plantations are concentrated at the foot of the Loma la Cordillera in El Guayabo and along the Escocesa Bay. The total area of coconut plantation is estimated at about 1,400 ha. The average unit yield is estimated at 1.0 ton/ha (desiccated nut).

3.7.3 Farmer's Economy

The distributed land per beneficiary is between 3.8 ha (60 tarea) and 2.7 ha (43 tarea) for El Aguacate and 2.8 ha (45 tarea) and 2.5 ha (40 tarea) for El Guayabo.

(1) Farmer's Property

Almost all the farmers in the study area have their own houses. The construction costs for these houses are diverse: from RD$150 (constructed in 1967) to RD$6,000 (constructed in 1985).

The majority of farmers keep such fowls as hens and ducks and the percentage of farmers who possess cattle for the agricultural or dairy use is represented by 40.9% and 62.5% for beneficiaries of El Aguacate and El Guayabo, respectively, and 60% for private farmers. The major difference in terms of property between the beneficiaries of agrarian reform and the private farmers is observed in the possession of agricultural machinery; the average values for the former is estimated to be RD$865 (RD$1,108 for El Aguacate and RD$198 for El Guayabo) and for the latter to be RD$4,295.

The average total value of property falls in the range of RD$4,997 - RD$6,789 for the beneficiaries and RD$15,493 for the private farmers.

(2) Household Expenditure

The average monthly expenditure per family ranges from RD$348.37 (El Guayabo) to RD$384.54 (El Aguacate); at the same time, this amount increases to RD$684.80 with respect to the private farmers. When the Engel's coefficient was calculated without considering self-consumption of crops and dairy products: it proved to be 62.2% and 54.9% for the beneficiaries of El Aguacate and El Guayabo and 50.6% for private farmers. In spite of the fact that all of the interviewed farmers are engaging in the rice production, almost half of them were impelled to buy rice for their diets, whose expense turned out to be a 3.6% share of the total household expenditures. Beans and tubercles are the principal foods in the life of the beneficiaries and they are consumed at a rate RD$68 per month covering about 30% of total food expenditure.

(3) Farmer's Income

In 1984, all beneficiaries except one received income from rice production. The gross annual income per family was reported at RD$4,693 for beneficiaries of El Aguacate and RD$4,560 for those of El Guayabo.

The private farmers, on the other hand, received a gross annual income of RD$54,394, more than ten times that of the agrarian reform beneficiaries.

Some part of families gained cash income by means of activities other than crop production, such as: working in other farms, being an agrarian promoter of IAD, working in a private firm, driver or rental of animals for land preparation.

(4) Agricultural Credit

B.A is the major source of the agricultural credit but also middlemen and rice mill owner have share of the credit sources. The credits from B.A are to issue coupons to farmers to purchase the agricultural input not be made by cash.

The credit amounts vary from RD$2,900 (IAD El Aguacate agrarian reform), RD$4,300 (IAD El Guayabo agrarian reform) to RD$13,000 (private farmer in El Aguacate).

(5) Production Cost and Net Return

Gross return, production costs and net return of agrarian reform beneficiaries for the rice production are summarized as follows:

(Unit: RD$/ha)

	El Aguacate	El Guayabo
1. Gross Return	2,016.0	1,932.0
2. Production Cost		
Seed	96.0	96.0
Fertilizer	94.0	94.0
Herbicide	18.0	18.0
Insecticide	22.4	22.4
Labor Cost 1/	360.0	360.0
Machinery	267.6	267.6
Land Preparation by Animals	30.0	30.0
Irrigation Water 2/	24.8	24.8
Others	40.0	50.0
Sub-total	952.8	962.8
3. Net Return	1,063.2	969.2
4. Gross Margin 3/	1,351.2	1,257.2

Notes: 1/ Including cost of family labor of RD$288.0.
2/ Paid RD$13.6/ha to INDRHI and RD$11.2 to IAD,
3/ Excluding cost of family labor.

3.7.4 Commercialization of Rice

(1) Market

Within the study area, the harvested rice is sold to the purchase center of INESPRE or to the middlemen.

Rice, harvested in farms, is filled in the bags supplied by INESPRE, carried to the nearest road by animales and transported to the rice purchase center of INESPRE without being husked. The rice purchase centers related with the study area are located at La Jagua (El Guayabo), Limon del Yuna and El Pozo. In case of La Jagua, collected rice is transported to the rice mill of the INESPRE at Villa Riva for drying and husking.

At the INESPRE's rice purchase center, the transported rice is determined the price after being evaluated its weight. The evaluation of weight for rice is made in accordance with a specific conversion table prepared by INESPRE. As of October, 1985, INESPRE paid at RD$77.37 to the producers for one "fanega" of rice. In case that rice contains 20% of moisture and 5% of foreign materials, one "fanega" is determined to be 120 kg; if rice is dried and with less foreign materials, one fanega comes to be 110 or 115 kg, but in the opposite case, it exceeds 120 kg. The intervals of payment by INESPRE fluctuate between 15 days and 2 months; the INESPRE passes the invoice to the B.A. and the latter pays to the producers who sell their production to the INESPRE.

Not a little rice is sold to private merchants (middlemen). This is because, despite their price is inferior (RD$76.00/fanega) to that of the INESPRE, middlemen pay immediately when they purchase.

There is no fluctuation of price in terms of quality in both cases of the INESPRE and middlemen.

(2) Rice Processing Facilities

The INESPRE has two country elevators at Villa Riva and at Arenoso and one rice mill factory attached with drier at Villa Riva.

The said three facilities have a total storage capacity at about 9,000 tons of rice and drying and milling capacities are around 100 tons and 30 tons per day (12 hours), respectively. The drying capacity of dryers may be deteriorated due to the high moisture contents of rice in the peak harvest season. However, the grade of incapability in drying rice of INESPRE is supposed to be smaller because a part of rice is processed at private factories. The lack of drying capacity will become more serious, because with the spread of mechanization in the harvest, daily demand for the drying will be expanded.